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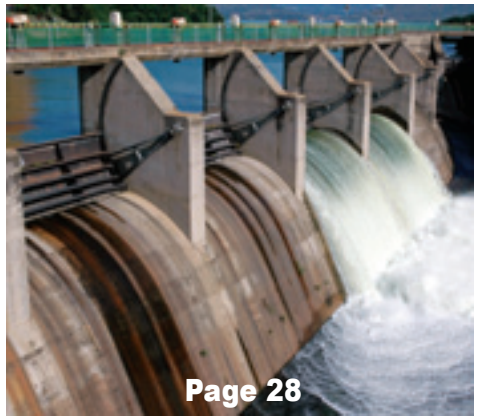

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Senior Editor

TERRY WILDMAN

POWERPOINTS

Helping our Neighbours – It's Human Nature

One of the best things about writing the editorial for the mag is the journey of discovery I often find myself on during the research and preparation phases. It never ceases to impress me how selfless people become in response to calamities. I'm speaking of the kicking laid on the Eastern Seaboard of our neighbour to the south by some of the most powerful hurricanes in recorded history and the willingness of so many people to pitch in and help. This time the culprit is Sandy.

I think of how fortunate I am to sit at my computer in a city supported by a first-rate infrastructure that boasts an impressive record of delivering electric power. It's hard to remember the last major hurricane to really wallop us. It was in October 1954 and was, after the fact, classified as two hurricanes – Hazels I and II. While it`s true we get heavy rains in summer and snow and ice in the winter, seldom have most of us ever had to stare down the throat of a monster like Sandy, Irene, Camille or Katrina.

Average people routinely do above average good deeds. For six days in January 1998, freezing rain coated Ontario, Quebec, New Brunswick, and parts of the Northeastern U.S. with up to 11 centimetres of ice. Trees, wires, poles, and transmission towers came crashing down putting over 4.7 million in Canada and some 500,000 people in the U.S. in the dark. The month-long disaster drove over 600,000 from their homes and business. Thousands, including military personnel, raced to help those affected.

Several years later, I covered in detail the stories of three utilities in the Southeastern U.S. seriously battered by Katrina.

For the first time in its history, one power company lost every single one of its customers. Over 1600 kilometres of distribution wire and hundreds of transmission towers were left lying in the water and muck. Substations were submerged and the utility's storm centre was all but destroyed leaving communications in a shambles. Their storm plan of using 5,000 outside workers was not enough so they recruited nearly 6,000 technicians from 23 states and Canada. With the extra help the utility got power restored inside of 12 days to all those who could take it. In the end the crews replaced more than 9000 poles, 2300 transformers and repaired or replaced some 1865 kilometres of conductor.

Another utility watched in horror as the nine metre surge driven by 233 km/h winds moved across southern Louisiana. Levees failed to contain the rush and within hours more than 100,000 homes, or nearly 80 per cent of the city, lay under water. Nearly 1.1 million customers were without power. Substations were destroyed as they sat under salt water. The flooded coastal areas presented the biggest challenges because crews had to fight tooth-and-nail just to reach the equipment.

POWER POINTS

Sitting squarely in the middle of the area of Louisiana mauled by Katrina was a smaller energy company serving about 265,000 customers spread over 25 of the state's parishes. Crews with outside cooperation and help managed to restore power to 80 per cent of the 87,000 homes and businesses within three weeks. The company's radio system was the only working form of communication in the affected region for more than a week. The utility declared victory over the monster just 29 days after she hit.

Many workers from each utility saw their own homes and property destroyed, yet showed up every single day to work long, gruelling hours to restore power to their neighbours.

An example of the restoration efforts was clear as one of the heavier hit utilities set up 30 staging areas where they lodged nearly 11,000 personnel that arrived from other states and Canada. The company provided over 35,000 meals a day. Beds of all description were found in mobile sleeper units (semi-trailers), school gymnasiums, military facilities, college dorms, tents, the utility's own facilities, and hotels within a reasonable radius. The sleeping areas were hot, crowded, and noisy. This mixed with the adrenaline from the inordinate pressure the restoration crews were under, led to sleepless nights for many. It was imperative that safety inspectors were always near in the event a sleep-deprived technician was tempted to take a shortcut or risk safety.

A storm assignment is very often different from an employee's day-to-day job with the utility. When the 'All Hands on Deck' order is yelled, disaster directors must ensure every employee and outside worker's storm task is as close to their individual skill sets as possible.

Once on site, large numbers of workers were regularly affected by heat exhaustion, poison oak and ivy, insect bites, sunburn, rashes, cuts and scrapes, and even snake bites. Anyone who had to work long hours in standing water was inoculated against tetanus and other pathogens but there was no quick fix for the many cases of trench foot and other jungle-rot-type afflictions. Once the water subsided it left a thick layer of sludge that soon dried and formed a fine dust that became airborne. Getting an adequate supply of protective masks became a real problem. And there was the constant frustration among storm crews of having to wait for equipment and supplies that were trying to be moved through badly damaged handling facilities. The biggest single item of need was fuel for trucks and stand-by gennies.

Without electricity law enforcement, medical centres, sanitation stations, and fire departments are off-line and often hamstrung. Government agencies are also helpless in getting the necessary support and supplies desperately needed for the recovery.

One utility vice president reminded the region that the Katrina storm crews weren't just getting the lights on, they were restoring hope. I smile with pride when I think of the stories and accounts that I heard about kids in the various affected areas. They knew Canadian crews were coming to help and as soon as they spotted the trucks the word spread and every kid raced to get their hockey stick. They somehow knew that if there were Canadians around, there was a good chance a road-hockey game would break out at some point.

Hurricane Sandy put over 8 million people in the dark, caused untold damage due to flooding and high winds, and paralyzed commerce in the most heavily populated region of the country. The massive clean-up continues and I'm proud to say that my son-in-law, a lineman with New Brunswick Power is part of a 15 crew contingent sent to Massachusetts and Rhode Island to help restore power to countless homes and businesses and provide hope to people. I'm pretty sure he and his co-workers have their hockey sticks.

Duke Energy to give $2 million to Palmetto Clean Energy (PaCE)

Charlotte, NC, November, 2012 - As part of its continuing commitment to the communities it serves, Duke Energy has given the first half of a $2 million contribution to Palmetto Clean Energy (PaCE), a South Carolina non-profit program designed to improve the quality of the environment by promoting the development of renewable energy resources, such as solar, wind and water.

"Spearheading the advancement of technologies that promote the generation of electric energy through environmentally friendly, renewable resources in South Carolina is important to Duke Energy," said Clark Gillespy, Duke Energy state president – South Carolina. "Our ongoing partnership with PaCE and this contribution highlight our commitment to these efforts."

"We are pleased to receive this significant donation," said Robert Long, chairman of the PaCE board of directors. "Gifts such as this play a vital role in helping us expand renewable energy responsibly in South Carolina. Without this gift or the financial support that PaCE receives from its other generous donors, PaCE would not be able to achieve its goals of encouraging and supporting renewable energy in South Carolina."

The $1 million contributed by Duke Energy will be followed by an additional $1 million in 2013 and is part of a settlement agreement reached with the Southern Alliance for Clean Energy (SACE) and the Coastal Conservation League (CCL) as part of the Duke Energy-Progress Energy merger.

"Dollars contributed to PaCE will support renewable energy produced right here in South Carolina, giving a boost to our state's economy while protecting our environment. That's why we worked hard to secure this commitment from Duke Energy," said Blan Holman, attorney at the Southern Environmental Law Center, who represented Environmental Defense Fund, the CCL and SACE in negotiating Duke Energy's contribution to PaCE.

Renewable energy is electricity produced from resources such as the sun, wind, water, waste and other sources and is an important part of Duke Energy's efforts to reduce its carbon footprint and promote energy security. Renewable generation is an essential part of the solution to a clean, reliable and affordable energy future.

Duke Energy is working to help the renewable energy industry grow, while ensuring that electricity remains reliable and affordable for the millions of households and businesses that depend on the company and its utilities.

Customers interested in making contributions to PaCE or becoming a renewable generator for PaCE should contact: http://www.palmettocleanenergy.org/.

AEP Seeks FERC Approval to Move Forward With Full Competition in Ohio

Columbus, OH, November, 2012 - American Electric Power (NYSE: AEP) has submitted filings to the Federal Energy Regulatory Commission (FERC) seeking approval to fully separate its Ohio generating assets from its Ohio distribution and transmission operations following an Oct. 17 decision from the Public Utilities Commission of Ohio in the company's corporate separation case.

"These FERC filings are an important next step in our transition to full competition in Ohio. We have requested approval to transfer ownership of a portion of our Ohio generation-related assets from AEP Ohio into a separate unregulated generation company, to transfer other generation assets currently owned by AEP Ohio to Appalachian Power and Kentucky Power to help satisfy their long-term capacity requirements in the PJM Interconnection, and to end the current system interconnection agreement for our Midwest utilities," said Nicholas K. Akins, AEP president and chief executive officer. "If the process moves forward as we expect, we will be in a position to fully separate our Ohio generation from our Ohio utility operations at the beginning of 2014."

AEP requested approval to transfer approximately 9,200 megawatts (MW) of AEP Ohio-owned generation to a new wholly owned company – AEP Generation Resources Inc. AEP also requested FERC approval to transfer AEP Ohio's current two-thirds ownership (867 MW) in the John E. Amos Plant Unit 3 (1,300 MW) to Appalachian Power and to transfer 800 MW of the 1,600-MW generating capacity of Mitchell Plant to Appalachian Power and the remaining 800 MW to Kentucky Power. Additionally, AEP asked FERC to terminate the existing interconnection agreement, or pool, that exists among AEP's utilities in the Midwest and to approve a new Power Coordination Agreement among Appalachian Power, Kentucky Power and Indiana Michigan Power.

AEP also requested approval to merge AEP's Wheeling Power utility into Appalachian Power.

AEP anticipates a decision on the FERC filings by mid-2013, with implementation of corporate separation and the other items in the related filings Jan. 1, 2014. Appalachian Power and Kentucky Power will submit necessary state regulatory filings in the fourth quarter of 2012.

Bluebonnet Electric Coop Launches Innovative Mobile App

Bastrop, TX, November, 2012 - Continuing its commitment to provide innovative services to its 65,000 members, Bluebonnet Electric Cooperative launched a free mobile app that gives residential and commercial users fast, simple access to accounts and provides valuable tools to help monitor and manage energy use.

Bluebonnet is one of only a handful of energy providers in the country that offers members and customers access to their accounts via their smartphones.

"Our mobile app is another powerful tool our members literally have at their fingertips to manage their energy use and potentially save money on their electric bills," said Mark Rose, Bluebonnet's general manager. "Now, no matter where they are – the athletic field, the back porch, or the back pasture – our members can access their accounts and do nearly everything they can do on our website."

The mobile app allows members to track daily electric consumption, pay bills, report outages and receive important and helpful information directly on their phones.

The ability to see past and present energy use in easy-to-read charts means the app is more than informative: It is also a way to help users understand and manage their energy consumption, with the potential to save money on home electricity use.

Users can also choose to receive alerts covering a number of issues — spikes in daily usage and if their monthly bill exceeds a budgeted amount.

The app is also truly interactive. Users can report outages and provide feedback to Bluebonnet — questions, comments and suggestions — directly from the app.

The development of the mobile app is part of Bluebonnet's pledge to continually seek new ways to provide safe, reliable power and effective customer service to its members.

The app is initially available for Apple iPhone® and Google Android™ smartphones.

Virginia Gov. Bob McDonnell Dedicates Dominion Virginia Power's Virginia City Hybrid Energy Center

St. Paul, VA, September, 2012 - Virginia Gov. Bob McDonnell joined Dominion Virginia Power officials in dedicating the new Virginia City Hybrid Energy Center, marking the completion of a four-year, $1.8-billion construction project that is bringing an economic boost to Southwest Virginia.

The power station, one of the cleanest of its kind, will help Dominion Virginia Power meet an anticipated 4,000-megawatt growth in electricity demand from its customers during the next decade. The facility uses coal and renewable biomass to generate enough electricity to power 146,000 homes.

The station brings significant economic and environmental benefits. It will account for $258 million annually for the economy of Southwest Virginia, including $6 million in annual tax payments to Wise County. Virginia's air will be cleaner because the company is converting the older coal-burning Bremo Power Station to natural gas as part of the Virginia City air permit.

"This amazing project is part of a $4 billion planned investment by Dominion to provide for the energy needs of a growing Virginia economy, an investment that will include completion of six power station projects over the next two years," McDonnell said. "The station's state-of-the art environmental controls prove that coal can be burned cleanly and will remain an important part of the commonwealth's energy picture for decades to come."

Thomas F. Farrell II, Dominion chairman, president and chief executive officer, said: "Virginia City is a welcome addition to our generating fleet and helps ensure reliable power, a diverse energy mix and stable, economic rates for our customers. We are committed to being a good neighbor in Southwest Virginia because that is an integral part of who we are as a company."

Gov. McDonnell and Farrell were joined at the ceremony by many officials and civic leaders from Southwest Virginia, including state Sen. Phillip Puckett, D-Tazewell, Delegate Terry Kilgore, R-Scott and former state Sen. William Wampler, R-Bristol.

"The Virginia City Hybrid Energy Center has been a great long-term benefit for our entire region, especially during this Great Recession," said Puckett.

"As a major supporter of this project since 2004, I am delighted that this clean coal power station has completed its final milestone – the dedication," said Kilgore.

Virginia City entered commercial service in July. The station uses advanced circulating fluidized-bed technology and burns run-of-mine coal, waste coal and up-to-20 percent renewable biomass in two boilers to produce 585 megawatts of electricity. Emissions of sulfur dioxide, nitrogen oxides, particulate matter and mercury are held to levels that are roughly 99 percent below levels of similar units built in the 1960s.

Farrell singled out Eva T. Hardy, a retired Dominion executive vice president, for being a champion of the Wise County project. "Eva worked tirelessly with state and local officials, regulators and community groups to pave the way for the acceptance and support of this power station."

At the ceremony the Dominion Foundation presented gifts of $25,000 each to Feeding America – Southwest Virginia, a regional food bank; Mountain Empire Older Citizens for the agency's fuel fund for the elderly; and The Health Wagon, a free clinic and administrator of an annual three-day health fair, RAM, that provides free medical and dental care to roughly 2,000 people.

THE GRID TRANSFORMATION FORUM

Envisioning the 21st Century Grid

How Customer Engagement Solutions can Revolutionize the Relationship between Utility and Consumer

We are speaking with Norm Daigle, executive vice-president, Harris Utilities, SmartWorks

EET&D: What is a customer engagement solution and what role does it play in the smart grid?

Daigle: A customer engagement solution (CES) is web-based tool that residential and commercial consumers can access to measure, monitor, and manage their resource consumption. Utilities are currently looking to CES technology to revolutionize the way they engage with their consumers, in both a proactive and collaborative manner that has, until now, been impossible. A top-quality CES helps businesses and homeowners view usage patterns, access targeted educational materials and address account questions without ever needing to contact their utility's customer service representatives (CSRs).

With near real-time meter reads available, today's smart grid technology delivers an unprecedented volume of data. A CES interprets that data and enables utilities to showcase usage information in terms that the consumer understands. This is the first time that utilities have been able to demonstrate the value of the smart grid to the consumer. By putting the power into the hands of the consumer and allowing them to make smart decisions about their consumption, they become active participants in resource demand and conservation.

EET&D: What do utilities need to consider when implementing a CES?

Daigle: One of the biggest opportunities is consumer education combined with proactive communication – letting the consumer know that there is now a new way to view and manage their daily resource use. While most consumers have heard about smart grid technology, it is unlikely they will understand what it means specifically for them. This presents a positive opportunity for the utility to inform their consumer-base and explain how they can all become involved in resource management. The utility can have the best tools in the world, but if the consumers aren't aware that they are available, then adoption will naturally be low.

One of the most important first steps is initial consumer enrolment. However, it is really important to ensure that this is communicated in the benefit-terms of the consumer – what it will mean for them, whether they are motivated by reducing their bills, or contributing positively to conserving the environment. Consumer marketing is a good start: include messaging in bill inserts to notify users of the new tools available, or segment your consumer-base and offer incentives to trial the new CES. Once a user logs in, even once, the utility will have the mechanisms to proactively communicate with them.

EET&D: What do you consider the best practices to be in rolling out a CES?

Daigle: Ensure consumers are only going to one place for their information. If consumers have to log into multiple systems to pay their bills, register complaints, and find out what their usage is, it is likely to cause frustration and they will not return. Once you lose a consumer's interest, it's much harder to win it back. Also, having different sites and different tools available also makes it hard from a training perspective for the utility and its own staff. CustomerConnect was designed in collaboration with a range of consumers and provides all the necessary tools in one easy-to-use interface.

Select a CES before you begin your smart meter roll-out and market it alongside the deployment to avoid duplication of effort in terms of consumer marketing and communication. This way you can inform consumers when both the smart meter installation will take place and when new tools are available that will help them make smart choices about their resource consumption. This will improve the chances of early consumer-enlistment and enable you to educate consumers from the outset.

Recruiting consumers to use the CES should be at the forefront of the minds of CSRs. As utilities migrate across more consumers to use the CES to access information and pay bills online, it makes the support of the consumer base far easier. For example, if consumers can view their consumption information online, they are less likely to make regular calls to the CSR. But if they do, however, they have the most accurate information at their fingertips making resolution easier and faster. A simple way to encourage the customer service team to recruit users to the engagement solution is to have small giveaways, for example, as rewards to the team.

Ensure that the information you present is always up-to-date and current. A good CES works on the same principles as social media, where information has to always be reliable and trustworthy. If the information is accurate, consumers will remain interested and value the offering.

Adjust your CES strategy and content based on consumer trends. Today's strategy may be to encourage conservation in peak periods, but tomorrow there may be different business drivers. Once utilities start to understand trends of the users, they can create segmented strategies. Utilities can use analytics to track user behavior, what content is popular and target users accordingly.

EET&D: Can you give some examples of utilities you've worked with where customer engagement will make an impact?

Daigle: One of our customers, Lakeland Electric – a central Florida utility, chose CustomerConnect to help encourage its consumers to make better decisions about their energy consumption.

As part of a year-long exercise, the solution will be pilot tested in about 2,000 homes and businesses before it is rolled out to all 124,000 consumers. Once fully implemented, Lakeland anticipates that CustomerConnect will be able to provide consumers with the information they need to reduce their electricity during peak periods.

Lakeland anticipates that it will need more electricity generation capacity in the next eight to ten years. However, the utility estimates that by leveraging their CES to showcase the value and intelligence of the smart grid to its consumers, the construction of a new generator could be delayed by an additional five to seven years. This will save Lakeland millions of dollars.

EET&D: How do you see CES evolving in the future?

Daigle: It's important to keep in mind the evolving needs of the consumer, whether the information an end-user is looking for is through their smart phone, the web, or via texts. Consumers want information at their fingertips, and soon they will want it faster than is currently available. Although we present data in near real-time already, some utilities still decide to display only data that has been validated by the meter data management solution. This has potential to cause delays in data delivery for up to as much as 48 hours. We see this time gap slowly decreasing to the point where validated consumption data is available to consumers in real-time.

EET&D: What are some ways utilities can prepare for those changes in the future?

Daigle: One of the first ways is ensure CSRs are ahead of the curve and fully understand the benefits of CES for the consumer. This means training CSRs on customer communication and marketing strategies, which includes the discipline of always following up with your consumer. It's also important to target programs to specific groups, and understand the segments of your consumer base. Every single group won't be responsive to a standard message or communication and it's important to understand how different consumers think and their intrinsic motivation and target accordingly.

EET&D: Thank you Norm for the time you have taken out of your busy schedule to speak with us. I agree that the future of energy delivery will be highly dependent on 'big data.' As such, the CES will be an invaluable tool in improving the lives of utilities and end users.

About the interviewee: Norm Daigle is executive vice-president of SmartWorks, the innovation arm of Harris Utilities. He has more than 15 years of leadership and management experience in the enterprise technology industry. Prior to joining Harris Utilities, Norm served in a variety of executive-level roles for technology firms such as Capital Technology Partners, MTS Allstream and xwave solutions. Norm holds many professional memberships in the energy industry including the Energy and Utilities Network, Ottawa Technology Network, and Smart Grid Executive Forum. He can be reached at *ndaigle@harriscomputer.com*

GREEN OVATIONS

Innovations in Green Technologies

Three Areas Where Data Matters for Commercial Energy Efficiency

By Bennett Fisher, Retroficiency

Commercial energy efficiency is a growing area of focus as utilities seek ways to meet and exceed new efficiency targets, manage demand without increasing capacity and deliver added value to customers. According to the Consortium of Energy Efficiency, U.S. utilities spent nearly $3 billion on commercial and industrial (C&I) efficiency programs in 2011, a number that has grown 26 percent per year since 2007.

While we aren't yet tapping the full potential of building efficiency, the tide is quickly turning with the infusion of data into energy efficiency evaluation. Utilities are recognizing the need to collect this data and use software analytics across many of their business processes. Mapping to various stages of the utility efficiency lifecycle, the areas we see being positively impacted by greater data access are:

- Identification: More effective targeting and engagement
- Evaluation: Comprehensive, streamlined energy audits
- Post-Implementation: Improved measurement and verification

More effective targeting and engagement

Industry conventional wisdom suggests that, on average, a major retrofit can save a building 30 percent in energy consumption. While we've found that to be true through energy analytics done on our platform, we've also seen a major variance in savings opportunities across buildings. Across several utility portfolios we have assessed, about 35 percent of the buildings account for 75 percent of the energy savings potential. As a result of this, it's imperative to understand which buildings have the best potential before taking the next step to avoid wasting time and money.

Data and associated analytics can help us identify true savings opportunities in a single building or across a portfolio before ever stepping foot on site. Identifying which buildings to target allows us to focus on those with the best potential, making it easier to get buy-in to move forward with an on-site audit, which remains an integral part of the sales and evaluation process.

Better targeting and engagement can also help more effectively manage the grid. Instead of only targeting customers based on energy savings potential, some utilities are considering targeting the highest potential customers, which are served by sub-stations at near capacity. Granular consumption data mapped to network performance can delay capital investments by leveraging energy efficiency.

Comprehensive, streamlined energy audits

Identifying energy conservation measures and determining the savings each measure will drive are critical components to on-site energy audits. On-site energy audits are a critical component for utilities to identify energy conservation measures in each building and determine the savings each measure will drive. Energy audits, which can run from as a little as $3,000 to $4,000 up to $50,000 or more, are a costly endeavor that utilities often pay for or fund a portion of. This means that utilities must not only focus on buildings with good potential, but also ensure they are capturing all of the savings opportunities that exist.

Utilities are also challenged to determine whether the audit findings are accurate and correct. Whether they are done by internal personal or external partner vendors, audits and energy engineering calculations are done with different formulas and different assumptions, which makes it difficult to 'audit the audit' quickly and accurately.

By standardizing what building asset data is collected during an audit and the reporting of the findings from that audit, utilities and their partners can systematically evaluate a comprehensive set of measures in each building, be in sync in terms of the savings that will be achieved, and more quickly drive projects towards implementation. Utilities can also more effectively refine their strategy and segmentation over time when this information is centrally stored to see what types of customers, buildings, and projects actually convert into real projects.

Improved measurement and verification

Once implemented, it is often difficult to measure the realized benefits of an energy efficiency project in a cost-effective way, as traditional hardware or manual approaches can be cost-prohibitive for most retrofit implementations. With operational changes and weather patterns impacting energy consumption from one period to the next, energy savings can sometimes be 'hard to see' for a typical building owner, leading to confusion and frustration over where savings can and should be claimed. When that happens, a building owner is unlikely to implement retrofits on other buildings or speak positively about energy efficiency.

Granular data on energy consumption or a calibrated energy model, allows one to break down consumption by end use (heating, cooling, lighting, etc.) to objectively determine how a building would have performed if a measure had not been implemented during a given period of time. By comparing this to what actually happened building owners and service providers can quickly align on the true energy savings of a particular retrofit.

These are just three of the ways in which the increase in data availability is beginning to help utilities drive commercial energy efficiency projects faster and more effectively. In each instance, there are various players, programs and initiatives using different data sources in different ways. Converging on standards and best practices to leverage this data will be important for the industry as a whole. As this happens, the commercial efficiency market will continue to grow and invite more participation by asset owners, vendors and investors alike.

About the Author

Bennett Fisher is the CEO and Co-Founder of Retroficiency. The company enables utilities, energy service providers, facility managers, utilities, and building owners to cost-effectively prioritize high potential buildings and evaluate thousands of energy efficiency measures in minutes. For more information, please visit *www.retroficiency.com*

Solving Power Problems in the Face of a Troubled Grid

By Terry Wildman, Editor-in-Chief interviews Mark Cerasuolo, OutBack Power Technologies Inc. and J.K. Thomas, Malankara Plantations Ltd.

Early on July 30 of this year, some 370 million people were dropped in the dark when an inter-connect substation near Agra, home of the Taj Mahal, tripped causing the automatic shutdown of all power plants in the Northern region. Fortunately, Delhi's international airport, hospitals, police stations, large-scale commercial and industrial power users, and higher-end homes were okay with backup generators. Not so fortunate were the everyday people who were stuck with no light, no heat, and no public transport. Traffic jams were a nightmare with no traffic signals; rail commuters were stuck in dead electric trains, and countless small businesses had to close.

The following day, the eastern and north eastern power grids went dark. The 20-state blackout saw somewhere between 620 million and 680 million people – about half of India's population – trapped with no power. This time, some critical operations also lost power. The calamity was caused by a few states in the northern grid that overdrew power beyond their permissible limits, ignoring warnings from the dispatch centre and regulatory body to stop the practice. The three biggest culprit states overdrew in June by an average of 29.8 million units per day and then overdrew on average 15.1 million units each day from July 10 to 16.

What's troubling is that these states have refused to install under frequency relays (UFRs) for automatic demand management programs. They opted instead to run the risk of a huge failure and it has cost them dearly. According to local authorities, overdraw has been much higher in the past as well and this continued abuse of grid discipline over time has systematically weakened the system

As automatic relays shut down the most overloaded transmission lines and generators, power surged around the rest of the network taking increasingly unpredictable pathways. As this unbalance sped through more and more of the system, an untenable number of emergency shutdowns occurred until the grid and power generation collapsed across the region. The fingers of blame didn't stop pointing there. Around 56 per cent of India's total power generation capacity is from coal and there was a shortfall of 88 tons of the stuff for that power sector for 2012 and 2013. Natural gas production has been falling off over the last few years leading to shortages for power plants.

"Today, India is caught in a vice between rapid commercial growth and intense energy demand, which are obviously related," says Mark Cerasuolo. "The country now competes with China, Japan and South Korea to import fossil fuels, and recently has been contending with sanction-driven cutbacks on Iranian oil imports. The situation is at the point where inherent shortages of oil, gas and coal have 'substantially contributed to a second year of slowing economic growth in India,' as Vikas Bajaj reported in a NY Times article in April. Rahul Dhir, the head of Cairn India, Ltd., India's largest private oil company, is quoted in early July as saying that 'we are headed 100 miles an hour into a brick wall on energy security unless we do something radically different.' This latest event proves his point.

"India is not unique in this; there are a number of rapidly developing countries that are bypassing the traditional infrastructure expansion models and leapfrogging into less centralized technology," continued Cerasuolo. "One case in point is telecommunications. The U.S. and much of the West had decades of wired networks in place before wireless became the default, whereas India and other countries are sidestepping this wired stage, and moving straight to wireless. Consequently these countries rely on decentralized power generation to accomplish this because there's no grid near the remote stations. Renewable power has seen a lot of growth in India for this reason, since converting solar or other generated energy onsite is essential to powering these emerging wireless networks.

"At the grid level, the same thing applies: the country has a patchwork of local electricity grids, which suffer from instability and inconsistency and are exacerbated by extremely high fuel prices. This has spurred growth in renewable energy highly accessible to India, such as solar. When paired with backup systems, renewable energy provides more reliability. This latest historic outage event shows how important it is for India to achieve as much independence as possible from fossil fuels and move toward practical, sustainable onsite generation."

All of this was not lost on the forward thinking of Malankara Plantations Ltd. in Kerala, India when they elected to use OutBack Power for the necessary tools and advanced photovoltaic (PV) technology to divorce the business from the grid and get out from under their on-going electrical power challenges that exist because of the nature of the electricity system in their country.

The building complex was originally connected to a private power grid owned by a local maharajah and in 1950 was taken over by the Kerala Electricity Board. The complex was slated to move off grid because it had some backup generation. In order to be free of the grid no less than a unique and ambitious engineered solution was required that would make absolutely no alterations or disturbances to the original structure.

"The idea of setting up a solar power plant was a long-standing ambition," says J.K. Thomas. "When we could not get the one megawatt project under the Ministry of New & Renewable Energy (MNRE) Scheme, we decided to put up a 25 kilowatt (kW) PV system for our office complex for which we have used OutBack inverters and charge controllers."

The compound houses an 86-year old structure that is classified as 'heritage' so a strict preservation policy is in place, which is mandated by the state. The plantation is located in Kottayam district in southwestern India and the tropical climate means daily temperatures in March, April and May consistently exceed 86 degrees Fahrenheit (30 degrees Centigrade). Intense rains accompanied by severe lightning occur during this time and humidity is regularly 90 per cent and higher. This type of weather takes a real toll on people and equipment.

The new system is powered by a three-phase 27 kW array of nine OutBack GVX 3048 off-grid inverters. The arrays consist of 25 kW modules in space frames, comprised of thin-film PV elements. Grid-interactive PV inverter systems solve problems that have plagued both off-grid and grid-tied applications, providing integrators with previously unavailable flexibility and reliability for high-end deployments.

"When the project was completed by Team Sustain we were proud to realize that we were one of the first office complexes in India to be fully solar powered, including 17 tons of air conditioning, all lights, fans, three motors and our three packeting machines," Thomas continued. "It was more of a novelty than a financially viable operation when we installed it in January 2012. However, today India faces a huge power shortage and power failures and power cuts are a daily recurring problem to all energy consumers so we are really happy that we do not use any grid power and are fully insulated from power supply interruptions. With the tax concessions and other incentives provided by the government of India we hope to recover our capital cost within five years considering the ever increasing cost of power."

Advanced power electronics that harness the elements for greener, cheaper power generation and delivery were ideal to meet the Malankara challenges. They are the products of choice for providing solutions in harsh environmental conditions where product reliability is paramount. To this end, off-grid inverters with battery back-up, grid-tie inverters with battery back-up, maximum power point tracking (MPPT) charge controllers, communications/network products, and integration hardware is ideally suited. Inverters that deliver pure sine wave power to residential and commercial entities along with rugged and reliable conversion electronics for battery storage are fast becoming one of the key go-to technologies that will help define the use of renewable energy in the first third of this century.

Malankara Plantations Ltd. – A true commitment to using renewable energy

Following the installation the complex was disconnected from the grid and continues to function solely on self-generated solar power. It is one of the first Net-Zero office complexes and is among the first Net-Zero Energy buildings in India, has a five-star energy efficiency rating, and has the capability of selling excess electricity to the grid.

"In fact, we are now negotiating with the Kerala State Electricity Board (KSEB) and Kerala State Electricity Regulatory Commission (KSERC) for evacuating our excess power to the grid which we hope will become a reality by the end of this year. If so we will be the first to supply solar energy to the grid in Kerala," remarked Mr. Thomas.

The success of this installation has generated a lot of interest and has resulted in several inquiries from other plantations in the region. The Malankara project has shown that the potential is there to help countries like India tackle its electrical power problems. Hospitals, factories, government buildings, and residential blocks could generate their own power and scrub off a portion of their draw from the grid during peak demand. These systems could be self-reliant if solar was added to the generation mix supported by a demand response program, and energy storage systems.

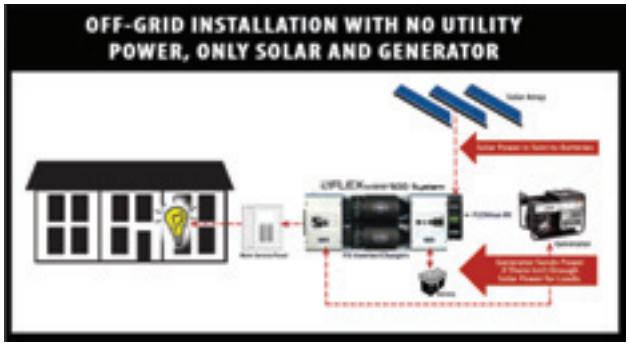
Solving Power Problems in the Face of a Troubled Grid

It was quite telling when the media started calling for the installation and use of micro grids – pockets of power and consumption that can look after themselves and also have the ability to bail out the main grid when it's under pressure – and solar power.

The question now before the people is: *Could smart grid technologies help solve the problems that caused these blackouts?*

It's no secret that India's grid is in a terrible state. It consistently loses money and is plagued by daily power outages, and consistent power losses in the 20 to 50 per cent range due to technical and non-technical power losses such as inefficiency and theft. The country's fast-growing technology sector has had to come up with its own power. Unfortunately, most of that backup power comes from inefficient diesel generators that pollute the neighbourhoods in which they run.

As backup power technologies continue to advance, they could be the ticket to unlocking India's smart grid potential, at least in the short term. The future looks strong for micro grids.



Typical configuration – straightforward, reliable, expandable, and sustainable

Looking to the future, India's potential to become the next big solar power market is in question. Its high-voltage grid is relatively stable, making large-scale solar integration a viable proposition. However, the low-voltage and medium-voltage grids are in rough shape. The country is coming on as a hotbed for off-grid solar power and the potential for installing in excess of 1 gigawatt per year by 2016 is in the offing. Given that more than a third of India lacks electricity from any source, rural micropower will offer huge prospects and a true need for rugged, reliable, and cost-effective solutions.

About the contributors

Mark Cerasuolo manages marketing at OutBack Power, a designer and manufacturer of balance-of-system components for renewable and other energy applications. Previously, he held senior marketing roles at Leviton Manufacturing, Harman International and Bose Corporation, and was active in the Consumer Electronics Association (CEA).

Mr. **J. K. Thomas** joined Malankara Plantations Ltd. In 1980 and is currently managing director. He received a Bachelor's degree in Economics in 1976 and three years later was awarded a Bachelor of Law degree. In 1982 Mr. Thomas completed the Management Education Program (MEP) at the Indian Institute of Management, Ahamedabad (IIMA). He is active in the Plantation industry and several social services organizations in Kottayam.

Managing Critical Power Transformer Assets

A Good Practice Asset Management Framework for Salt River Project

By Will Williams and Martin Jones, Black & Veatch and Scott Anderson, Salt River Project

The current financial climate presents utility managers with a key challenge: the delivery of levels of service to customers at the most efficient balance of cost and risk. Increasingly, utilities are adopting asset management approaches in an effort to improve performance, enhance reliability, meet regulatory requirements, optimize capital investment, and reduce operational costs.

Utilities readily adopt tactical asset management approaches, which focus on understanding asset condition and performance and improving asset maintenance. However, more strategic approaches to asset management decision making are less commonly adopted. These strategic approaches involve the implementation of an integrated, information driven, decision making framework that links the tactical decisions in a measurable way to the strategic goals of the organization.

Salt River Project (SRP) in Arizona developed and is implementing a strategic, good practice asset management framework for the management of critical power transformer assets.

SRP's Critical Power Transformer Fleet

SRP owns and operates about 500 transformers with a high side voltage of at least 69 kV. Of these transformers, 15 per cent have voltages at or above 230 kV and are referred to as Extra High Voltage (EHV). Numerous failures in the EHV transformers have been recorded in recent years, mostly independent of age.

SRP recognizes the criticality of these assets and has adopted a proactive approach to understanding and mitigating their risk of failure. SRP's transformer management program consists of time based maintenance scheduling, monitoring and condition inspection and testing, quality audits and inspections, spares management, emergency standby mobile transformers, and an ongoing replacement program.

Drivers for Asset Management Implementation

In 2011, a critical power transformer unexpectedly failed at one of SRP's vital receiving stations. The transformer was not salvageable so an available spare was installed in 30 days. The component root cause analysis determined there was a bushing failure however the details of the true root cause have not been finalized. Further analysis of SRP's historical performance data showed that a significant proportion of SRP's critical power transformer failures, particularly at high voltage levels, are due to bushing failures.

One of the results of this sequence of events was for SRP to commission an outside consultant (Black & Veatch) to review the way SRP manages its 230 kV and 500 kV transformer fleet. The review was to consider the complete asset lifecycle, examining how SRP engineers, specifies, designs, procures, installs, commissions, maintains, tests, and manages these critical assets.

SRP and Black & Veatch decided to undertake the review using Publically Available Specification 55 (PAS 55) which provides a framework for assessing and optimizing asset management maturity. Now internationally recognized, PAS 55 provides an essential, objective definition of what is required to demonstrate competence, establish improvement priorities and make better, clearer connections between strategic organizational plans and the actual day-to-day work and asset realities.

Assessing Asset Management Maturity

Effective asset management is all about achieving the appropriate balance between cost, risk and performance. Black & Veatch's focus was to provide results that could be used to manage SRP transformer related risks now, as well as providing a roadmap for asset management process improvement in the future. Figure 1 summarizes the overall project approach.

Figure 1: Approach to Transformer Asset Management Maturity Assessment

The review included assessment of:

- Current SRP organizational structure and responsibilities for transmission/distribution operations, maintenance and testing
- Historical transformer and transformer component failure data for transformer failures with high side voltage greater than 69 kV and larger than 20 MVA
- Operation and maintenance history for 69/115/230/500 kV transformers
- SRP standard transformer specifications
- Industry analyses of failure data and survival curves for transformers and related equipment
- Industry practices and procedures documentation
- Current SRP policies and procedures related to operations and maintenance of transformers, including:
  1. Technical procedures associated with procurement of new transformers
     - Design review process
     - Supplier qualification process
     - Supplier surveillance procedures
     - Supplier approval process
  2. Supplier quality control audit procedures
  3. Factory and field test procedures for transformers

The results of this assessment was an agreed set of issues, activities, and areas of focus which was used to ensure the work in subsequent stages was well targeted and cost effective.

The asset management maturity assessment commenced with a series of structured interviews and workshops aimed at gaining a complete 360 degree view of those areas of focus relating to SRP's design, procurement, engineering, operations, maintenance and testing procedures and processes.

Historical Failure Data: Industry Survey and Other Sources

The initial stages of the project entailed the collation and analysis of existing historical data in order to ascertain what the key issues are, what the current quality of data and information is and start to mine this data to identify common causes of failure and components of risk. Analysis of historic data was a very important aspect of this project as it was used to establish failure trends and patterns that informed subsequent phases of the work and identified 'quick win' process improvements.

Industry Survey. In order for any statistical analysis of historical failure data to be meaningful, sufficient failure data must be analyzed. Due to the relatively small stock of critical power transformers owned by SRP, the failure dataset was relatively small. To supplement the SRP data, some 12 organizations were approached and agreed to participate in an industry survey to share experiences and failure data. These organizations were asked whether transformer failures are an issue for them and whether they have relevant failure data that they are prepared to share. Organizations who contributed their data to the pooled dataset were given access to the complete set of assembled data in return.

Other Information Sources. In order to maximize the use of all available failure data, a range of research, published papers, industry associations and manufacturers data were also analyzed including institutional sources (EEI, IEEE, CIGRE, etc.), private sources (Hartford SB, IAEI, etc.), and EPRI (with aid from SRP). These data were used to supplement SRP and industry survey data to ensure the analysis was unbiased by the sample composition and that every opportunity to access relevant data had been taken.

Application of PAS 55 to SRP

Using the PAS 55 maturity assessment approach, a total of 33 interviews were held with a range of SRP staff whose responsibilities cover the whole of the transformer asset lifecycle, along with corresponding processes and documentation. Each of the 28 practices in the PAS 55 checklist were addressed and scored and a gap analysis undertaken to identify areas of deficiency compared to defined good practice. In addition to the interviews, three workshops were held with operations, maintenance and management staff to discuss the initial analysis and clarify initial conclusions. From this gap analysis an improvement plan was then developed, designed to close the identified gaps.

A key output of the gap analysis was the development of an asset centric (rather than an organization centric) view of transformer management. This view was applied to target the recommendations at each phase of the transformer asset lifecycle, as illustrated in Figure 3.

About PAS 55

Developed by the Institute of Asset Management (IAM) in the United Kingdom, the latest version PAS 55:2008 is published by the British Standards Institute and is used by utilities and asset-centric organizations worldwide. The PAS 55 specification defines good practice asset management and provides guidance for its implementation in asset intensive industries. It is currently being developed into ISO standard 55000 with some 22 countries (including the United States) engaging in the process.

PAS 55 provides a management framework that enables an organization's strategic vision and goals to be achieved through the development and application of asset centric strategies and plans (see Figure 2, adapted from PAS 55:2008). This integrated approach establishes a single 'line of sight' from the organization's leadership team down to the asset operators and maintainers, so everyone has a clear understanding of what they are required to do in order to achieve the organization's strategic goals.

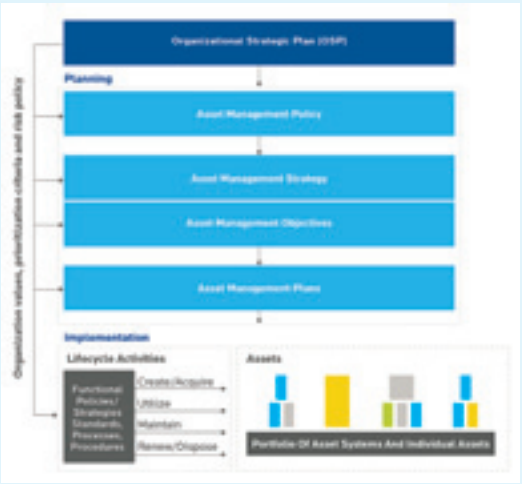


Figure 2: PAS 55 Asset Management Framework (adapted from PAS 55:2008)

This framework enables the leadership team to implement an asset management policy that defines the approach to asset management within the organization and that can be communicated within the organization and to external stakeholders, in the same way that health and safety, or environmental policies are.

Strategies and specific, measurable, objectives can then be developed to focus on the management of the asset lifecycle for different asset groups (asset lifecycle strategies) and the development of process and procedural improvements (functional strategies). Asset management plans (such as network development plans, capital investment plans, asset maintenance plans) are then developed in accordance with the strategies.

The PAS 55 specification contains a 28-point checklist of good asset management practices. Detailed guidance is provided along with examples of good practice in each of these areas. The focus is on an integrated approach to asset management that is systematic, risk based, and optimizes the asset lifecycle for performance, cost and risk.

PAS 55 is used by many organizations worldwide. National Grid was one company to lead the way in development and implementation of PAS 55. It is used by a number of utilities in the United Kingdom including all the electricity and gas network utilities, and a growing number in Europe, the Middle East, Asia and the Americas. Energy industry examples include TRANSCO in Abu Dhabi, CLP Power in Hong Kong, BC Hydro and Hydro One in Canada.

There are a number of benefits that these organizations are gaining from using PAS 55, including being able to demonstrate competent sustainable asset stewardship to stakeholders, who can include regulators, investors and customers. Improved processes, clearly defined strategies and targets and following a risk based approach will lead to improved decision making and achieving the optimal balance between cost, risk, and performance. The benefits of PAS 55 for leadership teams include the implementation of an asset management policy throughout the business to ensure alignment of activities with the strategic goals of the organization, provision of a framework for a long term asset management capability improvement plan, the ability to track and report on improvements in the organization's asset management capability and clear sight and the ability to review the organization's asset management approach to ensure its suitability and effectiveness.

Figure 3: SRP Transformer Asset Lifecycle

For each of the asset lifecycle phases, a guide to good practice was developed to assist in the assessment of the current 'maturity' or effectiveness of SRP's current approach to transformer asset management as well as to provide a summary reference document for SRP's future use. These good practices were developed based on Black & Veatch subject matter experts' industry knowledge and experience, PAS 55 guidance for asset management good practice, and Asset Management – an anatomy published by the Institute of Asset Management.

Findings and Initiatives

The overall score for SRP's transformer asset management maturity put SRP in the asset management 'development' stage, as defined by PASS 55. The maturity assessment has highlighted areas for improvement and the gaps that need to be closed.

Formation of a dedicated transformer asset management team is recommended, along with development of a transformer asset management policy, strategy and objectives. Black & Veatch and SRP also developed a number of asset management initiatives (listed below) and a roadmap for their implementation:

- Transformer criticality assessment
- Risk management process development
- Condition based maintenance strategy
- Updated maintenance processes and procedures
- Prioritized bushing replacement program
- Creation of a transformer asset management system 'Toolkit'
- Transformer spare and replacement process
- Escalated installation of substation Intelligent Electronic Devices (IEDs)
- Additional transformer analysis

Recommendations for short and long term improvements were prioritized using a cost-benefit analysis (CBA) approach so that the tangible business benefits of each investment were clearly understood.

Implementation

SRP plans to implement the identified initiatives over a period of three to four years to fully embed asset management good practice across the lifecycle of transformer assets.

The challenge of improving asset management practices should not be underestimated. Concerted effort is required to change organizational culture, paradigms, practices, and in some cases, the structure of the organization.

Leadership and communication are fundamental to this effort, and the initiative must have full buy-in at the highest levels to be successful. However, the successful implementation of an improvement plan is not the end of the journey. A key element of PAS 55 is continual improvement, so further refinements and improvements should be considered where it is cost effective. Effective leadership at all levels in the organization will be required to sustain and improve asset management good practices.

About the Authors

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Martin Jones is a Principal Consultant at Black & Veatch, and a civil engineer specializing in utility asset management, regulatory audit, and wastewater engineering. He has conducted asset maturity assessments, asset valuations, and PAS 55 strategy development and implementation for utilities in North and South America, the UK, and around the world. Contact Martin at *JonesM2@BV.com*.

Scott Anderson is the Manager of Apparatus Engineering at SRP responsible for the specification, procurement, award, commissioning and acceptance of all substation equipment.The department also oversees substation supplier quality and is in the process of developing an asset management program. Prior to joining SRP in 2002, Scott worked for Motorola where he was responsible for electrical and control systems at semiconductor manufacturing facilities. Reach him at *scott.anderson@srpnet.com*.

Tryvertising Opens Door for Adoption of E-Bills in the Utility industry

By Eric Leiserson, Fiserv

Over the course of the last decade, online electronic bill payment has found favor with many consumers, becoming a mainstream service in many segments, including the utilities industry. On the other hand, electronic bill presentment, in which an electronic version of a bill (e-bill) is delivered to a financial institution or biller website, has seen slower adoption. Even though e-bills have been available for nearly as long as electronic bill payment, there still remains a widespread lack of consumer awareness about the availability of e-bills, how they work and the benefits e-bills provide to recipients.

The benefits of encouraging e-bill adoption are becoming too great to ignore. Consumers are becoming increasingly demanding of flexibility. Most visit their biller site for billing and payment related activities, and nearly a quarter of consumers report changing the way they pay bills month to month. The 2012 Fiserv Billing Household Survey showed that 40 percent of consumers who receive e-bills through their bank's website also report visiting the biller's website directly one or more times per month. This gives billers, including utilities companies, an opportunity to directly engage with customers.

A study conducted by AccuData on behalf of Fiserv and Con Ed found that customers who receive e-bills via a financial institution or the company's website are more likely to make on-time payments and utilize online self-service rather than costly customer service calls. Online billing and payment is an important and strategic part of the customer experience and ultimately improves the overall relationship.

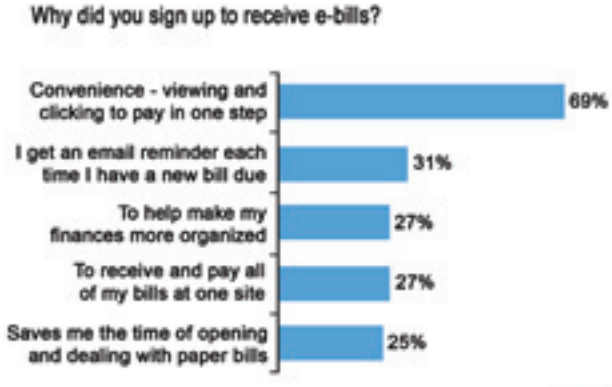
With consumer interest in e-bills growing, now is an ideal time for billers to begin promoting the service. In order to convert growing interest in e-bills to e-bill activation, consumers must first be aware that e-bill is an option and then understand the advantages of the service.

Traditional Marketing and E-bills

In order to plan a successful consumer marketing campaign it's important to think about the process through which consumers adopt technological innovations. According to Everett Rogers' classic book, Diffusion of Innovations, there are five stages in the technology adoption process – knowledge, persuasion, decision, implementation, and confirmation.

When it comes to marketing e-bills, most billers have relied on traditional marketing strategies that focus on the first three stages of this process – knowledge, persuasion and decision. The first step involves providing knowledge about what an e-bill is and what value it holds for the consumer. The second involves persuading the consumer to try e-bills by providing an incentive such as a free offer, charitable donation or credit. The third step is to provide a call to action asking the consumer to adopt the e-bill.

Overall, these tactics have played a major role in producing positive incremental growth in e-bill implementation, and these efforts should be continued, utilizing strategic messaging on the reported benefits of e-bills (see figure), such as the ability to view and pay bills in one step and the ability to manage finances more efficiently and effectively, to market the service to prospective users.



Source: Consumer Trends Survey, Fiserv Inc., August 2011

However, for e-bill to become a mainstream consumer service, billers should also give consumers a chance to experience and confirm the usefulness of e-bills. This involves receiving e-bills and associated alerts and becoming accustomed to the entire process while still receiving paper bills. Firsthand experience will give consumers the confidence to confirm the decision to leave paper bills behind and close the loop on adoption of e-bill technology.

A Hands-on Approach to E-bill Adoption

Tryvertising, a relatively new marketing trend borrowed from the broader world of retail marketing, enables consumers to become familiar with new products by trying or previewing them before a purchase is made. It's similar to iTunes® allowing customers to listen to a 30-second clip of a song before purchasing or SiriusXM™ radio equipping new vehicles with an automatic °trial of its service. The concept has gained wide appeal among consumers.

When applied to billing, tryvertising encompasses the use of e-bills side-by-side with paper bills for a specific duration so that consumers gain firsthand experience of the benefits of receiving e-bills. This is significant because, according to the Fiserv Billing Household Survey, the biggest single motivator for online consumers to try e-bills is the ability to try e-bills while they are still receiving paper bills.

By experiencing electronic bill presentment and associated capabilities such as due-date alerts while still receiving paper bills, consumers are able to establish a comfort level with the electronic process. An introductory period also assures consumers that e-bills, along with due-date alerts, provide the reminders necessary to help make certain bills are paid on time. This eliminates one of the primary impediments to paper bill turn-off – the reliance on paper bills as a reminder to pay.

Putting the Theory into Practice

By allowing consumers to try e-bills before turning off their paper bills, billers can build consumer knowledge and comfort with the service, motivating more consumers to adopt e-bills and encouraging existing e-bill recipients to sign up for more e-bills.

A series of pilots of the e-bill tryvertising program was conducted with a leading Telco, four top 10 banks and one top 10 credit union. The pilots were structured so that customers began receiving e-bills alongside their paper bills for a 90-day period. Once the pilot was complete, the customers were then given the option to opt-in to e-bills or they would revert to receiving only paper bills.

Over 395,000 active online bill payment customers at the various institutions were included in the pilot. On average, the participating financial institutions and biller realized the following results:

- Activation Rate: the number of e-bill activations was three times higher for customers enrolled in the pilot than for customers who were not enrolled
- First Time E-bill Users: 74 percent of those that activated an e-bill were first time e-bill users
- Draft Effect on E-bills: nearly 70 percent of pilot participants who activated an e-bill activated at least one additional e-bill from another biller; on the average, two additional e-bills were activated.
- Draft Effect on Bill Payment: more than 60 percent who activated an e-bill added an additional bill for payment through their financial institution

These results show that an introductory period can have a significant impact on e-bill adoption, particularly among first time users. In other words, tryvertising really does work to help consumers implement and confirm that e-bills are the right choice for bill presentment.

E-bill: A Critical Piece of a Bigger Picture

As consumer interest in e-bills increases and adoption is forecast to grow, now is the time for the utility industry to revisit their e-bill strategy. While consumers appreciate the convenience, financial organization and control e-bills provide, many still don't know if their gas or electric company offers e-bills at the biller site or through their financial organization, how e-bills work and how they can benefit from electronic bill presentment. Utilities organizations have the opportunity to help educate consumers and drive e-bill adoption by promoting e-bills through traditional marketing, offering e-bills through channels such as online banking as well as new approaches such as tryvertising.

By offering and encouraging the use of digital channel technology such as e-bills, the utilities industry can deliver a more complete personal financial management experience that will enhance the overall customer relationship while containing costs.
www.fiserv.com/resources/con-edison-ebill-study.htm

About the author

Eric Leiserson is a senior research analyst at Fiserv, where he is responsible for the development of consumer-related electronic billing and payment research, adoption strategies, and marketing programs. He has conducted numerous primary research projects and Webinars in the areas of green marketing, consumer segmentation, longitudinal surveys, Web usability, and focus groups. Prior to joining Fiserv, Leiserson held marketing and sales positions at Unisys Corporation and Intuit.

EnVision 2030 - Getting Ready for EV Evolution

Ideas for a Better Planet

Part 3 of 3

Jon Brock, Desert Sky Group LLC seeks the answers in this the final installment of our three-part interview with Dr. Russell Lefevre, IEEE Fellow

The previous session ended with Dr. Lefevre outlining the technical challenges that have to be addressed to successfully provide and store power for EVs once the adoption is underway.

This interview addresses EV standards and their potential impact on vendors and consumers; overall value to the end user; how cities are preparing for the EV; and the ability of the Smart Grid to handle energy demands.

Brock: What standards work is underway to realize these technologies?

Lefevre: There are a lot of standards. The Society of Automotive Engineers (SAE) is working with EPRI on standards and they've been very, very active. The most important things, from my perspective, are the charging level standards. We'd be nowhere if those standards didn't exist or were not accepted.

In mid-October, one of the most important events in Electric Vehicle Standards occurred. The SAE released a new fast-charging 'Combo' coupler standard (SAE J1772TM). The standard is based on the previous J1772TM standard that defined AC Level 1 and Level 2 charge levels and specified electrical interfaces. The new revision includes DC charging where DC Level 1 and Level 2 charging are defined. This EV quick charging standard is viewed by some as a 'game changer.' However, it is another step in an ongoing standards war between the new SAE 1772TM standard preferred by US and European manufacturers and CHAdeMO preferred by Japanese manufacturers. The standards are not currently compatible; however, talks are ongoing to agree to a global standard.

There are two other things that are going on that I want to mention.

The first is that IEEE has an electric vehicle standards working group, P2030.1. What they're working on is guidelines for utilities, auto manufacturers, infrastructure developers, and end users of electric vehicles. They work on things like terminology, methods, equipment, planning, and they're developing a road map for electric vehicle deployment. IEEE does a lot this type of standards and P2030.1 is working on these guidelines for electric vehicles.

The second point: In March, the American National Standards Institute (ANSI), which is considered one of the most important standards organizations in the world, started an electric vehicle standards panel. This is a really big deal. They've got industry and academics involved. In April 2012 they released the ANSI Electric Vehicle Standards Panel (EVSP) Standardization Roadmap for Electric Vehicles. This document identifies, makes an inventory, and assesses existing standards, codes and regulations, and related programs. Of major importance is that it identifies gaps and recommends solutions.

Brock: How will those standards impact vendors?

Lefevre: If electric vehicles are going to deploy, they're going to need standards, for example, for communicating with the Smart Grid. They're going to need standards for how to build a charging station that will work with 30 different types of EVs. There might be 30 by the end of 2012.

Brock: Can you highlight any examples of cities or states that are amply prepared for the adoption of EVs in the near future? Please elaborate.

Lefevre: The Department of Energy, under the American Recovery and Reinvestment Act (ARRA) of 2009, which is the stimulus bill, has put out a number of contracts to companies including ECOtality, Coulomb Technologies, and General Motors. There are others but these are the big three. They expect to have more than 22,000 charging points by 2013. That's going to be a very, very big deal.

There are many cities preparing for the adoption of EVs including Austin, Los Angeles, New York City, Orlando, Redmond, Sacramento, San Francisco, and Washington, DC.

Austin is a good city to highlight: The IEEE-USA held its annual meeting in Austin this year and they had a full-day electric vehicle workshop. An Austin Energy executive talked about what the company is doing. It has a program called 'Plug-in Everywhere.' It is going to put in 100 to 200 Level 2 or Level 1/2 charging stations around Austin so that nobody is ever more than 5 miles (8 kilometers) from any charging station.

There are concerns about how to deal with handicapped parking places, how to deal with multiple cars trying to charge at the same time, and locations – you want the stations to be near malls or theaters or places where people go so they can charge their car while they are at the theater or shopping. In addition, Austin has a program called 'Plug-in Partners,' which aims to encourage Level 2 charging in homes. There are several elements to that, but the biggest is they have a rebate of US$1500 for a home that puts in a Level 2 charging station.

And I would be remiss if I did not raise this one point: When it comes to infrastructure, I like to point out that my home state, North Dakota, already has the infrastructure for electric vehicles everywhere. If you go to any motel or hotel in the state of North Dakota, all of the parking spaces have electric outlets that the guests use to supply energy to the head bolt heaters in their cars so when a driver gets in the car after a night of minus 40 degree weather, the engine will turn over. When I was in college at the University of North Dakota, I lived in a fraternity and at night the cars would be parked in the back of the house and there would be an octopus of cords going out to the cars in the parking lot. There would be one outlet and all the extension cords were going off that outlet. I have no idea how safe that was, but it was funny to see that string of cords.

Brock: In President Obama's State of the Union speech in January 2011, he set a goal that the United States would deploy one million electric cars by 2015. Do you think the Smart Grid will be able to manage the energy demands this will place on it?

Lefevre: The Department of Energy (DoE) has done an estimate to determine if we can build a million vehicles, and the answer was yes according to DoE published estimates in 2011. However, as has become apparent, there is no chance that there will be one million electric vehicles on the road by 2015. The DoE report estimated that Chevrolet Volt would deliver 120,000 vehicles in 2012. Through August 2012, Volt has sold 13,497 cars. This is not an inconsequential number but reaching the DoE plan is clearly not going to happen.

This indicates that the near term impact on the Smart Grid will be fairly minimal. However, utilities are concerned about the long term effects. Most analyses indicate that the impact of electric vehicles on the generation and transmission part of the grid will be relatively minor. It is characterized as similar to the widespread adoption of air conditioning. Utilities are examining a potential problem with clusters, i.e. multiple electric vehicles in the same neighborhood on the same transformer. Researchers have shown that two electric vehicles using Level 2 chargers in the late afternoon could significantly stress the transformer. Using Smart Grid concepts such as Demand Response are viewed as potential solutions to these problems.

Brock: What can/should industry do to help?

Lefevre: Something else that is important is that cities and counties have got to make sure that building codes are OK for adding Level 2 chargers. And it might be really important to create building codes stipulating that if you do construct any new homes or perform renovations, that the ability to put in Level 2 chargers is included.

Brock: That's a sizeable task, dealing with municipalities, is it not?

Lefevre: Representatives of both Pacific Gas & Electric (PG&E) and Southern California Edison (SCE) have mentioned that they have been working with municipal people to do those building codes. When you think about it, it's not an easy job, because San Francisco's building codes are different than those of Los Angeles, they're different than San Diego's, Sacramento's, and they're significantly different from those of Austin, Texas or Detroit, Michigan. So it's not an inconsequential task to make that happen.

Brock: What will be the ultimate value to the end consumer of EVs?

Lefevre: Well for environmentalists EVs will help reduce the carbon footprint and they will offer tremendous potential for using renewables. People, certainly the early adopters, can put photovoltaic solar panels up on their roofs and charge their cars using solar, and if there are enough people to do that, it's a huge thing for reducing the carbon footprint. I have previously noted that those concerned about oil imports are in favor of EVs. Everybody in the country ought to think about reducing dependence on oil from unreliable suppliers.

Regarding the value of EVs to regular consumers, well, they will enjoy long-term cost savings. That is especially true if gas goes up. It's going down a bit now, but I've heard that at some point it's going to go up to $5 per gallon.* That would make EVs into really a good thing. People who have driven Chevrolet Volts and Nissan Leafs get on the blogosphere and can't say enough good things about those cars so consumers will own a really cool automobile. And another thing that is important is that these cars are very low maintenance. So those are the kinds of benefits you get.

Brock: Are there any other items or key points that you would like to cover?

Lefevre: There is one. The conventional wisdom is that electrical vehicles are cheaper than gasoline vehicles to operate. I'll throw that out as a question and then answer it: Why?

The conventional wisdom is that electricity is a lot cheaper than gas. And it turns out that that's very questionable. A gallon of gas has about 33 kilowatt hours of energy, and so that costs somewhere between $3 and $4 a gallon depending on where you live. Suppose you want to use electricity to get the equivalent amount of energy. How much would that cost? Well, the average cost of electricity over the U.S. is about 11 cents per kilowatt hour. Multiply 11 cents by 33 kilowatt hours and you get $3.63. That's right in the ballpark of how much a unit of energy costs for gasoline.

Lefevre: So, then, why is it so much cheaper to operate an electric vehicle? The answer is because electric drive trains are tremendously more efficient than internal combustion engine (ICE) drive trains. The difference is that electric drive trains are about 75 per cent efficient, or more and internal combustion engine drive trains are about 25 per cent efficient. So if you think about it, for example, a Chevy Volt can get something in the ballpark of 95 miles (153 kilometers) per equivalent gallon of gas, whereas a car gets about 25 miles to 30 miles (40 kilometers to 48 kilometers) per gallon.

I drive a Prius and I get in the ballpark of 35 miles to 40 miles (56 kilometers to 64 kilometers) per equivalent gallon, but I don't get 95 miles per equivalent gallon. And that brings me back to why it is so important to deal with power electronics. If you can make the electric drive train even more efficient, you can make that difference even bigger. And one thing to remember about the ICE is that people have been driving that technology since Model As and Model Ts, and they've been working on improving the efficiency ever since. They've done a tremendous amount to improve the efficiency, but you're up against fundamental problems. Physics isn't going to let you do much more with ICE drive trains, but there is still more benefit in electric drive trains and more potential to improve them.

Finally, one thing I think that is important to address is the value that IEEE brings to the electric vehicle community. One major element is that IEEE is the repository of a significant amount of EV intellectual property. To prepare for this interview, I searched Xplore, which is how the IEEE Digital Library is accessed. I entered 'electric vehicles' as a search term and received 13,674 results. These articles are contained in IEEE journals, magazines, and conference proceedings. And all of this information doesn't even count the panels that are convened in various settings, such as those held during conferences supported by IEEE's Reliability Society, Industrial Applications Society, Power Electronics Society, Vehicular Technology Society, and others. I also note that in addition to our standards activities, the Standards Association is supporting the Smart Grid Vision-Electric Vehicles activity that will project what the field will be in the future.

IEEE members are recognized as experts in most technology fields associated with electric vehicles. They are researchers, engineers and entrepreneurs. The organization and its members are also involved in outreach to society to indicate how EVs will impact peoples' lives. For example, the 2012 International Electric Vehicle Conference was held in Greenville, SC March 4-8, 2012 with sessions on technology, standards, policy and business. Further, IEEE's Transportation Electrification Committee and Spectrum Magazine sponsored a highly successful Emerging Technology Forum on electric vehicles in October 2011 in Mountain View, CA at the Computer History Museum promoting and publicizing electric vehicles and IEEE involvement in the field.

Brock: **Well, Dr. Lefevre, I think we've covered it. I can't thank you enough for your time and giving us the benefits of your vast knowledge and insights into EV ownership, industry standards, the country's state of readiness, the capability of the Smart Grid to integrate the technology, and more.**

Lefevre: My pleasure Jon. It's been very enjoyable speaking with you.

*One U.S. gallon is equivalent to 3.785 liters

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THE BIGGER PICTURE

BY ADAM CHAMBERLAIN,
BORDEN LADNER GERVAIS LLP

The Renewable Energy Approval – Ontario's 'Streamlined' Approval Process

This article is another in the series looking at the all-important Feed-in-Tariff (FIT) and its ramifications, from the legal standpoint that will impact energy producers and consumers well into this century.

Background

In 2009 the Ontario provincial government made a significant policy shift to encourage the development of renewable energy generation in the province. With the introduction of the Green Energy and Economy Act, 2009 the province embarked on a new approach to incentivise the development of renewable power generation.

Ontario has a long history of renewable energy. Early in the last century Ontario harnessed the power available in many rivers and in particular the water that would have fallen wastefully over Niagara Falls. However, early development in this area was undertaken by a monopoly that came to be known as Ontario Hydro. The power from Niagara and other similar facilities was so much a part of the provincial consciousness that Ontarians, to this day, refer to electrical power as 'Hydro' power despite the fact that less than half the electricity in the province is generated in this fashion.

If we fast forward about one hundred years to 2009 and a time in which the former monopoly had been disassembled, by a previous government, around the turn of the millennium the province had just made a commitment to eliminate coal generation as a source of power. To realize this commitment other sources of power were needed. With the introduction of the Green Energy Act the province attempted to do just that.

One headline aspect of this new green energy regime was the Feed in-Tariff (FIT) that offers preferential prices for power generated by renewable sources and twenty year contracts to help would-be developers obtain financing. Another key element of the new legislative program was the introduction of the Renewable Energy Approval (REA) that was intended to bundle most of the environmental assessment and related approvals into one efficient and timely approval process.

The Renewable Energy Approval

The REA sounds like an excellent idea – and it is! Making the Ontario Ministry of the Environment (MOE) the front line agency for approval was exactly what was needed. Most of the approvals that would, in the past, have been needed for a renewable energy project were already the responsibility of the MOE. What has become apparent since its introduction, however, is that coordinating the various bodies that feed into the approval process can be challenging.

While the MOE is the main window into the process for project proponents many other agencies or ministries feed into the process. Two of the more significant such bodies are the Ontario Ministry of Natural Resources (MNR) and the Ministry of Tourism, Culture and Sport (Culture). MNR has responsibility for, among other things, wildlife and endangered species and Culture's responsibilities include archaeological heritage. Without describing the specific requirements of MNR or Culture it is easy to see that they could be significant depending on the nature of a project that is proposed and the impacts its construction and operation could have. As such, the amount of coordination between MOE, MNR, Culture, and other ministries in the REA process is significant.

This was anticipated at least to a certain degree and the Green Energy Act also created the Renewable Energy Facilitation Office (REFO) to assist in the coordination of the various interests within government. With a three year track record, observers have commented that the REFO was perhaps less organized than would have been desirable initially. To its credit, the REFO has continued to evolve over time and has received more favourable reviews as time has passed.

Another element of the REA that was intended to facilitate development was the introduction of a six month service guarantee related to the time it would take to either be granted or refused the approval. The idea is that once the MOE receives a 'complete' application it will make a decision regarding the REA within six months. Again, this sounds great. However, real life can be a little different than the headlines and this is no exception to that rule.

Faced with a complex approval to consider, the MOE has understandably moved much of the work required for the approval to the pre-application stage of the process. Consequently, proponents of renewable energy projects have found that it can take around two years to prepare a complete application for a wind development and close to a year for a sizable solar facility. While proponents and their consultants are getting better and more efficient in the preparation of REA applications with experience, the process remains somewhat more time consuming than was originally advertised.

Appeals

At the other end of the approval process is the potential for appeals of issued REAs. To provide some certainty of process and to ensure appeals were dealt with promptly, the test on appeal was made quite difficult to meet and a deadline for the appeal process was set at, a rather familiar sounding, six months. So far only REAs for wind projects have been appealed and none, at the time of writing, have been successful. Thus far, no solar or biogas REA appeals have been brought.

It is unclear how many other REAs will be appealed or whether they will be successful. What is clear is that the renewable energy sector in Ontario is well into a new phase. It will be interesting to see how it continues to evolve and how it looks when seen from the point of view of the future.

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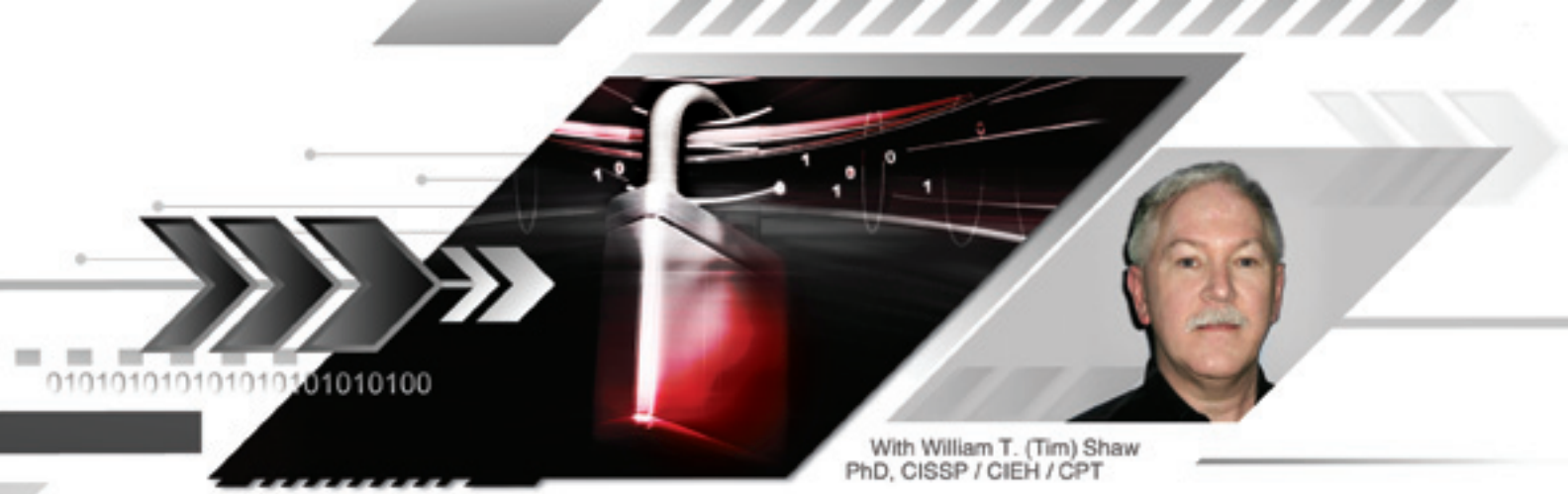

With William T. (Tim) Shaw
PhD, CISSP / CIEH / CPT

SECURITY SESSIONS

Power to the (security) people!

There was a television program in recent years that involved taking a group of people and firing questions at them round-robin until one person in the group was designated as "the weakest link" (and called that name by a shrill British woman who seemed to enjoy doing so). My point is not about the poor quality of television programming, but rather the notion that a person in your organization could be the weakest link in your security program. The latest statistics still show that the majority of physical and cyber security breaches are enabled due to the actions, or inactions, of personnel, possibly even personnel with security responsibilities. Let's consider how and why this continues to happen.

Today most organizations have begun to accept the fact that both physical and cyber security are essential aspects of their business operations, either because they are regulated (e.g. electric utilities, nuclear power plants) and required to address security in order to avoid fines and sanctions, because they are subject to specific laws (such as HIPPA and SOX) or because they have been 'shown the light' by their underwriters who have explained that increased risk exposure means increased insurance rates. Some organizations take security seriously, particularly those that have experienced or witnessed security-breach impacts. Others are still thinking that 'it can't happen here' and just doing the minimum required to avoid fines and legal liabilities. You would think that after learning about Stuxnet, and seeing company after company announce data theft, that the non-believers would see the light. I guess it is like climate change (a.k.a. 'global warming') you either believe it is happening or you don't. And no amount of evidence will change your mind if you think it a hoax.

But I digress (which happens more often as I grow older). Ignoring intentional malicious actions for the moment, why is it that people continue to be the weakest link in most security programs? Most studies and research show that it is because of inadequate training or the total lack of applicable training. A corollary to this is that appropriate training had been provided, but not periodically refreshed. I don't know about others, but I know that my brain has a small leak and when I fill it full of new information that information immediately starts to drain away and within a year it is as if I had never put anything in there at all. One of the reasons I like to teach is that it affords me a means for constantly refilling my leaky brain.

I have personally witnessed examples of cyber and physical security being badly messed up, in spite of the best efforts and intentions of the individuals involved, because of their lack of applicable training.

One such situation involved the implementation of an intrusion detection system (IDS) which, for those who may not know, is the cyber equivalent of a quality-control inspector that watches product passing down a product line and checks each item to make sure it meets the specifications. An IDS checks every message passing through a communication channel and examines them for malicious content or improper structure and may even evaluate them based on prior related messages that it previously examined. An important part of that last sentence is "every message." In order for an IDS to be effective, that condition (inspecting EVERY message) must be the case. In the situation I am referencing, the person in charge of implementing the IDS had no formal training or vendor-specific training on the implementation of the IDS product. Moreover, they had limited knowledge of networking and network elements such as Ethernet switches. On the plus side, however, they did have a book about IDS technology and the vendor's product literature. The individual had decided to use a spare port on a switch to connect the IDS to the network. This switch had 16 ports, all running at 100 MB/second (i.e. 100 Megabytes per second is considered 'Fast' Ethernet) and 14 of them were connected to various system components. They configured the switch to replicate all messages going in or out of all of the other ports and sent those replicated messages to the port where the IDS was connected (this is called port-mirroring or, if you are a Cisco user, setting up a SPAN port). That all sounds good, but in reality it can't work under heavy load conditions. There are 14 ports running at 100 MB/second and only one port (also running at 100 MB/second) into which all that traffic needs to flow to be delivered to the IDS.

If all 14 devices connected to the switch are sending message traffic all at once then some of the replicated messages will be lost, which means that the IDS won't see everything and can't be trusted to identify attacks and malicious content such as viruses and worms. The person setting up the IDS ran some simple tests and everything seemed to work. Of course that testing was done 'off-line' and not under actual operating conditions on the production systems.

After we discussed the situation, and the bandwidth limitations were explained, the implementation was changed to utilize network 'taps' that aggregated all of the traffic. The IDS was equipped with a gigabyte Ethernet adapter so that under full-load conditions no messages would be lost. An equivalent physical-security analogy would be; if you had a video camera monitoring and surveillance system where the cameras stopped working for a few minutes every so often. It was clear that the person setting up the IDS was well intended but had no idea that the setup would not be effective. It was equally clear that if the individual had been allowed to attend IDS vendor training, the installation and configuration would have been done properly in the first place. Does this sound like a case of 'penny wise and pound foolish'? Two issues are at play here: there was insufficient bandwidth to examine all of the message traffic and the person lacked the expertise to ensure that the rules, signatures, and pattern-matching configuration setup of the IDS was done properly.

Another situation that I see on an all-too-regular basis is the successful use of social engineering methods to gain unauthorized entry into supposedly secure areas, as well as its use to compromise computers and obtain confidential information. This is another case where untrained (or trained too long ago) personnel are the weakest link. Unlike the previous example where I was dealing with people who were involved in implementing cyber security, susceptibility to social engineering ploys tends to be a problem with personnel in general and senior management in particular. Social engineering is basically tricking people into doing something they would not normally do, such as giving out confidential account information like a password. Intruders also use a method called 'piggy backing' where they help someone enter an area using their own credentials. Social engineering attacks are best countered by providing all personnel with familiarization training (with periodic refreshers) and having policies and procedures that are aimed at preventing such manipulations from being successful.

Today the most common means for cyber attackers to gain access to company computer systems and networks is through the use of phishing attacks. This is a form of social engineering that uses email as a way for enticing a victim into 'clicking' on a link or opening an attached document, which results in their PC being infected. There are technical countermeasures that can be deployed to block such attacks, but the constant arms race between hackers and your IT department is invariably won by the hackers. They are continually finding new exploitable vulnerabilities so that phishing attacks continue to be successful.

Regardless of the vulnerabilities in a browser, or one of its 'plug-ins', there is still the need for the victim to 'click' on a link or to open an attachment. If personnel are well trained in social engineering ploys and in phishing scams in particular, then the chances of their falling for one are greatly reduced. One organization I know of began social engineering familiarization training, including generating its own phishing scams to test personnel awareness, and recorded a dramatic decrease in PC infection incidents over a two year period.

The bottom line is that skimping on training, both for the personnel who are responsible for your cyber and physical security, and for all personnel as a whole, is probably going to end up costing you more than you would have spent on providing the training.

I started this column by excluding intentional malicious actions on the part of personnel. In reality we don't have that luxury; the malicious insider threat is one of the most serious. There are things that can be done to limit the amount of damage that can be caused by a malicious insider and things that can be done to reduce their ability to act without being detected … but that will be the subject matter for a future column.

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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. Shaw is a prolific writer of papers and articles on a wide range of technical topics and has also contributed to several other books. He has also developed, and is an instructor for, a number of ISA courses. Dr. Shaw is currently Principal & Senior Consultant for Cyber SECurity Consulting, a consultancy practice focused on industrial automation 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*

Guest Editorial

Securing Utilities from Cyberattacks

"For the times they are a-changin"

By Eric Byres, Tofino Security at Belden Inc.

When Bob Dylan sang "*For the times they are a-changin*'" in the 1960s, it was an ode to recognizing and accepting change. This same frame of mind is required when we think of securing electric utilities from modern cyber threats.

Up until the last decade most disruptions in power grids were not caused by cyberattacks. For example, the Northeast blackout of 2003 was caused by a series of inter-related events. As we all know, a generating plant near Cleveland, Ohio went offline during a time of high demand, putting strain on high-voltage power lines, which led to a cascading effect. Other factors such as overgrown trees and a bug in the software used to manage the energy system for one utility contributed to the blackout. The result was that one hundred power plants were shut down and about 55 million people in the U.S. and Canada went without power for 8 to 16 hours.

A notable blackout that was likely caused by a cyberattack occurred in Brazil in 2007. It resulted in outages that left 60 million people across multiple cities without power. Not many details are known about the attack, likely because Brazil, as well as other nations, did not want the hacking community to know that their electric grid is vulnerable to such attacks.

Despite the Brazilian incident, overall the risk of an external malicious cyberattack on a power utility was considered minimal. However, over the last decade utilities have been moving to smart grid infrastructure, which introduces many points of cyber vulnerability, at the same time as worldwide cyberattacks on energy systems have increased.

Hackers and nation-states focus cyberattacks on energy providers

Focused control system cyberattacks, like the Brazilian one, reached a zenith in July 2010 when the Stuxnet malware was discovered destroying the centrifuges used for uranium enrichment at Iran's Natanz nuclear facility, proving that industrial sabotage by malware is possible.

Stuxnet's fame made it all but impossible for governments or other entities to keep the vulnerability of electric grids off hackers' radar. Once the media started publishing Stuxnet stories (media as varied as '60 Minutes' and 'Vanity Fair' have covered it), security researchers started focusing on hacking industrial systems and devices, particularly those in the energy sector.

Stuxnet's design also provided the hacking community with a toolkit for developing a type of sophisticated malware known as APTs (advanced persistent threats). Like earlier malware, APTs are designed to be very hard to detect, so they can do their dirty work over a period for years.

Flood-gate at a hydro dam in South Africa

The combined impact of Stuxnet and other APTs was called out in a 2011 study done by McAfee, the computer security firm, and the Center for Strategy and International Studies in Washington. It surveyed utility industry executives from 14 nations and noted:

> "One of the more startling results of our research is the discovery of the constant probing and assault faced by these crucial utility networks. Some electric companies report thousands of probes every month. Our survey data lend support to anecdotal reporting that militaries in several countries have done reconnaissance and planning for cyberattacks on other nations' power grids, mapping the underlying network infrastructure and locating vulnerabilities for future attack."

Vulnerability deluge

Further evidence that a tipping point in cyber landscape for power systems occurred in 2011 when more ICS (industrial control system) vulnerabilities were made public (many with exploit code available on the internet), than in the entire previous decade, and the trend has continued well into 2012. Power utilities had exposure in relation to many of the problems reported.

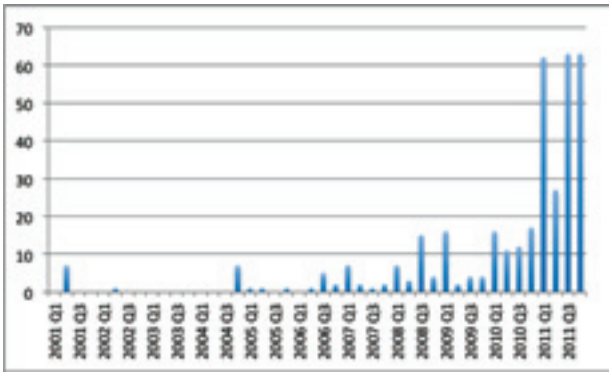


Fig 1. *ICS Specific Vulnerabilities in the Public 2001-2011 (by quarter). Chart used with permission of creator, Sean McBride.*

For example, recently Telvent, the smart grid giant owned by Schneider Electric, reported that hackers breached its network, left behind malicious software and accessed project files for its OASyS SCADA system. This system is used by Telvent to control power grids, gas pipelines, and industrial controls around the world.

This attack is another milestone in escalating cyber threats, as it was not just an example coded by a security researcher but a real attack with serious implications. The hackers, which clues indicate are a Chinese group, might be able to learn how the Telvent OASyS system works, and use that information for further attacks.

Another development is that detailed descriptions of SCADA system vulnerabilities have started to be widely published. A prime example of this was the January 2012 release of cyberattack tools for the GE D20 RTU. The ICS-CERT reports that 40 percent of the publicly disclosed vulnerabilities include working attack software.

Shamoon: Low-grade malware with high-grade impact

Another example of the changed cyber threat landscape occurred in August 2012 when an insider, possibly with Iranian backing, successfully attacked Saudi Aramco, and Qatar's RasGas with the Shamoon malware. At Saudi Aramco, it destroyed the data on a huge number of computers (30,000 – 55,000) at their world headquarters facility.

Leon Panetta, the U.S. Defense Secretary recently described Shamoon as the most destructive attack the business sector has seen to date and a 'significant escalation of the cyber threat.'

A disturbing aspect of Shamoon is that it lowers the bar for effective disruption of a business or agency. A programming effort that involved a small group of people with skills slightly better than amateurs was able to penetrate a well-protected network and destroy massive amounts of data (albeit with insider access). In addition, they did it at a scale and speed that is unprecedented.

For utilities that are linking up legacy systems to IT technology and have to contend with millions of endpoints such as smart meters and grid controls, the challenge of securing the system has never been greater. Imagine the damage that could be done if any group of people with an axe to grind against your utility activates a similar attack against you. The success of Shamoon is sure to attract copycats.

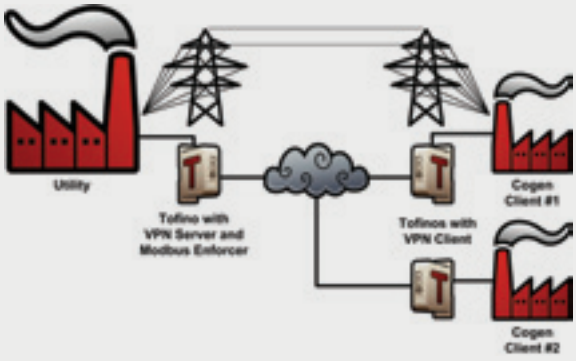
ESP Challenge Solved with Defense in Depth Solution

By Eric Byres, Tofino Security at Belden Inc.

A large utility had an agreement to buy and sell power with several industrial customers. This required real-time communications between the utility substations and 3rd party facilities for power quality metering. The utility owned the metering equipment, but it sat in another company's premises, making the definition of an ESP fuzzy.

If inside the ESP, demands for physical isolation and auditing would be unrealistic. If outside, the traffic needed to be routed through the ESP firewall, adding complexity and risk. There was also the issue of how to manage any connectivity supported by 3rd party network elements. Fine-grained control of SCADA traffic between the customer and the utility cannot be assured by a standard IT firewall, which can only deny the SCADA protocol in use, and not filter it for specific content. This potentially allows dangerous functions, such as programming commands or malformed SCADA messages, to be injected from the client site into the utility's control systems as part of the permitted data stream.

The solution was to define the meters in a separate zone that had low security capability. The conduits between the 3rd parties' facilities and the utility needed three attributes in order to provide adequate security—encryption of messages, authentication of the end points and fine-grained inspection and filtering of all SCADA messages.



Utilities need to secure all communications with other entities in the grid to ensure protection.

A firewall on each conduit, with deep packet inspection (DPI) and VPN encryption modules, allowed SCADA data read commands (and corresponding reply messages) and blocked all other traffic. The VPN authenticated all connections and encrypted all traffic. The security devices also provided alerts for blocked SCADA messages or suspicious connection attempts.

Bottom Line: Prepare for the attacks

Whether it is a highly sophisticated, targeted APT attack or a low grade Shamoon-like attack, and whether it is motivated by a political agenda or activist groups, the cyber threat landscape is in a new era. It's time to renew your defenses to protect your power infrastructure.

In October 2012 the U.S. Defense Secretary Leon Panetta declared:

> "....foreign cyber-actors are probing America's critical infrastructure networks. They are targeting the computer control systems that operate chemical, electricity and water plants and transportation systems."
>
> He said the government knows of 'specific instances where intruders have successfully gained access to these control systems, and that the intruders are trying to create advanced tools to attack the systems to cause panic, destruction and death.

Defense approach 1: NERC CIP compliance

Systems that transmit and distribute electricity have not been designed with cyber security as a priority. Instead, reliable continuous delivery of electricity has been the focus, and it was assumed that utility systems would stand apart, in locked industrial sites and control centers. Nowadays, as utilities implement the smart grid, many of the SCADA systems in use, particularly ones that have been in operation for 10 or 20 years or more, are vulnerable to exploitation.

The North American Electric Reliability Corporation (NERC) has been focused on Critical Infrastructure Protection (CIP) for a number of years, and the fifth version of their security compliance standards has recently passed the first stage of approvals. By law, bulk electric producers need to comply with NERC CIP regulations. In doing so you might assume that you are protecting your systems from the new wave of cyber attacks. Unfortunately that is not necessarily the case.

There are number of limitations of NERC CIP.

a. **Focus on compliance versus effective security**

When considering the effectiveness of a standard, a top concern is whether or not it reflects a well-thought-out design for security. In the case of NERC CIP, particularly the versions preceding version five, there is a high focus on compliance and less of a focus on effective security. The

penalties imposed are about compliance (for example, not providing comprehensive audit logs) rather than low security effectiveness.

b. NERC CIP exemptions

Any asset that can be claimed as not critical to the Bulk Electric System (BES) is exempt in NERC CIP. Also, small generation facilities (defined as 500 MW in version three and 1,500 MW in version five) are exempt. The difficulty with this is that a security breach may allow the initiator to impact the main network once access is achieved at the 'non-critical' facility. As well, an attack on a few non-critical assets could be as equally as damaging to a company as an attack on a single critical asset.

c. Electronic Security Perimeter (ESP)

NERC CIP defines security in terms of having a strong boundary, i.e. the ESP, as the only layer of defense. This is a model known as the Bastion model and it has failed in military campaigns and in IT security. It will fail for electrical systems.

This doesn't mean that boundary protection is not important: it is, but there needs to be additional layers of defense to back it up – what is known as Defense in Depth (DiD).

Let's look at a couple of examples of boundary issues. People are one of them: they cross the boundary all the time and they are able to introduce malware inside of it.

Another example is cogeneration (cogen) facilities. If you define cogen as being outside the NERC CIP BES criteria, then it is outside the ESP. This then begs the question of how to secure the interaction between the cogen and the primary systems.

A different perimeter problem occurs when utilities communicate with their large customers. When information about usages needs to be exchanged, how do both sides insure that only the proper communications are exchanged?

Defense approach 2: Defense in Depth and best practices

If NERC CIP does not ensure security, what does? The answer is to use a number of best practices that contribute to providing DiD.

ISA IEC 62443

Instead of only relying on an ESP, production networks should be segmented according to ISA IEC 62443 standards (formerly ISA-99 standards). Each zone of devices with similar security requirements should be protected with its own industrial firewall. Such a firewall should be optimized to secure SCADA protocols such as DNP-3 and IEC 61850, rather than email or web traffic. Web and email messages simply have no place in the electrical system; products that inspect these protocols simply add cost and complexity to the security solution. Industrial firewalls also have an advantage over IT firewalls because they can be deployed into live networks by field staff with no risk to operations.

Seven steps to ICS and SCADA security

We have developed, in partnership with exida, our own best practices for ensuring good security, called the '7 Steps to ICS and SCADA Security.' They apply to both industrial automation and power utility operations. We condense numerous industry standards and best practice documents and combine them with the experience of our staff. The result is an easy-to-follow process:

1. **Assess existing systems:** Understand risk and prioritize vulnerabilities
2. **Document policies and procedures:** Determine position regarding ICS and develop company-specific policies
3. **Train personnel and contractors:** Develop and institute policy awareness and training programs
4. **Segment the control system network:** Create distinct network segments and isolate critical parts of the system
5. **Control access to the system:** Provide physical and logistical access controls
6. **Harden the components of the system:** Lock down the functionality of components
7. **Monitor and maintain the system:** Update antivirus signatures, install patches and monitor for suspicious activity

A white paper detailing this process is available at: *http://web.tofinosecurity.com/download-7-steps/.*

Focused efforts

Enterprise IT teams focus their efforts on their more important assets. Every control system has one or more assets that would seriously impact production, safety or the environment if successfully attacked. Often these are not the same as what the NERC-CIP regulation define as 'critical.' Your engineers know what really matters to the operation. If those assets are aggressively protected, the chance of a truly serious cyber incident is massively reduced.

Another area for focus is detection. The industrial automation world is poor at detecting anything unusual on controls networks, and this adds a level of vulnerability to power utility operations as well. Make sure your firewalls and other security devices have good reporting capabilities, and ideally are integrated into an industrial management system. Your production engineers and operators should be immediately alerted if a read-only remote operator station suddenly tries to program a remote terminal unit (RTU). Waiting for the IT team to analyze the event the next morning is too late.

For the times they are a-changin'

The golden years when power utilities needed minimal physical protection and SCADA systems were considered to be under the radar of the hacker community are gone. The question is when, not if, a power utility will come under cyberattack. The recent escalation in cyberattacks against energy companies and the warnings of the U.S. Defense Secretary indicate that now is the time to renew the cyber defense initiatives for your utility.

As Bob Dylan sang:
The order is
Rapidly fadin'
And the first one now
Will later be last
For the times they are a-changin'.

ABOUT THE AUTHOR

Eric Byres, P. Eng. and ISA Fellow, is recognized as one of the world's leading experts in the field of SCADA security. His technical knowledge combined with his background as a process controls engineer has been indispensable in his role as CTO and VP Engineering for Tofino Security at Belden Inc. He has written extensively about the malware Stuxnet. Eric founded the British Columbia Institute of Technology (BCIT) Critical Infrastructure Security Centre and shaped it into one of North America's leading academic facilities in the area of SCADA cyber-security. As a result, Eric was awarded a SANS Institute security Leadership Award in 2006.

He is a notable contributor to industry standards and is Chair of the ISA99 Security Technologies Working Group and Chair of the ISA99 Cyber Threat Gap Analysis Task Group. Eric is Canadian representative for IEC TC65/WG13, a standards effort focussing on an international framework for the protection of process facilities from cyberattack.

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— Randy Williams, Components Account Executive, ABB Power and productivity for a better world™

SCHEDULE

Tuesday, Feb. 12

8 a.m.-Noon General Session

Noon-4:30 p.m.
Facility Tours, ABB & Siemens
Or Golf Outing with GE
Or City Tour by Normandy

5:30 p.m.
Welcome Reception by ABB at NASCAR Hall of Fame

Wednesday, Feb. 13

8 a.m.-Noon	Tracks 1 & 2
Noon-1 p.m.	Lunch, Expo
1-5 p.m.	Tracks 1 & 2
5:30-7 p.m.	Reception, Expo
7-9 p.m.	Dinner Gala

Thursday, Feb. 14

8 a.m.-Noon	Tracks 1 & 2
Noon-1 p.m.	Lunch, Expo
1 p.m.-5 p.m.	Tracks 1 & 2
5:30-7 p.m.	Reception, Expo

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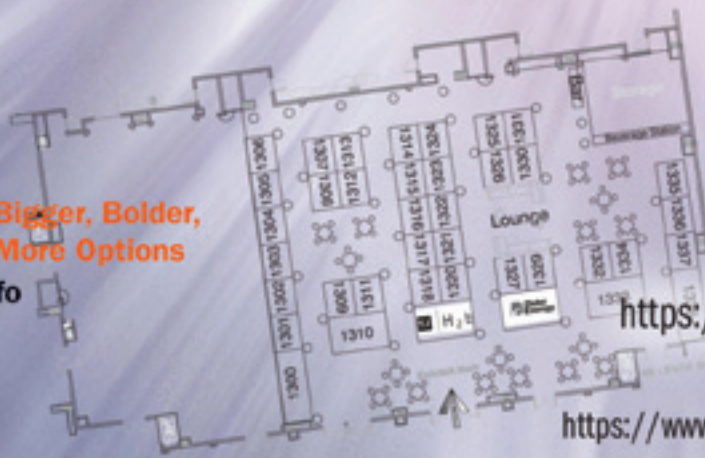

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