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NOVEMBER-DECEMBER 2010 Issue 7 • Volume 14

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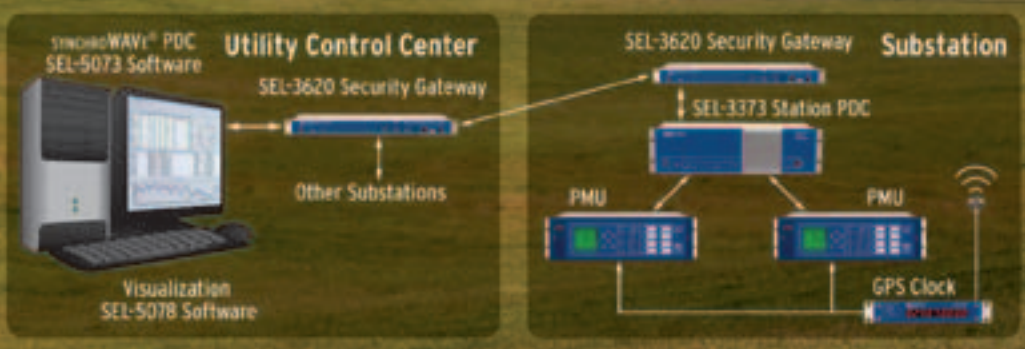

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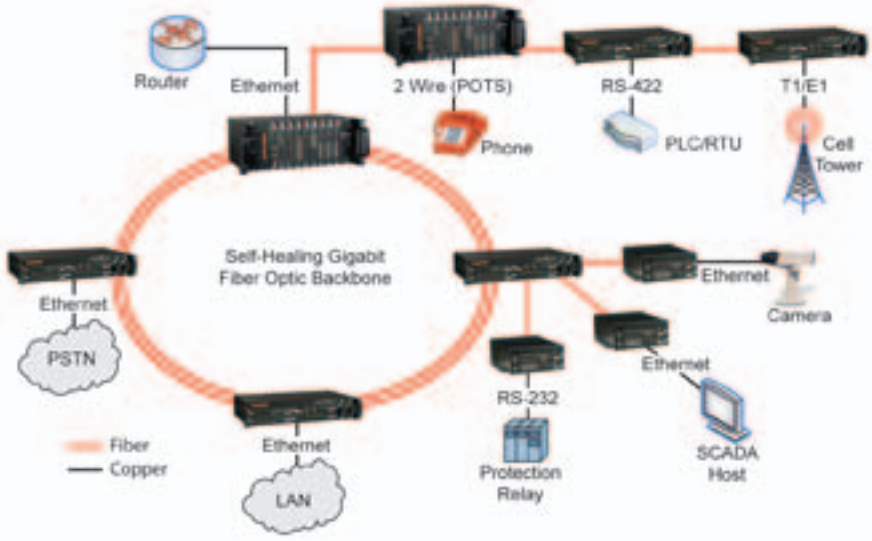

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GRIDLINES

MICHAEL A. MARULLO, EDITOR IN CHIEF

It's ~~Not~~ Easy Being Green…

Qui-Gon Jinn, a fictional character in the Star Wars series and a wise protagonist in the 1999 blockbuster, "*Star Wars Episode I: The Phantom Menace*" – is credited with the admonition, "*How well you focus will determine your reality.*" I freely admit to having been intrigued by this phrase from the first time I heard it because even though it was voiced by a fictional character (*…a long time ago in a galaxy far, far away…*), I've always felt that it speaks volumes about real life in the here-and-now.

There are lots of scenarios where this theory can be applied – various sports and business analogies come to mind – all concerning the basic notion of visualizing oneself scoring, beating a formidable opponent, advancing to the next level, winning the game… or the bid, the promotion, the job, or whatever. But today I want to focus your attention on the myriad challenges we face today relative to energy, efficiency and environment, both now and in the immediate future.

Yes, these are sometimes polarizing issues, to say the least. However, my objective here is not to suggest radical new theories or take sides, but rather to present a balanced perspective on these issues, which are vitally important not only to our industry and our economy but also many other dimensions of our very existence.

Not so very long ago it was more than a little difficult to get any traction in these areas without being labeled a kook or a radical and ostracized for being "green" (Just ask Kermit the Frog!). Today, however, that has mostly changed as more and more people, companies – even countries – embrace the value and propriety of living, working and yes, even playing in greener, cleaner ways.

Yet in the utility industry many of us are just starting down this still-evolving path and aren't too sure about where it will lead or how we will even know when we've reached our goals, whatever those might be. But, if we drill down to a narrower focus – automation and information technology professionals, for example – we are seeing an increasingly aggressive adoption of green (or "CleanTech," if you prefer) initiatives all across the industry. Hmm, not really that surprising, I suppose, since these are typically the people and organizations that are routinely charged with blazing new trails and exploring new technological frontiers.

As I read the flood of news releases that comes across my desk daily, I'm seeing nearly as many green initiatives coming from the automation/IT community as I see from the marketplace at large. Now it's fair to say that as an automation/IT-centric publication, it shouldn't be too surprising that the scales are tilted, but what I do find a bit surprising is the rate at which these companies are rolling out products and systems designed to facilitate green initiatives.

I probably need to clarify here a bit: What I'm NOT talking about are companies that are just going through the motions of being green without any creativity or innovation. What do I mean by that? Well, I'm sorry, but virtually anyone can put a note on an email urging recipients to "Think Before Printing", and these days it certainly doesn't take a rocket scientist to print with soy-based inks on recycled paper. As a friend of mine likes to say, "That's so 20th century!" Hey, it is; there's nothing new or creative or innovative.

By contrast, show me someone that has figured out how to use electric vehicles as a distributed resource with a fully functional communications network and advanced software for managing that resource just as if it were an infinitely distributed power plant – as I learned from FERC Chairman Jon Wellinghoff's presentation at the Smart Grid RoadShow in Portland earlier this month – and I'll be duly impressed!

In this issue, we're launching a new dimension of "GrEEEn" – the three *E's* translating to *Energy, Efficiency & Environment* – in a supplement included further along in this issue. This special section offers an information-rich sample of what our two GrEEEn issues in April and October of next year will cover.

Our focus for these new issues is broad in the sense of the 3 E's, but narrow with regard to the relevancy of these topics to electric power transmission and distribution, as represented in the name of this publication. In addition, each issue will have a primary focus, which for this first run, is electric vehicles (EVs).

Had we undertaken this approach five or six years ago, none of it would have made a whole lot of sense – well, at least not in a T&D context. But a lot of water has passed under the bridge (or, should I say, power over the wires?) since the terms "Smart Grid" and "Smart Meter" made their way into our vocabulary. Now that we have 2-way power and 2-way communications flowing in a variety of ways, the rules of the game are very different. Being green is no longer just a cliché; it has rapidly become part of the fabric of what we do, and in many cases, how we do it.

The fact is, it's actually fairly easy being green these days – we just need to work a little harder at it. And if we do, who knows what we might be able to accomplish? Just remember, "*How well you focus will determine your reality.*" – ***Kermie.***

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Industry NEWS

Green for All and SJF Institute Recognize Petra Solar as One of the First Ever Honorees of the Green Jobs Award

Green For All and SJF Institute have selected Petra Solar, a South Plainfield based cleantech company, as one of the Green Jobs Award recipients. The Green Jobs Award honors innovative private businesses that contribute to the economy and the environment. The selection was based upon key considerations including Petra Solar's contribution to environmental quality, the quality of its jobs and benefits, the diversity of employment opportunities, and its level of community engagement. Petra Solar was honored last night at the Citi Executive Conference Center in New York City.

"We are grateful for the recognition from Green for All and SJF Institute," said Shihab Kuran, CEO and President of Petra Solar. "Our goal at Petra Solar is to create and grow green jobs as we create smart solar generation systems and export them across the nation and around the world."

The company designs and manufactures SunWave™ systems that combine distributed solar energy generation with smart-grid communications and electric grid enhancement functions to create a comprehensive utility grade solution. SunWave systems are specifically designed for installation on existing structures such as utility distribution poles or other assets.

By creating its own R&D and manufacturing supply chain, Petra Solar's job count has grown from 15 in the spring of 2009 to 166 currently, over a 10 fold increase. In keeping with the company's commitment to return ratepayer and taxpayer support, the company will create new manufacturing facilities in jurisdictions in which it does significant business. As a result, major contracts with utilities will result in the creation of jobs to staff local manufacturing operations. "Each of the companies chosen this year does its part in building the green economy through innovation and job creation here in the United States," says Phaedra Ellis-Lamkins, CEO of Green For All. "They are demonstrating that by addressing the climate crisis we can take real steps in addressing the economic crisis as well."

"We hope that by acknowledging the tremendous work these companies are doing, we can support their noble efforts, and inspire other business leaders to follow their lead," says Bonny Moellenbrock, Executive Director of SJF Institute. For more information about Petra Solar visit *www.petrasolar.com*.

Circle **18** on Reader Service Card

KCP&L Offers Customers New Paperless Option with doxo

Paperless billing and online file cabinet helps customers save time and get organized

KCP&L announced a partnership with doxo to offer an additional easy-to-use online billing solution for residential customers. KCP&L customers can visit *www.doxo.com/kcpl* and sign up to receive, manage and file KCP&L bills for free within doxo. This service is in addition to the current paperless option available through AccountLink at kcpl.com.

Once connected to KCP&L on doxo, customers will receive KCP&L bills directly in their doxo account. Within doxo, a user can take action on a bill; file it in a personal online file cabinet where it is securely stored forever; and manage KCP&L bills along with documents from other companies – like mobile phone bills and credit card statements. Keeping everything in one place helps users stay organized and not miss due dates.

"We continually work to provide more convenient options for our customers and improve their experience with KCP&L," said Kevin Bryant, KCP&L vice president of Energy Solutions. "Our partnership with doxo provides a great new way, in addition to our own AccountLink service, for customers to manage their bills online."

"We're very excited to work with KCP&L to provide a new channel for paperless adoption and make online interaction even more convenient for users" said Steve Shivers, doxo CEO.

For more information about KCP&L's paperless billing options, please visit the Residential section of *www.kcplsave.com*.

More information can be found at *www.doxo.com*.

Circle **19** on Reader Service Card

CenterPoint Energy Selects ABB for Intelligent Grid Automation Deployment

Phase 1 of intelligent grid to improve power reliability and restoration in central Houston

CenterPoint Energy Houston Electric, LLC, a subsidiary of CenterPoint Energy, Inc. (NYSE: CNP), announced that it has selected ABB, a leading power and automation technology company, for the electric company's intelligent grid Advanced Distribution Management System (ADMS). Using ABB's Network Manager™, the ADMS will process data from power line sensors and smart electric meters to identify the location of power outages and remotely control intelligent grid switching devices to shorten the duration of power outages. Phase 1 is expected to be completed in 2013 and will cover more than half a million Houstonians in central Houston and along the Houston Ship Channel.

"Once deployed, this system will give us greater insight into the health of our electric infrastructure and eventually create a 'self-healing' grid," said Kenny Mercado, division senior vice president for CenterPoint Energy's Regulated Operations Technology. "With this technology, we will be able to automatically reroute power around many outage locations to help us get the lights on sooner. We selected ABB for our smart grid network after a rigorous review of several major vendors, and we are pleased to be installing an advanced system from a leader in power and automation technology."

Network Manager is an operations management system designed to provide advanced network modeling and management, integrated switching and tagging, trouble call and outage management, crew management, and historical archiving and reporting. Network Manager offers integrated advanced applications, such as fault location, unbalanced load flow and simulation modes, as well as interfaces to other information systems that permit organizations to leverage time-critical data across the enterprise. Network Manager is part of a suite of software offered by **Ventyx**, which was acquired by ABB earlier this year.

"We are very excited to be working with CenterPoint Energy," said Salim Khan, head of Network Management for ABB in North America and based in Sugar Land, TX. "CenterPoint Energy is a true industry leader and we believe ADMS will be a showcase of the promise of smart grid technology that will benefit the entire industry."

Since March 2009, CenterPoint Energy Houston Electric has installed more than 700,000 smart electric meters along with supporting communications infrastructure and computing systems. Recently, the company began installing intelligent grid switching devices on power lines across central Houston and plans to eventually extend its self-healing intelligent grid throughout its 5,000-square-mile electric service territory in greater Houston in subsequent phases.

A portion of the funding for deploying smart meters and the ADMS is provided through a U.S. Department of Energy Smart Grid Investment Grant. CenterPoint Houston Electric is using $150 million of the grant to accelerate completion of the installation of more than 2 million smart electric meters across Houston from 2014 to mid 2012. The remaining $50 million is being used for phase 1 of the intelligent grid deployment.

For the latest information on the CenterPoint Energy Houston Electric's smart meter and intelligent grid programs, visit *www.CenterPointEnergy.com/EnergyInSight*.

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Canadian Electricity Association Recognizes Hydro One Networks Inc. and Toronto Hydro-Electric System Limited for Excellence in Sustainability Performance

Hydro One Networks Inc. and Toronto Hydro-Electric System Limited were recognized for outstanding performance on sustainable development under the Canadian Electricity Association's (CEA) Sustainable Electricity program. The 2009 Sustainable Electricity Awards, adjudicated by the program's independent Public Advisory Panel*, recognize best sustainability performers in environmental, social, and company of the year categories.

The Environmental Commitment Award was presented to Hydro One Networks Inc. for its biodiversity initiative aimed at minimizing woodland habitat loss due to the construction of a new transmission line between the Bruce Nuclear Complex and the Milton Switching Station. "We were extremely pleased with Hydro One's approach to habitat enhancement in the affected area, and the approach they utilized to develop an ecosystem based valuation methodology in partnership with various local stakeholders," said Mike Harcourt, Chair of the Sustainable Electricity Public Advisory Panel.

As the first North American utility to roll out smart meters and Time of Use (TOU) rates in a major city, Toronto Hydro-Electric System Limited was presented with the Social Responsibility Award for their Get Smart Toronto communications initiative. The campaign was a highly integrated marketing and communications strategy to prepare its customers for the smart meter rollout. "This is an example of the electricity sector becoming more and more innovative in the delivery of electricity to consumers, while engaging stakeholders in a meaningful manner," noted Will Bridge, Chief Technology Officer at TransAlta, and Executive Chair of Sustainable Electricity.

The Panel also selected Hydro One Networks Inc. as the recipient of the 2009 Sustainability Company of the Year Award for its outstanding performance in all three areas of sustainable development – environment, social, and economic. In 2009, Hydro One Networks Inc. showed a substantial commitment to developing an electricity grid that is modern, flexible and smart; and one that will contribute to a better environment, and deliver clean renewable power to and from growing communities in the province of Ontario.

"The electricity industry is becoming increasingly sustainable in its activities, and we support the leadership and innovation shown by Hydro One and Toronto Hydro," said Pierre Guimond, President and CEO of CEA.

The Canadian Electricity Association encourages frank and open discussion about some of the options and challenges Canadians must face with respect to the modernization and greening of Canada's electricity system. Tyler Hamilton, representing the Toronto Star, is this year's recipient of the Sustainable Electricity Journalist of the Year Award for his "...high level of enterprise journalism," that was held by our experts to be "comprehensive, informative, and well written in developing a number of themes and stories about sustainable electricity."

Founded in 1891, the CEA is the voice of the Canadian electricity industry, promoting electricity as the critical enabler of the economy and Canadians' expectations for an enhanced quality of life. Its members ensure reliable electricity service to Canadians from coast to coast to coast.

Circle **21** on Reader Service Card

Detroit Edison Seeks Renewable Energy Proposals

Detroit Edison has issued a Request for Proposal (RFP) that will continue to add Michigan-based renewable power to the company's energy portfolio. The utility is seeking approximately 245 megawatts (MW) of renewable energy from wind, solar, hydro, biomass or landfill gas facilities that would be operating by the end of 2014. Of that amount, approximately 120 MW would be operating by the end of 2012.

The notice of intent to bid this RFP is due by Jan. 21, 2011. Potential bidders can view the RFP at *www.dteenergy.com/renewsuppliers* after November 18. Potential bidders who believe they are qualified can view detailed bid documents on the PowerAdvocate bid event platform. Potential bidders must be registered with PowerAdvocate to access the bid documents; the registration site is *www.poweradvocate.com*.

This RFP is part of Detroit Edison's broader efforts to expand the company's renewable energy resources. To meet the state's renewable energy goals, Detroit Edison expects to add about 1,200 megawatts of renewable power. Detroit Edison plans to provide 10 percent of its power from renewable resources by 2015. The company plans to own facilities to supply up to half of that power and contract with third-party producers for the rest. Detroit Edison expects the majority of its renewable energy to come from wind resources. The company has acquired easements on more than 75,000 acres of land in Michigan's Thumb region for development of utility-scale wind farms. The company also has two solar energy pilot programs that could produce approximately 20 megawatts of power.

Detroit Edison announced in September that its largest contract to purchase renewable energy was approved by the Michigan Public Service Commission, setting in motion a 20-year agreement with Invenergy Wind that will result in 200 megawatts (MW) of new wind energy in Michigan. The agreement – which represents a $1.1 billion commitment to renewable energy by Detroit Edison – paves the way for Invenergy Wind to install and operate a 30,000-acre wind farm near Breckenridge in Gratiot County, Mich.

The Invenergy contract boosted Detroit Edison's renewable energy capacity to nearly 4 percent of total generation. Information about DTE Energy is available at *www.dteenergy.com* and at *www.twitter.com/dte_energy*.

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Industry NEWS

Garrettcom Marks 100,000th Shipment of its Flagship Magnum 6k Managed Industrial Switch

GarrettCom®, Inc., has shipped its 100,000th Magnum™ 6K Managed Switch to Schneider Electric. The landmark switch, a Magnum 6KL Managed Edge Switch, was shipped as part of an order including a variety of Magnum 6K switch models and Magnum DX Industrial Routers for deployment into various naval facilities.

The Magnum 6K line of managed Ethernet™ switches are designed for demanding industrial Ethernet applications on the factory floor, in power plants and substations, transportation and industrial security and surveillance. The 6K line is designed to operate reliably in environments that require additional hardening for operation under extreme temperatures, dust, dirt, moisture, vibration, and other hostile conditions. The 6K family features fiber-rich, modular switches that can be configured with a variety of AC or DC power options and a wide selection of port options for the highest level of installation flexibility. The 6K switches can be mounted on a rack or DIN-Rail, and come with the best-of-breed MNS-6K managed networks software (release 4.1.9 and release 14.1.9 SECURE).

Steve Bowles, Southeast Regional Manager for GarrettCom, presented a plaque displaying the 100,000th Magnum 6K Switch to Mitch Morgan, Program Manager–Government Business, at Schneider Electric.

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FirstEnergy Named Recipient of the 2010 ReliabilityOne Award™ in the Midwest Region

Awards Presented to Utilities that Excel in Delivering Reliable Electric Service to Customers

FirstEnergy (NYSE: FE) was recognized by PA Consulting Group (PA) at its annual awards ceremony Wednesday in Washington D.C. as the recipient of the 2010 ReliabilityOne™ Award in the Midwest Region. The ReliabilityOne™ Award is given annually to the utilities that have achieved outstanding reliability performance and have excelled in delivering reliable electric service to their customers. FirstEnergy also was presented a PA ServiceOne Balanced Scorecard Achievement Award that recognized its achievements in Field Service.

In addition, Jennifer Schalmo, a business analyst in FirstEnergy's Process and Performance Analytics group, was presented the Outstanding Contributor Award for the work she did to enhance the value of the PA Customer Service benchmarking program.

"We are honored to be recognized for the quality of service we provide our customers," said Charles E. Jones, senior vice president and president of FirstEnergy Utilities. "Our utilities have an excellent track record for reliable electric service and we are pleased that our employees' dedicated work has been acknowledged with this prestigious award."

FirstEnergy's utilities – Ohio Edison, The Cleveland Electric Illuminating Company, Toledo Edison, Pennsylvania Power, Pennsylvania Electric Company, Metropolitan Edison Company and Jersey Central Power & Light – have improved distribution reliability. In 2009, the company posted its best results since 2001 as it further reduced the number of customers affected by outages and the average length of time a customer is without service during the year.

All utilities operating electric delivery networks in North America are eligible for the ReliabilityOne™ Award. There are a total of five regional awards including Northeast, Mid-Atlantic, Midwest, Plains, and West. The selection of provisional recipients is based primarily on system reliability statistics that measure the frequency and duration of customer outages. After provisional recipients are selected, each company is independently reviewed to confirm the selection.

"As a ReliabilityOne™ award winner in the Midwest Region, FirstEnergy has distinguished itself for its commitment to delivering outstanding reliability to customers in a manner which shows that it has really sharpened its focus towards setting the bar for industry performance," said Jeff Lewis, PA's ReliabilityOne™ Program Director. "As one of the top utilities in the country when it comes to keeping the lights on, this honor is well deserved."

Circle **24** on Reader Service Card

Puerto Rico Approves High Voltage Broadband Over Power Lines Trial

San Juan, Puerto Rico, November 2010 – In a ground breaking trial and part of its Smart Grid Initiative, the Puerto Rico Electric Power Authority (PREPA) has signed an agreement with PowerNET International, LLC to engage in a trial of a High Voltage Broadband over Power Lines (HVBPL) communications network utilizing state-of-the-art, patented technology held by International Broadband Electric Communications, Inc. (IBEC) and Amperion, Inc.

"We are pleased to finally be able to utilize the next generation of BPL technology in Puerto Rico, HVBPL," stated Scott E. Lee, Chief Executive Officer of IBEC, the nation's leader of BPL technology. "PREPA's trial project will demonstrate HVBPL's ability to communicate to substations without an existing telecommunication service. After successfully establishing BPL networks on low and medium voltage systems, HVBPL was a natural leap forward."

Nachum Sadan, CEO of Amperion added, "Amperion has successfully demonstrated the benefits of HVBPL in recent field tests with American Electric Power (AEP) and we are very excited to work together with IBEC and bring this innovative solution to Puerto Rico."

Regarding HVBPL, the cost to install HVBPL is a fraction of installing other types of communications networks because HVBPL relies on long-established and existing high-voltage electric power lines and infrastructure. The actual HVBPL technology was developed with a grant from the U.S. Department of Energy in 2007 and the first successful tests of the patented technology were announced in 2009.

HVBPL connects substations via transmission lines. "HVBPL can backhaul aggregated data from the grid's feeders and from inside the substation, enabling applications such as line protection, SCADA expansion, video surveillance, substation automation, and data and voice backhaul," noted Sadan.

PREPA is a government-owned electric power generation, transmission and distribution utility company and the main provider of electric power to all residential, commercial and government entities in Puerto Rico. PowerNET, working with IBEC and Amperion, will provide project management and oversight throughout the network design and initial testing of the HVBPL trial.

Last March, PREPA, PowerNET and IBEC announced the deployment of a Smart Grid BPL communications network to provide a high-speed, "always-on" communications pipeline over medium and low voltage power lines for the purpose of interconnecting and testing IP based Smart Grid energy monitoring and administrations systems. The network has been a success.

Circle **25** on Reader Service Card

GUEST EDITORIAL

Protecting Intellectual Property Rights for Smart Grid Innovations

By Dick Lord, CEO, The Steadfast Group

According to a recent US Department of Energy report, more than US$1.5 billion in venture capital has been infused into the smart grid vendor community over the past three years. Where did that money go? Not to the mega-players in smart grid technology – they all have their own sources of funding. You know their names because most of them have been mainstays in the electric utility vendor community for decades. No, that venture capital – all $1.5-plus billion of it – went to the start-ups that weren't funded either by angel investors or by their own resources. With that level of funding, those start-ups are playing an increasingly important role in the smart grid vendor community, their numbers now comprising more than 25% of the smart grid technology vendors.

Winning Combinations

Most of that venture capital funding went for innovations in the advanced metering infrastructure and home and building energy management market segments, technologies that depend neither on hardware nor software alone, but rather on the integration of hardware and software together to achieve an effective product offering.

One of the leading metrics that differentiates ultimately successful technology start-ups from those who do not succeed is a healthy intellectual property position. Venture capital fund managers prefer funding opportunities with start-up technology companies that have significant intellectual property assets, generally characterized by strong patent portfolios.

The smart grid relies on the two-way flow both of energy and of information. The information part of that necessarily involves communications and, thus, the smart grid relies heavily on *information and communications technology*, and that technology depends on software. Of the thousands of smart grid granted patents and patent applications, most involve a combination of hardware and software.

Patent Eligibility

The US patent statutes describe an invention that is patentable as "any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof." That's pretty straightforward when it comes to machines, even computers. But what about software? Is software a process? Is software a method? Is software an object?

A business method is certainly a "process," but software claims in patents can be drafted as a process, machine, or manufacture. Software patents are frequently confused with business method patents, but they are different. Sometimes it may be difficult to separate them because businesses today depend on software to such a great extent. It is generally understood that a software patent claim can be drafted as a process. Typically, software claims are written as "method" claims, resulting in their confusion with "business method" claims. However, a business method need not utilize software. Software claims may also be drafted as a machine or manufacture. In fact, it is typical for such patent application claims to describe computers plus signal bearing media that store the software.

Re: Bilski v. Kappos

As technology advanced, opinions on patent eligibility have varied widely over the years and the United States Patent and Trademark Office (USPTO) pendulum has swung back and forth. It's currently stuck on the question of whether or not a 'business method' can be patented.

Last June, in their final session before this year's summer recess, the Supreme Court handed down a narrow ruling on "business method" patents, denying an appeal in Bilski v. Kappos, a ruling that had widespread implications for those who wish to obtain patent protection for inventions in technologies for the smart grid.

Here is a little background leading up to that ruling. Years ago, Bernard Bilski and Rand Warsaw filed a patent application for an invention that explains how commodities buyers and sellers in the energy market can hedge against the risk of price changes. The key claims at issue were as follows:

Protecting Intellectual Property Rights for Smart Grid Innovations

By Dick Lord, CEO, The Steadfast Group

Claim 1 describes a series of steps instructing how to hedge risk, namely:

(a) initiating a series of transactions between said commodity provider and consumers of said commodity...
(b) identifying market participants for said commodity having a counter-risk position to said consumers...
(c) initiating a series of transactions between said commodity provider and said market participants...

Claim 4 formulates Claim 1 into a mathematical formula

The rest of the claims describe how claims 1 and 4 can be applied to allow energy suppliers and consumers to minimize the risks resulting from fluctuations in market demand.

The USPTO has held that utility patents are examined and approved or rejected based on what is referred to as the "machine or transformation test," which states that "a patent must be associated with a machine that can carry out the particular process, or that the patent be involved in the transformation of one thing to another." Acting on the Bilski application, and operating under those patent eligibility guidelines, the Patent Examiner rejected the application on the grounds that the invention was not implemented on a machine or an apparatus and was thus just a method for solving a mathematical formula.

Mr. Bilski appealed repeatedly. The Board of Patent Appeals and Interferences agreed with the examiner, as did the Federal Circuit Court. The US Court of Appeals concluded that the "machine-or-transformation test" was the sole test for determining whether a process was patent-eligible. Applying this 'sole' test, the court determined that the Bilski patent application did not satisfy this test and was therefore not patent-eligible. Mr. Bilski appealed again and the case ultimately landed in the Supreme Court.

Smart grid vendors and others who choose to protect their intellectual property with patents and who depend on software for usefulness and novelty in their products had followed the Bilski case with intense interest, hopeful that the high court would rule definitively that novel and useful inventions relying on software were legally patentable. But that was not to be.

On June 28, 2010, the Supreme Court ruled narrowly, rejecting the Bilski patent application appeal because it failed a USPTO prerequisite condition: "...that laws of nature, physical phenomena, mathematics, mathematical formulas (by themselves), algorithms (by themselves), and abstract ideas are not eligible for patent protection."

In writing the majority opinion for the court, Justice Anthony Kennedy stated, "The Court of Appeals incorrectly concluded that this Court has endorsed the machine-or-transformation test as the exclusive test. It is true that Cochrane v. Deener, 94 U.S. 780, 788 (1877), explained that a 'process' is 'an act, or a series of acts, performed upon the subject-matter to be transformed and reduced to a different state or thing.' More recent cases, however, have rejected the broad implications of this dictum; and, in all events, later authority shows that it was not intended to be an exhaustive or exclusive test."

Justice Kennedy added "But times change. Technology and other innovations progress in unexpected ways. For example, it was once forcefully argued that until recent times, 'well-established principles of patent law probably would have prevented the issuance of a valid patent on almost any conceivable computer program.' ... But this fact does not mean that unforeseen innovations such as computer programs are always unpatentable."

Shortly after the Bilski Supreme Court decision, the USPTO issued new guidelines to Patent Examiners entitled "Interim Guidance for Determining Subject Matter Eligibility for Process Claims in View of Bilski v. Kappos."

The Interim Guidance document still emphasizes the machine-or-transformation test but offers that the Supreme Court ruled that the machine-or-transformation test is not the sole test for establishing patent eligibility and that "Bilski held open the possibility that some claims that do not meet the machine-or-transformation test might nevertheless be patent-eligible." The guidelines go on to state, "to date, no court presented with a subject matter eligibility issue, has ever ruled that a method claim that lacked a machine or a transformation was patent-eligible."

As far as smart grid vendors are concerned, the most important part of the decision is the conclusion that the machine-or-transformation test is not absolute in determining the patentability of an invention. So, the door for software patents has been left open a crack.

Pendency

The second part of the patent process that is likely to stymie smart grid entrepreneurs is what the USPTO refers to as *pendency*, the time period during which a patent is pending, measured as the length of time between the patent application filing date and the date when that application reaches final disposition (i.e., allowed, denied, or abandoned). Currently, the USPTO's average pendency is 35.4 months – almost three years.

Protecting Intellectual Property Rights for Smart Grid Innovations

By Dick Lord, CEO, The Steadfast Group

That number has been steadily growing for decades. Twenty years ago it was about 18 months. Ten years ago it was around 24 months. But, today, even that 35.4-month pendency is understated by the USPTO because they have traditionally counted a *request for continued examination* as an abandoned application followed by a re-filed one. New metrics being provided by the PTO counting a request for continued examination as part of a single patent application prosecution show a more realistic pendency rate of 42.8 months, a little more than 3 1/2 years.

Even more worrisome for smart grid entrepreneurs, is the length of time between the filing date and the USPTO's First Office Action, currently averaging 26.2 months. That means that, on average, it will take more than two years for patent applicants to receive the first indications from the Patent Examiners that their applications may be eligible for patenting. That's a long time to wait to find out if you have intellectual property that may or may not be of value, especially when you consider the rapid evolution of technology these days. This is certainly bad news for smart grid entrepreneurs and start-up companies who are looking for venture capital funding in the short term.

Rejection

The third area of concern for smart grid entrepreneurs and start-ups is the USPTO's rejection rate for patent applications. The USPTO has put a plan in place to reduce the pendency time from its current level to 20 months by the year 2015, but some such attempts have failed in the past. For example, in 2004 the USPTO changed its policies regarding rejection of certain patent applications. Since 1975, the rejection rate had been consistently around 35%. In 2004 the rejection rate began to skyrocket in an effort to reduce the patent application backlog and, thus the pendency time. In the third quarter of last year, the rejection rate topped 59%. But new leadership at the USPTO is trying to change the course now, stating:

"One key is to expeditiously identify and resolve issues of patentability – that is getting efficiently to the issues that matter to patentability in each case, and working with applicants to find the patentable subject matter and get it clearly expressed in claims that can be allowed. The examiner and the applicant share the responsibility for the success of this process."

"On the subject of quality, there has been speculation in the IP (Intellectual Property) community that examiners are being encouraged to reject applications because a lower allowance rate equals higher quality. Let's be clear: patent quality does not equal rejection. In some cases this requires us to reject all the claims when no patentable subject matter has been presented. It is our duty to be candid with the applicant and protect the interests of the public. In other cases this means granting broad claims when they present allowable subject matter. In all cases it means engaging with the applicant to get to the real issues efficiently – what we all know as compact prosecution."

When a claimed invention meets all patentability requirements, the application should be allowed expeditiously.

Life after Bilski

In view of the Supreme Court's ruling in the Bilski case, the time involved in applying for and being issued a patent – and the still-somewhat-high rejection rate – how will smart grid start-ups and entrepreneurs likely react, and what can they do to increase their chances of being granted a patent?

In drafting patent applications for inventions based on computers in the post-Bilski era, more details concerning the type and function of the computer will likely be provided in technical descriptions and claims. And, I use the term *computer* here in its broadest sense. For example, advanced metering infrastructure components, distribution grid management systems, and wide area situational awareness facilitation equipment may all be characterized as computers just as a cell phone is a computer, a digital camera is a computer, and a digital video recorder is a computer. Data may take on object-like characteristics whose signals may be transformed in one manner or another.

If Bilski is interpreted as applying only to method claims, a temptation will exist to avoid the machine-or-transformation test entirely in drafting patent applications by eliminating method claims in favor of system, product, or apparatus claims. However, this may be a bad idea in terms of potential infringement. On the surface it would appear that an act that infringes a method claim for software would identically infringe a product claim for a computer program. But, damages awarded for patent claim infringement in the case of a computer program product may be based on the program's value whereas infringement damages awarded in the case of a method could be based on the entire resulting process.

Another potential result of Bilski may be to dampen the desire to patent some valuable smart grid intellectual property content because of the hurdles involved. Of course, this is a shortsighted view because the full consequences of the Bilski decision are yet to be seen and, under any circumstances, Bilski certainly will not be the final word on patent eligibility. ■

About the Author

Dick Lord is CEO of The Steadfast Group, a Seattle-based consultancy, and an active inventor in information and communications technologies. He has more than 50 patents pending at the USPTO.

The 2010 Automation/IT Leadership Series

Bob Kirchner
Managing Director
Energy & Cyber Services

Bill Lawrence, PhD
Chief Technology Officer
Energy & Cyber Services

Lockheed Martin Corporation

Lockheed Martin Corporation (LM) sees helping to solve our nation's energy challenges – from efficiency and management, to alternative energies and climate monitoring – as the ultimate systems integration challenge. Bringing to bear decades of relevant experience and more than 136,000 innovating minds, their specific energy focus areas include Smart Grid; cyber-security; energy efficiency, management and storage; next-generation alternative energy generation; climate monitoring and overall sustainability management. In this insightful interview, we peer into one of the most successful and talent-rich global enterprises to learn how they are applying their vast arsenal of technological weaponry to the energy industry. – ***Ed***.

EET&D: Right now, a lot of our readers are probably asking themselves: "Lockheed Martin in the energy industry? They build airplanes, don't they??" It's a legitimate question, so we should probably start with a little background on the company itself. Then we can move on to the specifics of why you're in the energy industry and what you bring to the party. I think a lot of them will be more than a little surprised at how much you've already done in this field and where LM is headed as we go forward.

Kirchner: Yes, we get that a lot, Mike. Most people quickly recognize our name, but there are still many – perhaps most in the energy industry – that don't get the complete picture of who and what we're really all about. Headquartered in Bethesda, Md., Lockheed Martin is a global security company that employs about 133,000 people worldwide and is principally engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services. The Corporation's 2009 sales from continuing operations were $44 billion, including broad scale support to DOE and other federal agencies. As new technologies such as distribution automation, renewable energy and AMI have emerged, we see an opportunity to help realize the benefits of those technologies in ways that are both cost effective and secure.

EET&D: How and where do you see the bridge between your government business and your commercial business flowing?

Kirchner: Drawing upon a full range of energy solutions provided to the government and industry – including the Department of Energy, Environmental Protection Agency, state and regional energy organizations, utilities and businesses – we believe that the technical expertise, operational insights and systems integration experience gained by designing and fielding complex systems for the national defense community can provide tremendous value in helping the energy industry implement secure scalable solutions, optimize critical resources, and manage risk.

EET&D: What do you see as some of the major energy industry trends?

Kirchner: Our nation faces unprecedented challenges to its electric grid as growing demand for electricity puts ever-increasing stress on an aging grid infrastructure. Much of the electric grid, built more than 50 years ago, has not benefited from the innovations that have revolutionized other American industries. Unless we address these challenges soon, consumers and industries will be seriously impacted by unreliable (or unavailable) power, resulting in risk to our quality of life, economy and national security.

EET&D: What about energy policy? Do you feel that we're headed in the right – or at least a pragmatic and workable – direction in that regard?

Kirchner: Aggressive federal and state policies and energy initiatives, Renewable Portfolio Standards (RPS), and federal cyber security initiatives constitute some of the key drivers in the energy industry today. Approved in 2007, the Energy Independence and Security Act (EISA) laid the foundation for characterization and implementation of the Smart Grid, but at the end of the day, the energy industry itself must determine the best course of action and articulate that vision to the policymakers at the federal, state and local level, and we'd like to help. This is not a new dialog by any means, but it is one that needs strengthening, and I personally believe that we're making excellent progress on that front. One of the best examples is the collaborative role that NIST (National Institute of Standards & Technology) has taken on recently in standardization and interoperability.

EET&D: What are some of the specific areas Lockheed Martin is working in the energy sector?

Kirchner: Well, we could probably fill the rest of this article with the full list of projects we have planned or already under way, but partnering with a broad range of industry-leading utility companies to create long-lasting, high-value smart grid services that are standards compliant, efficient, scalable and secure is certainly a priority for us. As you know, we're providing a diverse set of energy solutions to both the government and industry. Our customers include DOE, the Environmental Protection Agency, as well as several state and regional energy organizations, and of course, utilities and related businesses. I'll let Bill elaborate on a few of the specifics...

Lawrence: We're very proud of the work we have under way with various customers to address the nation's challenges in the energy field. These include major markets such as Energy Efficiency and Energy Management & Storage as well as some very broad areas like Alternative Energy Generation, Climate Change, Advanced Metering Infrastructure (AMI), and of course, Security – both physical and cyber.

EET&D: We can't possibly cover all of those things – as Bob correctly pointed out – but let's go a little bit deeper on a couple of the more high-profile topics that everyone wants to hear about. Let's start with Energy Efficiency; what is your role or direction there?

Lawrence: To support our nation's energy goals, our vision starts with energy efficiency – the cleanest, cheapest, and most readily available energy source. Lockheed Martin is one of the nation's largest implementers of utility energy efficiency programs. In fact, we run seven projects named by the American Council for an Energy-Efficient Economy as outstanding programs to help commercial, industrial and residential customers reduce energy use.

EET&D: What about Alternative Energy Generation; what's going on in that field? It seems like that could be an area where some of your "rocket science" might actually be applicable. Is that a fair assumption?

Lawrence: Yes, it really is a valid assessment of how a company like Lockheed Martin – which I think you can safely say really is a "rocket science" company – can bring resources and people together in ways that are difficult to do on a smaller scale. That vision continues with leveraging our innovations and manufacturing capabilities to research, design and produce the next-generation of alternative energy solutions. For example, applying missile defense radar tracking software to concentrated solar energy collection systems to follow and capture more energy from the sun. As we said, some of this really is rocket science.

Kirchner: Other examples include applying composite manufacturing processes from space programs to capture energy from the depths of the ocean using Ocean Thermal Energy Conversion (OTEC). And we're using advanced LIDAR technology to develop high fidelity wind tracking and forecasting for wind generators.

EET&D: Many people have said that renewables like wind and solar will never be able to achieve their full potential without some type of grid storage capability. What are you doing in that arena?

Lawrence: That's absolutely right. In the near future, this new mix of traditional and alternative energies will need to be smartly and securely stored, managed and distributed to consumers. Lockheed Martin teams are leveraging command-and-control, systems integration, and cyber security expertise to make that vision a reality. Also, space-based climate monitoring – an area that Lockheed Martin has been supporting for 50 years – will ensure that our nation and the world are making positive progress. We have already designed and built numerous environmental monitoring spacecraft. Moreover, our data systems expertise can help manage, store and analyze environmental information quickly, efficiently and reliably.

EET&D: Smart Grid solutions rely on tightly integrated technologies to enhance critical operations like demand response and outage management, while delivering energy efficiency and reliability. Can you offer a few examples of the Smart Grid technology areas that Lockheed Martin has been directly helping electric utilities to address?

Lawrence: Sure. Those areas include Advanced Metering Infrastructure, Distribution Automation, Micro-grids and Cyber Security, just to name a few of the most prevalent markets and applications where we play an active role directly with utilities. I might also point out that cyber security is more than a core competency for us – it's a way of life.

EET&D: Maybe it's obvious to some, but I think there are a lot of readers that would ask why cyber security so important at your company?

Kirchner: I guess the over-arching reason is that we see cyber security as a critical crosscutting enabler for all Smart Grid technology. It provides the secure controls necessary to realize the benefits of Smart Grid technologies while maintaining a strong security posture. The electric grid, once a collection of isolated manual devices, is becoming an even more highly connected network with millions of access points and ever-increasing vulnerabilities. Cyber security provides a series of defense mechanisms at the device and network levels to mitigate those vulnerabilities, securing the Smart Grid against a wide and variable range of threats.

EET&D: The Department of Energy (DOE), the Federal Energy Regulatory Commission (FERC), the North American Electric Reliability Company (NERC), and public utility commissions and public service commissions all across the country have made cyber security a top priority for Smart Grid deployments. And NIST has been tasked with identifying and evaluating not only existing standards, measurement methods, and technologies but, more importantly, identifying the potential gaps where new standards, methods, and technologies will be needed to facilitate Smart Grid adoption. Where do you see yourselves fitting into that myriad set of challenges and opportunities?

Kirchner: Lockheed Martin has been a leading security company for decades – for both IT and for control systems. We consider the safety, security and reliable provision of clean and abundant energy to be one of the highest priorities of our country and our world. As such, we have redesigned and tailored our security and cyber solutions to fit the energy industry, and we are currently working on security and cyber programs with a host of energy companies at various points all across the grid.

EET&D: What are some of the major cyber security challenges and trends you see in the electric utility industry?

Kirchner: For starters, there will be far more interconnections between previously separated utility systems and with other entities as we go forward; that much is inevitable. And by doing so, Smart Grid deployments bring millions of new "hackable" points online, creating a much increased possibility for an adversary to do harm from a distance.

Lawrence: Not only that, but there are also a lot of pitfalls that we have to become more aware of and work harder to mitigate. For one thing, those looking to do harm to our critical infrastructure can be persistent – these aren't just a few isolated cases. Most utility security leads will tell you that attacks are persistent and take place around the clock, 24/7/365. But there are also inherent threats that while not necessarily malicious themselves, can greatly increase vulnerabilities.

EET&D: What do you mean by "not necessarily malicious themselves" in this context?

Lawrence: Under normal circumstances, a lack of spares for key system components; the absence of rapid and accurate threat data; lax password management; and compliance uncertainties will not necessarily cripple or bring a system down, but in today's widely exposed operating environments, these are all potential threat accelerators.

EET&D: How do you see these challenges translating into present industry trends, and what are the resulting implications?

Kirchner: Well, let's see; there is quite a lot going on, but I'll try to hit on the most important ones – but in no particular order… We see increasing regulation of the cyber aspects of digital assets and also a ramp up in the use of networked digital equipment. Standardization is another key trend that is likely to continue. NIST has made substantial progress, but we still have multiple standards authorities, and in some cases, multiple standards that apply in a given scenario. This is causing some conflicts and confusion as the guidance continues to evolve. We are confident, however, that this can be worked out over time. Bill, go ahead and jump in on this…

Lawrence: We also see increased reliance on suppliers to provide secure hardware, software, and control system components – and the integration thereof – to users in a more complete and seamless fashion. Until now, we've seen quite a lot of piecemeal solutions, but the trend is definitely toward a more holistic approach. This is sometimes hindered by the involvement of multiple, incongruous contractors, but we think that will change too. Taking a stove-piped approach to security by not testing the entire system environment will simply not get the job done in the complex systems environment we have today.

EET&D: Okay, so then, what are the likely implications or outcomes of these trends?

Kirchner: Maybe the issues really aren't so much about implications as things that need to change. Today, for example, end-to-end security may not be considered – that's a major shortcoming that won't go away – it will only become more of an issue if something isn't done to mitigate potential vulnerabilities. It's really one of those "weakest link in the chain" problems.

Lawrence: Yes, and right along that same line of thought we also see inconsistent threat scenarios within an organization; inconsistent and localized interpretations of IT, non-IT, and control/safety/system risks; siloed approaches leading to redundant compliance and reporting initiatives; error-prone manual tracking of vulnerability analyses; and lack of effective security metrics and performance measurement techniques.

EET&D: It's clear that you have put a lot of thought into the multi-faceted problems of this highly complex area, so what's so different about Lockheed Martin's approach to cyber security for the energy industry?

Kirchner: First and foremost, we integrate security into everything we do. We actively draw on the experience, tools and approaches we've developed to defend some of our nation's most secure systems, including our own Security Intelligence Center, to tailor advanced operational situational awareness and cyber security capabilities in a joint project with AEP in Columbus, Ohio. We're also collaborating with DOE and a broad group of utilities and other industry stakeholders to identify the technologies, practices and policies that best enable threat and information sharing, a critical component of the overall cyber security approach. Finally, as electric utilities address the challenges of transforming legacy operations into highly automated, information-rich systems that enable the Smart Grid and all of its benefits, we are helping utilities meet those objectives with a full suite of cyber security services.

EET&D: How would you summarize the cyber security capabilities and approaches that Lockheed Martin brings to the energy industry?

Kirchner: Among other capabilities, our smart grid cyber security experience and capabilities include proven expertise in distribution automation, alternative energy, power and control systems, and data integration and analysis. We bring powerful tools for modeling, analysis and situational awareness, which are already providing value-added results today. We also offer unparalleled cyber security/ information assurance resources including our NexGen Cyber Innovation and Technology (NCITe) Center, a world-class Security Intelligence Center for network defense, and a large staff of highly experienced, trained, and certified information assurance professionals.

Lawrence: I'd also like to add that while we often focus on the delivery of critical solutions and technical services, our approach to cyber security is grounded in policy, architecture development, and secure, assured development practices. From this diverse orientation, we successfully help our customers manage risk and make optimal decisions for practical application of resources. Our processes cover end-to-end, full life-cycle cyber security, including real-time cyber operations. Rock-solid systems engineering and guaranteed interoperability based on decades of experience with complex multivendor projects are also some strengths we bring that are not easily reproduced.

EET&D: Can you offer some specifics of how these underlying strengths translate into sustainable advantages?

Kirchner: We focus on the big picture by effectively blending technology, processes, systems and industry teams, to create original solutions to mitigate or manage risk. By leveraging our exemplary system engineering and software development practices, methodologies, and processes, we are able to deliver solutions that are "secure by design." Development, testing, and quality management assure customers that their applications and systems will perform as desired. This is attributable to our rigorous independent validation and verification services.

EET&D: What about deployment? Is any of this capability available today?

Lawrence: Lockheed Martin has a proven track record of deploying large, complex solutions across geographically dispersed organizations. We match deployment methodologies and processes appropriately with each unique enterprise's mission requirements. We already manage major security and network operations centers nationwide. Our experience in government service delivery has helped us partner effectively to bring significant economies of scale and enhanced, assured operations, to many diverse customers. We also staff and operate Computer Emergency Response Teams (CERT) for many of our mission critical customers and have successfully applied these lessons to dozens of utilities and equipment manufacturers.

EET&D: Bob, I'll let you have the last word on this. How would you sum up the massage you'd like to get across to our readers regarding the expectations they should have about Lockheed Martin's role in Smart Grid and Grid Transformation initiatives?

Kirchner: A resilient, scalable and secure grid is essential to giving our world abundant, clean and affordable energy. We're committed to helping the industry achieve this important mission. ■

APS Takes Design Efficiencies to New Heights

By Brett Hauf, Information Systems Manager for GIS Services
Arizona Public Service

Just a few years ago, many utilities faced overwhelming growth pressures. Construction crews couldn't hook up new customers fast enough. Engineering drafters had trouble keeping up with demands for designs to support network expansions. And geographic information systems (GIS) analysts had huge backlogs of as-built information. Utilities like Arizona Public Service (APS), looked for ways to accomplish more with limited resources. Technology helped by allowing utilities to move away from paper to drive processes and communication improvements.

As the economy sputtered, growth slowed. But as the old saying goes, the more things change, the more they stay the same. Utilities still need to do more with fewer resources – and here again, technology plays a key role. To succeed, the computer-based processes utilities need to accomplish their work quickly and cost-effectively must be made more efficient, automated, and connected.

Focusing on the way it designs its underground distribution network, APS embraced new model-based design technology to accelerate the process. Virtually every task in the design workflow is now faster and more accurate. In fact, in the early stages of using this technology, the small group of designers who use it are able to complete many jobs more than 50 percent faster. The technology couldn't have come at a better time: as APS rolls it out to their designers, they are getting ready to support a return to growth—and help enable innovative design approaches as customers look to use more sustainable generation sources.

Overwhelming Growth

Originally incorporated in 1886, APS is now the largest subsidiary of the Pinnacle West Capital Corporation, and it delivers electricity to 1.2 million customers over a 35,000-square-mile service area. The company experienced significant growth in the 1990s, with annual growth rates as high as 8 percent. Attracted by Arizona's sunny climate and booming economy, people streamed into APS's service area. Real estate developers were constructing new subdivisions at a breakneck pace, and each subdivision needed to be served by new underground distribution systems.

The APS Energy Delivery Business Unit was overwhelmed with underground facility design projects. Each project took weeks to complete because at every stage in the design, APS drafters were slowed by manual processes. Take the preliminary design stage: Drafters produced a design for the developer that included information for permitting and trenching for electrical conduits. (The developers, and not APS, dug the conduit trenches.) The preliminary designs were relatively similar to each other, but drafters had to draw each element into its appropriate place in their CAD software. The entire process took about two weeks – and as much as four weeks or longer for large subdivisions.

After approval, drafters completed the final designs and produced construction documentation, including the bills of materials (BOM). Although the preliminary design provided some information to help with the final, many aspects were redrawn. This 'rework' slowed this stage in the process as well, but having to complete engineering calculations in a separate application took an even larger toll. Not only time-consuming, the disconnected calculation process introduced the potential for inconsistencies into the workflow. To save time, drafters often slightly over-engineered designs and over-ordered materials, such as wires and pipes. Under-provisioning can lead to extremely costly delays in the field, but over-specifying can be costly too, especially when it is a practice commonly exercised.

After construction, GIS specialists entered the new network information into the GIS, which is the source of spatial network data for the outage management system. Unfortunately, this process required that the specialist redraft the as-built designs into the GIS, and as-built backlogs of several months were common.

Although customer service agents were able to provide accurate information to affected customers, due to wall maps, and older outage prediction technology, this lag time sometimes made it difficult for field crews to locate the specific device(s) affected.

Connecting and Automating

Business leaders at APS decided to tackle inefficiencies in the underground facility design process by implementing a new design solution. APS identified five must-have requirements for the solution:

- Increase efficiency and productivity across the design team
- Capture and transfer institutional knowledge to offset the impact of impending retirements
- Reduce design cycle times dramatically
- Automate and standardize business processes, including pricing models, engineering calculations, and design techniques
- Improve data integrity

Through the years, frustration with slow design cycles inspired similar decisions – as well as efforts to find the right technology to accelerate the process. APS evaluated several technologies and found each had too many drawbacks. Some network design solutions executed designs and calculations too slowly, and APS did not see any advantage in shifting from manual processes to automated processes that were not much faster. Other solutions APS explored required too much setup and configuration on the front end, or too much retraining for APS's 400 CAD users.

Automation Saves Time

APS opted to implement the new utility design solution by targeting incremental phases to minimize risk and hoped to demonstrate early success. The first phase focused on configuring the solution to automate repetitive tasks and establish business rules. APS began by selecting a new subdivision slated to receive single-phase power as a pilot project. The team automated compatible unit and material specifications, such as those for transformers, streetlights, and junction boxes. At the same time, they automated repetitive tasks, including replacing streetlight blocks, dimensioning, and service arrow placement. They also configured the solution to generate wire and streetlight summaries that conformed to APS standards.

To ensure quality, APS validated and fine-tuned many of the solution's preconfigured aspects. For instance, the team ran engineering calculations for cable pulls, transformer sizing, and voltage verification within the solution. They then recalculated each one manually and found the calculations were accurate and in line with APS standards.

Throughout the phase one implementation, APS rigorously tracked time savings enabled by the new solution. The results were impressive, especially for repetitive tasks. The table below summarizes a few of the more notable time savings per task in minutes and seconds:

Procedure	Before	After	Time Saved
Cable pull program	1:50	0:07	1:43
Service arrows	6:54	0:57	5:57
Dimensioning	2:38	0:11	2:27
Streetlight blocks	1:40	0:22	1:18

Overall, APS determined that drafters were able to execute automated tasks up to five times faster, allowing them to complete designs in less time. Just as important, automation freed them to devote more of their time and expertise to enhancing design quality.

Moving to Phase Two

After completing phase one, the implementation team shared the results of the project more widely throughout the Energy Delivery Business Unit. The recorded time savings helped generate enthusiasm for moving the full underground distribution design process to the solution. More ambitious, the second phase of the project encompassed the end-to-end process for designing underground distribution for a three-phase feeder, commercial development, and subdivision.

Gila Bend Solar Plant

The team began by importing the vicinity map for the projects from the GIS. After validating the accuracy of the imported data, they began the preliminary designs for delivery to the developers. To drive time savings in this stage, the team automated trench detail labels and configured the solution to support the full range of engineering calculations required for underground three-phase power distribution. Still tracking time savings, the team was able to cut completion time for the preliminary designs by about a third.

Full integration of the solution with the IBM Maximo Asset Management system is a key future goal. APS wants the systems to work together to seamlessly generate work order package forms that included everything from the circuit diagrams and cable tag list to the pole installation report and the equipment details. The team is confident that the standardization enforced by the new system will help streamline the integration and support more accurate BOMs. More significantly, from a cost perspective, the automated engineering calculations will help prevent over-ordering of materials.

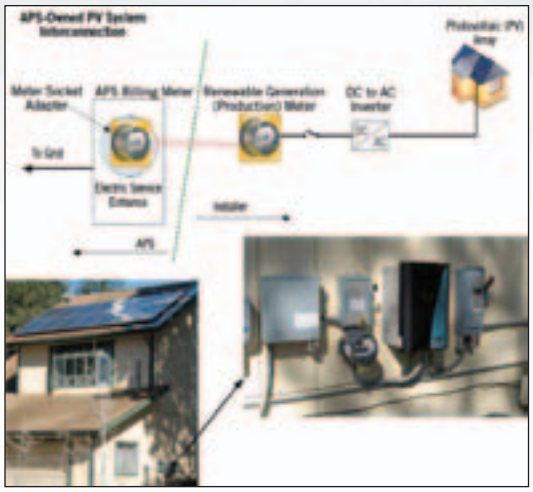
Upon completion of the three projects, the APS team assessed the effort's success. The team was able to complete the commercial project 47 percent faster and the subdivision project 48 percent faster. The time savings were even more impressive on the feeder design, with APS completing that project in 64 percent less time.

The Rooftop Revolution

While saving time on routine designs is a compelling benefit, moving the overhead design process to the new solution could help support an even more exciting – and revolutionary – program. APS recently undertook one of the most innovative alternative energy pilot projects in the United States.

The idea could turn entire neighborhoods into clean energy power producers. The program works like this: Homeowners allow APS to put solar panels on their rooftops. APS buys, owns, and maintains the panels. The power goes into the system, and APS sells power to the homeowner at a reduced rate. The project is being piloted with a small group of homeowners in Flagstaff, Arizona.

The program could help transform the way renewable power is generated and sold in Arizona. Once the design project moves to overhead, APS will be able to help deliver relevant designs with appropriate compatible units and modified engineering calculations based on solar technology quickly and efficiently. So, in a sense, APS's improved design process will extend from underground – to the sun.



APS-Owned PV System Interconnection

Looking Ahead to Overhead

APS finished phase two in October 2009, and rolled out the new solution to support underground distribution projects. The APS design team was now primed and ready to complete more designs faster than ever before. But growth had ground to a near halt. Developers were simply not breaking ground on new subdivisions that demanded underground distribution networks.

Of course, APS is a large utility, so there is always a demand for design work. As backlogs disappeared, maintenance projects pushed to the backburner during Arizona's recent growth boom took on new urgency. The underground design team turned their attention to projects affecting the existing distribution system and was able to execute them more quickly. And as they reviewed the old distribution designs, they noted significant inconsistencies and deviations from some current APS standards. The new solution made it easy to clean up old designs, increasing the accuracy of the information used to drive projects and manage the distribution system.

Since APS has experienced staff cuts and limited capital funding, the new underground Autodesk Utility Design solution has not been rolled out as quickly or to as wide an audience as originally envisioned. Consequently there is still a significant amount of 'anchoring' to be done. However, the team is still planning to develop the overhead design processes within the solution.

By driving distribution design tasks with a single solution, APS will be able to extend the time savings of process automation to all design tasks. It also will embed a fuller range of institutional insights, and corporate 'tribal knowledge' into the solution – an important benefit with many of APS' experienced designers nearing retirement age. But most important, it will ready APS for the return to the consistent growth that has long been the norm for Arizona. ■

About the Author

Brett Hauf is an Information Systems Manager at Arizona Public Service, a Pinnacle West company. Prior to APS, Brett worked for other utilities in the area. He has 28 years experience in Cartography/Mapping, CAD and GIS, including 23 years in the electric transmission and distribution business. In his present role at APS, he partners with Business Line Managers to ensure alignment between information systems and the technology needs of key APS initiatives.


Mark Hungate


Mitch McLeod

Evolutionizing the Smart Grid

By Mark Hungate, Field Maintenance Manager
Salt River Project
With Mitch McLeod, President & CEO
ARCOS, Inc.

According to the Department of Energy, today's electricity system is 99.97 percent reliable. But when the flow of electricity to customers is cut off, the Department of Energy says this loss of power costs Americans at least $150 billion each year. Sometimes the sheer size of the grid can blind us to the fact that behind all the technology are utility professionals. These engineers, line personnel and many others keep the grid and its 300,000 miles of transmission lines operating. In the end, the Smart Grid will be far brighter if we have more visibility into the work of the people running and repairing the grid.

By now most all of us have seen the GEICO caveman commercials. The premise is that cavemen live among us today, and they are anything but the Neanderthals that we commonly associate with that term. Rather, they are urbane and highly intelligent. It's funny stuff and gets GEICO's message across, albeit in a lighthearted manner.

It may come as a surprise then to learn that many distribution and emergency operations managers see 'cavemen' working alongside them every day all across the utility industry. Like their TV counterparts, these utility cavemen are very smart and quite capable. Yet the way they're being asked to go about carrying out some very important tasks is anything but intelligent – and their plight certainly isn't funny.

Let's say a pole goes down after normal business hours in our territory. We call a supervisor who has to search through a paper list and start dialing available crewmembers from his kitchen table in the middle of the night. We jokingly refer to that process as 'caveman callout' because smart people are being forced to use outdated methods to get the job done.

Today, the utility industry can't always easily and precisely identify problems with the grid. Indeed, in many cases, outage notification is still largely a manual process. That is, they rely on customers to "call in" the outage and roll trucks to the affected area(s) to track down the root cause and any ancillary problems – often a slow and painstaking process. In the end, these antiquated processes affect the grid's IQ and hence, its ability to respond intelligently.

For example, intelligent utility professionals with a long list of action items that they should be addressing during an outage are, instead, forced to hunt for available crew members like cavemen foraging for food. This one-at-a-time search for members of a repair crew unnecessarily lengthens the time of any outage. The process also delays restoration work, which frustrates customers, and costs a lot of money for utilities. More on that last point in a moment...

Manual callout is a process that's buried and in many ways under the surface of evolving Smart Grid technologies. In some instances, utility executives have even come to accept that manual callout and resource management is just the price of doing business – but it's not. The growing complexity of the Smart Grid includes things like optical current sensors that can tell utilities instantly that a fault has occurred as well as where it is located. Other smart technologies can even help us fix some distribution problems, for example, by remotely flipping substation switches.

Also on the horizon is the development of advance visualization technology for the grid. These tools, it is hoped, will be able to report the grid's condition to utilities on both a national and street level. And someday, information about blackouts and the quality of the power being generated will all be at a utility company's fingertips as well – some truly amazing stuff. As an industry we're clearly heading in the right direction, but identifying a problem with the grid is not the same as fixing it.

The Importance of Restoration

Customers are less tolerant of power outages than ever before. So, for our industry, restoration time has become increasingly important. Actually implementing innovative technologies across the utility industry has not been high on many companies' to-do lists. The utility industry is usually very conservative; however, we need to spend money on not only developing new technologies, but also implementing them to address our top concerns: Reliability and Restoration Time. Yet some operation centers still rely on paper-based wall maps and have just begun using computer programs for opening and closing circuits remotely.

Because of all the regulations and scrutiny, many utility companies are reluctant to spend the money on technology – even technology we really need – because of how much work it is politically to get systems approved. Automating callout needs to be on everyone's list of priorities.

If the Smart Grid is to help customers open a window into what's causing an outage and how long it will take to resolve, then utilities should focus on compressing restoration time like never before. Some utilities are taking bold steps in that direction. Xcel Energy's SmartGridCity project – a real-world lab where the utility explores an array of smart-grid tools in Boulder, Colorado – helps Xcel decide how to bring field-tested smart-grid technology into its business operations to net more efficiency. Customers, armed with new insight, will demand it.

> "Customers are less tolerant of power outages than ever before. So, for our industry, restoration time has become increasingly important.."
> – **Mark Hungate (SRP)**

Restoration time, especially after normal business hours, often hinges on how quickly a company can contact its available line personnel, assemble a crew and bring the team to the scene of an outage. For many utility companies across the United States, that process is still a manual one. One utility company in the Northeast, which for many years relied on an outmoded crew callout process for after-hours emergencies, states that its manual process took, on average, almost 80 minutes to assemble and dispatch a crew.

A Cascade of Challenges

The grid may be getting smarter, but when a storm knocks a power line down causing an outage, it is up to line personnel to put things back together. Even one incident like this creates a cascade of challenges for the utility personnel who manage emergencies, let alone a large storm causing lots of outages. Prolonged outages are also a financial drain for utility companies, investors and the consumers of electricity. Here's why...

Without a smart system for managing resources and crew callout, a utility facing an after-hours outage must call a supervisor at home, sometimes in the middle of the night. The supervisor grabs a cell phone and a thumb-worn file of available line personnel. He or she begins calling each name to try and get a crew assembled. When you are relying on a cell phone and a pad of paper to put together a crew late at night, it can often take one or two hours to reach available workers who are willing and able to accept the assignment. Often, compounding the callout process is a complex set of union rules that dictate which linemen can be called and in what order. If a sleep-deprived supervisor happens to run afoul of those rules, the union can file a grievance.

For a utility relying on a manual callout and resource management process, grievances like these can tally well over $100,000 per year. Even when the process runs smoothly, a utility still has to pay wait time (i.e., overtime) for each member of the crew who has accepted a callout, until the final member of a four-person crew agrees to work the situation.

In fact, the average utility company spends nearly $500,000 annually in what is commonly called 'paid wait' time.

Along with grievances and paid wait time comes lost meter revenue. The Smart Grid's growing list of technologies, such as electronic actuation of switches, is wonderful. But when systems fail and a call for help goes out, the time lost between the alert and the repair spells lost revenue.

To show the cumulative effect of antiquated callout, consider the following real-life example from a utility with 1,904,531 customers. While still relying on "caveman callout," this utility's SAIFI number and CAIDI minutes were pegged at 0.74 and 185, respectively. SAIDI minutes for the utility were 137, which converted to SAIDI hours of 2.28, slightly higher than the median value of 1.5 SAIDI hours for North American utilities, as measured by the Institute of Electrical and Electronics Engineers (IEEE). Customer meter revenue per hour stood at $0.12.

After crunching the numbers (i.e., Customers x SAIDI Hours x Meter Revenue per Hour), the utility learned that lost meter revenue across all their customers due to slow callout totaled $521,411 for the year. But after automating its callout and resource management processes, the utility saw a 20 percent improvement in restoration time and $104,282 in annual recovered meter revenue.

In the case of grievances, these are dollars that utility executives can avoid completely if they choose to make callouts smarter. Managers could also drastically cut paid wait time and shave time off lost meter revenue by managing their human resources with technology. Moving from a manual process to an automated one takes an investment to be sure. But implementing callout technologies delivers reporting tools to managers who can use this information to validate crew availability. These automated tools call hundreds or thousands of line personnel in a few seconds, while factoring into each call the complex union rules and labor agreements for overtime and rest.

Automated Callout: Pinpointing an Overlooked Area for Innovation

The utility industry is investing in technologies to give managers visibility into the grid and data on grid performance. As part of this innovation, utilities of all sizes are at least hearing about – if not implementing – projects for improving hardware, software and work methods. Utilities such as Kansas City Power & Light, Southern Company and Dominion Virginia Power are among the ones looking at efficiencies to get resources where they are needed, faster.

High-ranking utility executives everywhere can benefit by applying this thinking to their workforces. Utility industry executives often focus on how to make the work happening in the field more efficient. There is a desire to zero in on the line work, but trimming the elapsed time between contacting crews about trouble and getting them into their trucks to make repairs is an area often overlooked.

According to a utility executive from the Northeastern United States: "Automating callout and resource management is an innovative solution to a process that's always going to be needed. To complement the Smart Grid, crew callout and resource management should be underpinned by technology that serves up performance metrics based on bargaining agreements. It should monitor the time it takes to respond to emergency conditions. And it should manage crew rotations and hours worked."

If we could shave even ten percent off restoration time with better callout and resource management technology, just think of what it would mean for the bottom line! Sure, it's fun to watch the GEICO cavemen, but nobody really wants to become one when there's serious work to be done. ■

About the Authors

Mark Hungate is Field Maintenance Manager for Salt River Project, America's third-largest public power utility. Mark is responsible for line crew maintenance on SRP's electric system. Mark has nearly three decades of experience in the utility industry since beginning his career as a lineman.

Mitch McLeod is CEO of ARCOS, Inc. Since 1997, Mitch and his team have provided the utility industry with automated crew callout and resource management systems. Mitch is an expert in software development and voice applications. Before founding ARCOS, he worked for the U.S. Department of Defense and AT&T Bell Laboratories. Mitch holds a master's degree in software engineering from Johns Hopkins University.

Smart Security for Smart Grid Programs

By Mark Cioni, Executive Consultant,
Enspiria Solutions, Inc. , A Black & Veatch Company

The strong industry focus on Smart Grid security over the past few years has resulted in a substantial evolution of the standards and guidance from relevant influencers including DOE, NIST and others. In essence, the industry has made very significant progress in the "What" and "Why" aspects of Smart Grid security. And, as most people who have been involved in a Smart Grid project will attest, it's equally important to understand and execute on the "How" aspects of that security guidance. This article, based on a substantial number of AMI and Smart Grid implementations, attempts to focus on several key areas of program execution relative to Smart Grid security from an implementation perspective.

Although seemingly obvious and pragmatic, the areas that follow are too often marginalized to some degree during the Smart Grid program due to many contributing factors. Timing constraints on Smart Grid funding, internal resource constraints and even ignorance have been contributory on past programs along with other factors. Faced with the extremely small probability that any given Smart Grid program will occur under optimal circumstances, it pays to be aware of the following focus areas and to consider how to apply their lessons, regardless of where in the lifecycle a Smart Grid program currently resides.

- Choose More Security Involvement
- Nominate A Security Liaison Role
- Build and Deploy Securely From the Start
- Identify What Needs to Change

Choose More Security Involvement

Engage security resources early and often. Although elegant in its simplicity, too often this practice is not applied and the appropriate security resources are not involved as broadly or often as necessary. Security casts a large footprint on a Smart Grid implementation program, and even though some critical areas are obvious, others may not be as straightforward. Smart Grid implementers don't just need their security resources to review firewall configurations, but rather to take an active role in a broad range of activities. Some of the most important of these are addressed in the following.

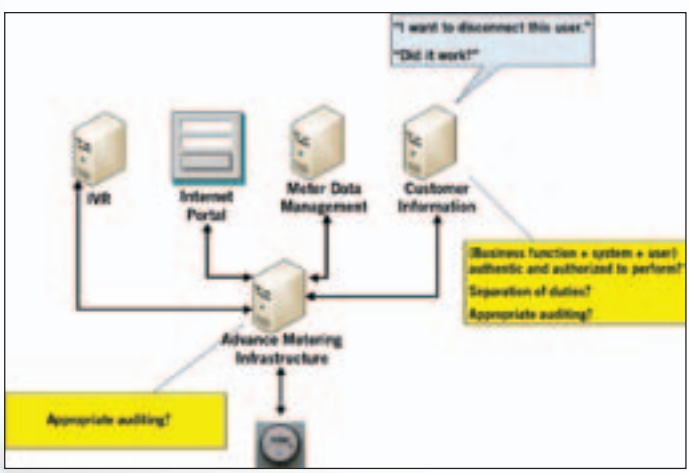
- **Business Case Development** – Security will most likely add a number of costs to the Smart Grid business case, including but not limited to acquisition costs for hardware, software, services and training, as well as ongoing costs associated with these items and others. Additionally, funding restrictions and other potential regulatory constraints mean the business case will likely need input and guidance from security resources relative to procurement and even cost allocation to the program and larger enterprise.

- **Cyber Security Planning** – Smart Grid investment funding is based on a number of core application criteria, the Cyber Security Plan being one of these that must be accepted before such funding is granted. Although fairly straightforward that security resources would be involved in the development of the Cyber Security Plan, the key takeaway is that these same resources would optimally apply that knowledge base to activities such as Conceptual Architecture, Vendor Selection, etc.

- **Solution Architecture** – Even before Vendor Selection, a Smart Grid program would optimally start to develop a solution architecture that presents a series of aspects or views as to how that solution would interact at a logical level, the candidate platforms on which it will be deployed, how integration will occur, candidate Electronic Security Perimeters (ESP) and network enclaves, instrumentation points and management components, and many other architectural facets that must align with and incorporate security controls. The solution architecture will help to frame and codify the organization's vision, as well as to communicate that vision to vendors and partners.

- **Process Refinement** – The instantiation of a Smart Grid solution will likely require the development of new business and operational processes, and refinement of existing processes as well. These processes may have both automated and manual elements that span multiple new systems. Security has an important role to play in these activities. Consider a simple example, yet one that causes worry for nearly every AMI implementer: Remote Disconnects.

  Although the implementer may already have an existing disconnect process, the ability to perform this operation remotely changes the landscape from a security perspective. Given this new capability, security resources should help the organization to evaluate which of their business and operational entities should be able to initiate this process, how to ensure separation of duties so that one entity (person) cannot shed load en masse, and alternatives for ensuring transactional closure (i.e. "We wanted to disconnect these 10 endpoints; how can we be sure that the operation completed correctly in a manner we can audit and prove, or if not what remedial action should we take?"), among others.



- **Vendor Selection** – A key engagement area for security resources, their expertise will help the organization to evaluate the security posture of candidate vendors and their offerings, as well as how well aligned their proposed solution will be with the organization's solution architecture vision. For example, whether candidate vendors follow a formalized Security Development Lifecycle, perform regular third-party testing and certification, and other best practices are important assessment criteria.

- **Program Documentation** – Throughout a Smart Grid program, formal documentation is usually required that reflect the decisions and rationale around security designs, compensating controls, disaster recovery and resiliency mechanisms, security practices and other core solution aspects. Not only does such documentation need to be developed, but this information must also be protected appropriately both internally to the organization as well as relative to outside entities.

Nominate A Security Liaison Role

Since security concerns and activities will likely influence broad areas of a Smart Grid program, ensuring consistent oversight is a key requirement. Very often, the organization's existing security resources cannot devote significant amounts of their time to the program, making consistent oversight challenging at best. The security liaison role doesn't necessarily need to be a full-time activity, however it needs to be engaged consistently throughout the program and fully involved during critical activities. This role should help to facilitate – relative to security – communication and cooperation among vendors, individual project managers, application and business function owners, technical staff and program executives.

Build and Deploy Securely From the Start

Key areas of security concern are too often overlooked or buried in different project plans with little coordination. Although often unwieldy to place every program management activity in a single plan, there needs to be cohesion between individual plans within the Smart Grid program, where the detailed activities and tasks are in one plan and appropriate touch points and milestones are incorporated into other plans. Some of the most important of these areas that usually span multiple project plans include:

- **Develop and Integrate the Security Project Plan** – The security project plan should be the central point for all security related activities – from firewall acquisition and configuration to creating enterprise directories – with logical touch points from and into other project plans within the Smart Grid program. For example, acquiring and configuring additional firewalls should articulate its activities, dependencies, resources and milestones within this plan, and incorporate appropriate influence and interdependent milestones from other project plans in the program. Likewise, those project plans should also reflect relevant milestones and interdependencies from the security plan.

- **Plan Multiple Environments** – Having multiple environments (e.g. Production, Disaster Recovery, Test, Development) for a Smart Grid deployment is nothing new and is a best practice in general. The key takeaway here is to ensure, with respect to pragmatic organizational constraints of budget, resources and others, that these environments can help to facilitate security posture and deployment in the solution. In other words, as much as feasible, make appropriate provisions to have Disaster Recovery, Test and Development environments that can accurately model the same security architecture (albeit perhaps at a reduced capacity in some cases) as Production.

Additionally, provisioning a "Sandbox" environment has become increasingly common as an area for IT resources, including security, to perform certain types and levels of testing and proof of concept.

- **Harden First, Then Relax With Reason** – A fundamental best practice in security is to harden systems, networks and other infrastructure components first, and grant permissions only after that hardening is complete and tested. In many cases, there are several factors that may work against this practice within a Smart Grid program, including everything from vendor hardware and software installation to compressed timeframes. For example, the inability for product vendors to communicate simple requirements such as port numbers, protocols, source and destination systems and other hardening information is still much too common an occurrence.

- **Test Security Controls and Monitoring Early** – The design, deployment and testing of security controls, instrumentation components, and subsequent monitoring and management will be absolutely critical to long term solution viability. Unfortunately, these items are often deferred or reprioritized during project execution when in fact the opposite should happen. Not only do Smart Grid implementers want to have these items in place as early as possible in order to be able to appropriately test them, these items in fact can help facilitate the security development and testing of the rest of the solution.

Identify What Needs to Change

The advent of a comprehensive security posture for a Smart Grid program will very likely give rise to the need to refine or instantiate changes in many areas of the enterprise. Although not a complete list of questions for consideration, some of the most common security changes driven by a Smart Grid program include:

- **Policies** – In many cases, security influences on existing policies drive appropriate refinements. For example, policies for several areas from subcontractor hiring and work to mobile devices to remote access could be affected. The enterprise may also need to enact new policies in some cases.

- **Processes** – Probably the biggest area for potential change due to the influx of new processes and the extension of existing processes over multiple disparate systems. For example, with the potential advent of new field tools and platforms for AMI, does the organization need to refine its Mobile Device Lifecycle process and infrastructure such as mobile device security?

- **Organizational Capabilities** – A common area for change is the organization itself. What new or expanded roles will need to be created, and will those roles need specialized training such as CIP awareness, Linux administration and security, and others? Relative to process changes, what organizational security changes should support potential changes such as separation of duties, field service, key management and others?

- **Partners** – What changes are needed with respect to existing outside partners? For example, will the organization need to restrict permissions and expand auditing in various domains due to integration with new Smart Grid components? What changes, such as new systems and protocols, might be needed with security partners such as logging/scanning services, vulnerability/pen testers and others? Will the organization need to add new partners due to changes in policies, processes and capabilities?

The continuing evolution of standards and guidance relative to Smart Grid security is necessary and contributory to the entire industry. Smart Grid implementers should remember, however, that guidance is only as effective as the execution that accompanies it. ■

About the Author

Mark Cioni is an executive consultant with Enspiria Solutions, a Black & Veatch company. He has over 26 years of experience with particular expertise in Information Security, Enterprise Architecture, and Systems Integration. He is a contributor to NIST's Cyber Security Coordination Task Group, and holds a BS in Electrical Engineering with concentrations in Computer Science, Physics and Economics.

The GrEEEn Issue

NEW FEATURE!

Introducing: The GrEEEn Issue…

Energy, Efficiency & Environment

Electric Energy T&D Magazine is once again raising the bar in the electric utility publishing industry with its groundbreaking GrEEEn Issue, the first of which is appearing as a special supplement to this edition of EET&D. This new feature will focus exclusively on the burgeoning CleanTech/GreenTech marketplace, grounded in these three E's: Energy, Efficiency & Environment.

Starting in 2011 there will be two new GrEEEn Issues, which will be published in April and October, annually. And, besides our regular print circulation, this and future GrEEEn Issues will be electronically broadcast to our entire 50,000+ global eNews circulation, making it a truly global medium!

Come on in… it's GrEEEN inside!

Within this supplement, you will find several articles about how our industry is responding to the rapidly evolving demand for cleaner, greener approaches to solving old problems as well as creative and innovative ways to address the many new challenges our industry is facing today, and especially in the years ahead.

Each issue will also have a special focus area, which for this first one is electric vehicles (EVs). This EV focus presents a variety of perspectives on this burgeoning and rapidly developing part of the Smart Grid and Grid Transformation marketplace. Here's a summary of what you'll find inside:

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GUEST EDITORIAL

Renewable Electricity Without Greenwashing

By Susan Herbert, VP Science Strategy
TerraChoice and TerraVeritas

The U.S. power grid is said to be the largest interconnected machine on Earth and represents an immense opportunity to make an impact on climate change. As worldwide renewable electricity consumption increases by 3 per cent per year – according to the U.S. Energy Information Administration in 2009 – more advanced and interconnected transmission systems will be required to meet this need.

The Rise of "Green Power"

Over the last several years, talk is increasing about the new green transmission superhighway and getting the U.S. transmission system up-to-date to be able to handle all of the new "green" power. As the transition to this new superhighway begins to take shape, transmission and distribution (T&D) companies may be tempted to promote their activities in a way that makes direct linkages with the green power itself.

Hand-in-hand with these green marketing opportunities are the challenges of keeping the message accurate and not open to misinterpretation by consumers. These are challenges faced by companies of all shapes and sizes, which are finding ways to market their environmentally responsible practices, and the energy industry is no different.

For transmitters and distributors, there is a lot of good "green" news to brag about. Smart meters, the smart grid and reducing transmission line losses are but a few examples of the important role that T&D companies are playing in making our entire system greener. These are really good "green" solutions, however, companies must be careful not to exaggerate the facts.

The development of additional transmission systems to meet the growing need for green power, for example, can have its own set of impacts (e.g. the building of these lines in new areas will mean road construction and may have impacts on flora and fauna). Messaging, then, needs to be careful not to overstate the good news (more transmission lines for renewable energy) when there may also be some bad news (impacts from building the transmission lines, high transmission losses, etc.).

What is Greenwashing?

The impulse to overstate "green" claims in marketing is a trend that crosses all products and services and even company practices. In a report on environmental claims in consumer markets released by TerraChoice Environmental Marketing in 2009, *The Seven Sins of Greenwashing*, 98 per cent of the products surveyed were found to be greenwashing (the act of misleading purchasers regarding the environmental benefits of a product or a company's practices).

On the upside, the study indicated that environmental claims are becoming more evidence-based. Legitimate certifications and transparent proof were both found to be on the rise. On the downside, greenwashing was found to be rampant. The problem of misleading consumers regarding the environmental practices of a company or the environmental benefits of a product or service appears not to have slowed since the first study, *The Six Sins of Greenwashing*, released in November 2007.

GUEST EDITORIAL

The Rise of "Green Power"

In an unpublished study on "green" advertisements, TerraChoice found ads promoting environmental marketing claims had increased almost tenfold in the last 20 years and has nearly tripled since 2006. The attempt by manufacturers and marketers to meet consumers increasing demand for greener products could not be clearer.

The reality is that claims of "green" are also being scrutinized today more than ever before, and that includes the environmental marketing claims made by the energy industry. Calling your company "green" in an advertisement can be viewed with scrutiny if not backed up by reliable evidence and competent explanatory information.

Green Guidelines

Adding regulation into this mix, the U.S. Federal Trade Commission (FTC) and the Competition Bureau of Canada have taken strong actions against false or misleading green marketing claims over the past couple of years. While the FTC's Green Guides (environmental marketing guidelines) at the time of writing this editorial have not been updated in more than 14 years, newly revised guidelines are expected to be published imminently, with the possibility that the revisions will include issues specific to the marketing of greener electricity and related products and services.

Under the FTC Act, unfair or deceptive trade practices are prohibited. For product and service marketers, this means they must have a reasonable basis to support their advertising claims. The FTC's Green Guides are meant, at least in part, to help marketers avoid making misleading claims. The dynamic nature of the environmental marketplace means that consumer perceptions of "green" claims will shift as education and advances are made in the science behind the environmental issues. The regulators' desire to protect consumers from deceptive and unfair practices, however, will not.

Similar to the communication challenges surrounding the promotion of renewable energy certificates (RECs) and carbon offsets, the potential benefits of green transmission and distribution practices are hard to quantify. Stakeholders may be wary of these claims, and, with this kind of uncertainty comes the potential for deception.

Transmission and distribution companies looking to communicate with their stakeholders and customers about their greener business practices or elements should be genuine and transparent, and follow three simple steps:

1) Make your message as credible as possible – look for ways to have its key elements independently validated, verified or certified;
2) Clearly communicate specific and, if possible, tangible details in the message – focus on the green "whos", "hows", "whys", "wheres" and "whats"; and,
3) Seek advice on the most accurate, yet meaningful, language possible in order to avoid overstating any environmental benefits and therefore possibly misleading the reader.

Conclusion

Communicating "green" progress should be encouraged, and companies should not be afraid of sharing their advances and improvements. "Green" is a trend that is here to stay and companies will find success in communicating clear and transparent environmental marketing messages about their products, services and company practices. Supporting "green" marketing claims with third-party validation and verification as well as specific, tangible details will ensure a company's reputation and credibility are preserved. ■

About the Author

Susan Herbert is Vice President of Science Strategy at TerraChoice, an environmental marketing and consulting company, and TerraVeritas, a sustainability validation services company, helping genuine environmental leaders build market share and accelerate progress towards sustainability. Find out more at *www.terrachoice.com* and *www.terra-veritas.com*.

ComEd: Helping Chicago Businesses Turn Green

By Kevin Bricknell, Program Manager
Marketing & Environmental Programs
Commonwealth Edison (ComEd)

In the U.S., commercial buildings consume more than 60 percent of all energy, and as much as 80 percent of which is wasted. Chicago-based Commonwealth Edison (ComEd) wanted to empower its building manager customers to reduce this waste by tracking their energy usage with the U.S. Environmental Protection Agency's (EPA) ENERGY STAR program. Yet collecting whole building energy usage data from back-end systems, as required by ENERGY STAR, is an intensive process, taking as much as six hours per request – putting large-scale conservation of this type out of reach.

ComEd is one of the nation's largest electric utilities, with approximately 3.8 million customers in the Chicago area. This footprint includes more than 350,000 businesses, including hospitals, hotels, medical office buildings, wastewater treatment plants, courthouses, financial centers, warehouses, schools and others.

ComEd, seeing the opportunity to drive commercial building energy efficiency among customers while harvesting considerable savings, knew it would need to first simplify the process of categorizing, analyzing, managing and submitting energy data for its large base of commercial customers. Only then would the utility be able to reduce the administrative burden of tracking building-level energy usage, and thereby facilitate broad, rapid enrollment in ENERGY STAR.

By automating the ENERGY STAR data submission process for these businesses, ComEd realized it would not only be able to encourage commercial and industrial customers to assess and improve their facilities[1] energy usage, but also would enable them to save money, reduce their impact on the environment, quantify the impact of operational improvements and increase their property value. A clear win all around, but how to make it happen?

ENERGY STAR Works

Americans, with the help of ENERGY STAR, saved enough energy in 2009 alone to avoid greenhouse gas emissions equivalent to those from 30 million cars – all while saving nearly $17 billion on their utility bills.

ENERGY STAR for Multi-tenant Facilities

The EPA's ENERGY STAR program was introduced in 1992 as a voluntary labeling program designed to promote energy efficient products. While the first labeled products were computers and monitors, the program has expanded to include major appliances and commercial buildings.

In a growing number of states, a commercial ENERGY STAR rating is now required at the time of building sale, rental, and for government grants. This certification has been shown to translate into a three percent premium in rental value and a sixteen percent increase in sale price for commercial buildings. In fact, ENERGY STAR has become so successful, it is now being incorporated as the standard yardstick by which buildings are measured for demanding standards such as Leadership in Energy and Environmental Design (LEED) 2009.

[1] Source: Doing Well by Doing Good? Green Office Buildings, a 10,000 building study by the Center for the Study of Energy Markets, University of California Energy Institute, September 2009

Syncing with ENERGY STAR

Beyond the administrative hassle, getting customers to begin tracking whole building usage was perhaps the most significant hurdle. Building managers had to retrieve an entire building's electricity consumption data manually through ComEd in order to enter the figure into ENERGY STAR Portfolio Manager, the program's interactive energy management tool that allows managers to track and assess energy consumption for an entire commercial building.

Moreover, each tenant who occupied space within that building would need to sign a privacy form provided by ComEd, who could then release the data for that particular tenant. Consequently, the process to acquire a building's usage data was extremely cumbersome and paper-driven, with additional customer fees required. Only a small percentage of building managers actually took the time to participate.

Further challenges were encountered as customers were exposed to minor address differences in tenant records, causing errors in data retrieval and further delaying the request process. Even single occupant buildings don't have an easy go of it. Oftentimes with multiple meters and addresses, these buildings face the same energy data collection challenges as multi-tenant facilities.

ComEd began looking for a solution that would automate this process of collecting, submitting, and validating energy usage data.

What is Green Certification?

With Green Certification, utilities can provide their customers with automated access to vital energy data from back office systems for their building and property manager customers. This empowers building managers to quickly and easily analyze energy consumption data and benchmarking.

Automating the ENERGY STAR Submission Process

In its quest to help hundreds of thousands of Chicago-area businesses begin the ENERGY STAR enrollment process, ComEd selected Calico Energy Service's Green Certification software, the first and only energy management solution designed specifically to facilitate the submission of building-wide energy usage data. Green Certification – an upgrade to ComEd's existing Energy Usage Data System (EUDS) – radically simplifies the process of organizing and sharing energy data by serving as an automated bridge between existing back-end utility data systems and Portfolio Manager.

The software allows Chicago building managers to quickly benchmark their building's energy usage. They can also easily baseline and evaluate building-wide energy consumption, set investment priorities, verify and quantify energy efficiency investments, and work toward gaining ENERGY STAR certification.

Since Green Certification is a software-as-a-service (SaaS) offering, regular technical improvements to Portfolio Manager are transparent to the utility and its customers. Furthermore, Green Certification is updated frequently to meet evolving EPA requirements. This enables the ComEd team to focus its resources on other initiatives and trust that customers' data will be successfully submitted every month as required by the EPA – without the need to develop, support, or maintain an internal software system.

The solution's enterprise-class data security systems and data aggregation (which eliminates privacy concerns by collecting individual customer data and eliminating the need to obtain data privacy release forms) ensure all customer usage data is safe, giving customers confidence in the calculation, storage and transmission of their data. It also includes separate dashboards for administrators, account managers and building managers – enabling utilities to assist customers with the configuration, management and submission of data to ENERGY STAR.

Small Change, Big Impact

ComEd estimates that the software reduces time spent on energy usage requests by 96 percent – reducing the time required to set up each building from 10-12 days to just 24 hours. As of today, the utility has automated the submission of energy data to Portfolio Manager for more than 300 million square feet of office space.

For ComEd, this new approach has dramatically reduced the administrative burden of gathering energy data, and helped building managers take full advantage of ENERGY STAR to examine and compare their buildings' usage history. Using this information, building managers are empowered to develop new energy-saving strategies and measure their effect.

Sustainable Impact

Energy management software such as that being used by ComEd provides an excellent approach to encouraging ENERGY STAR participation among businesses. It streamlines the submission process and saves both utilities and building managers time and money. More energy-efficient buildings mean less pollution, as well as cost savings that can be passed to consumers. Ultimately, this type of solution promises to contribute to the advancement and adoption of ENERGY STAR across the nation, providing utilities with a fast path to driving commercial building energy efficiency in their service territory.

Given the dramatic increase in the number of regulations and incentives at the state, federal, and local level, all of which require government and commercial operators to submit building energy usage reports through Portfolio Manager, ComEd's deployment is a lighthouse for both utilities and building owners. It shows that despite the barriers and potential for complexity, building managers can save money by increasing the energy efficiency of their buildings, complying with regulations and differentiating their properties for rental or sale.

For its efforts, the Association of Energy Services Professionals (AESP) awarded ComEd's solution its Outstanding Achievement in Energy Program Design or Implementation award in February 2010. ComEd also received the 2009 ENERGY STAR Special Recognition Award for Innovation in Customer Service.

About the Author

Kevin J. Bricknell is the Energy Data Services Manager in ComEd's Marketing and Environmental Programs Department. He joined the department in June 2005 and is currently responsible for management of the Energy Usage Data System and Energy Insights Online programs for ComEd in Chicago. During his 31-year ComEd career, he has held a variety of supervisory and managerial positions in the Customer Service and Treasury Departments. Kevin is a graduate of Roosevelt University, where he earned a Master of Science in Marketing Communications graduate degree and a Bachelor of Science degree in Marketing.

"Green is a Group Effort"

ComEd is dedicated to helping their commercial building customers reduce their energy use, and Calico is proud to be their partner in this effort. The utility is joined by other groups in Chicago dedicated to making a positive impact on the environment.

One group, The Chicago Climate Action Plan (CCAP), is known as the city's roadmap for reducing greenhouse gas emissions to 25 percent below 1990 levels by 2020 and 80 percent below 1990 levels by 2050. Like ComEd, the CCAP recognizes the significant environmental gains of reducing commercial building energy waste and has made energy-efficient buildings a top priority.

"This type of collaboration is essential, as 'going green' cannot occur in a silo. Green efforts require many people to make many changes over the long term. Chicago is a model for other cities that want to enact change at this level." – Brian Dawson, CEO, Calico Energy Services

Digging for the Truth About Geothermal Energy

By Ron MacKinnon
WhoKnowsThisStuff.com

National and international concerns over the price and availability of fossil fuels have recently been accompanied by the specter of environmental catastrophes such as the Deep Water Horizon oil spill. Additionally, some see costly wars in the Middle East as conflicts over oil. The desire to distance the nation from dependence on fossil fuels has made green energy a hot topic, with wind and solar energy frequently being touted as viable alternatives. However, another green option – geothermal energy – is often overlooked or dismissed as a practical source of cheap, clean and renewable energy.

One reason geothermal energy is often underutilized is a lack of knowledge among residential and commercial energy customers. While solar panels and wind turbines are highly visible, underground geothermal systems are not. And while one can feel the energy potential of the wind and sun on a breezy or hot day, many people are oblivious to the potential of geothermal heating and cooling systems, drawing their power from the ground.

This article will discuss some of the major misconceptions surrounding geothermal energy as well as ways to clear up these misperceptions in order to provide energy customers with the knowledge they need to make informed and practical decisions regarding their energy consumption.

What is Geothermal Energy?

Geothermal energy is energy derived from the Earth. The planet contains a great deal of heat stored underground. Geysers and hot springs are highly visible manifestations of this energy; however, even the soil and rock under our feet store vast amounts of energy that can be harnessed to both heat and cool buildings.

Geothermal Myths:

Myth #1: Geothermal Energy is too expensive.

A common misconception with geothermal energy, as well as green energy technologies in general, is that the installation, operation and maintenance of the necessary equipment is far more costly than traditional heating and cooling systems. If this weren't the case, why wouldn't everyone be using geothermal energy?

While the cost of installing a geothermal heating and cooling system will likely be more than traditional systems, the long-term savings will more than make up for this up-front expense. Typical savings range from 50 to 75 percent of traditional heating and cooling systems. Furthermore, government initiatives such as the American Recovery and Reinvestment Act offer tax incentives for the installation of geothermal systems.

Myth #2: The underground energy that geothermal relies on cannot provide enough energy to make installation of such a system worthwhile.

It's difficult for many energy customers to grasp the energy potential that lies beneath the ground. It is simply not intuitive for most people to think about pulling energy right out of the ground. When something seems too good to be true, the typical reaction is to assume that it is probably is.

While it may be hard to imagine the potential of pumping energy out of the ground itself, the fact is that geothermal energy systems can operate at up to 400 to 600 percent efficiency, compared to around 96 percent efficiency for a fossil fuel furnace.

Myth #3: Geothermal energy technologies lack the proven effectiveness of more traditional methods.

To many, geothermal energy is a novel idea that is on the cutting edge of technology. The idea of drawing energy from the Earth seems like something out of science fiction, something that is more of an ambitious theory than a scientific reality. If geothermal energy is truly an effective heating and cooling source, why haven't people been using it for years?

The reality is that geothermal heating and cooling techniques have been around for years. For centuries, the Earth's geothermal energy has been harnessed from naturally occurring hot springs in areas such as Hot Springs, Ark. Additionally, extremely low-tech concepts such as underground dwellings have been used throughout history to take advantage of the way the Earth's surface moderates temperature. Modern geothermal technologies simply take these concepts further and have been proven effective for decades in many European nations.

Myth #4: Geothermal energy systems are too complicated for the average consumer to install and maintain properly.

For contractors installing a heating and cooling system in a new building, the idea of a system of underground tubes, vents, ducts and compressors manipulating the temperatures beneath a structure to heat and cool the building may seem prohibitively complex for use in everyday construction. Sure, geothermal energy sounds great for large-scale, high-tech projects, but not for a single-family dwelling or an ordinary office building.

While, contractors should not endeavor to include a geothermal system in a new building without taking the time to learn about the technology and the installation process, this is not as difficult as many people assume. Organizations such as Milwaukee Stove & Furnace have set up programs to help contractors learn what they need to know to successfully utilize geothermal heating systems.

Myth #4: Geothermal is only for new construction.

Perhaps as a byproduct of the image many people have of geothermal energy as a new and ground breaking concept, many overlook the possibility of updating the heating and cooling systems in existing buildings to utilize geothermal energy.

The reality, however, is that the retrofit market for geothermal systems is expected to grow significantly in the coming years. In fact, geothermal systems may be especially attractive for older buildings with poor insulation due to the efficiency of these systems over traditional, fossil-fuel systems.

Conclusions

Clearly, there is a great deal of misunderstanding surrounding many aspects of geothermal energy. This article has offered a brief list of common misconceptions and provided some information to help clarify some generally held inaccuracies. But how can an energy provider more thoroughly educate consumers and contractors about geothermal energy?

Perhaps the most effective means of winning over geothermal skeptics is a simple cost comparison between geothermal energy and traditional, fossil fuel based energy systems. Between long-term increases in energy efficiency and currently available tax incentives, geothermal energy can be a very attractive way to save money for many customers, and by simply providing its customers with a cost comparison pamphlet with their next energy bill, an energy provider can help spread the word about the financial benefits of geothermal energy.

Additionally, as previously mentioned, some organizations offer training and support programs to help contractors install and retrofit geothermal systems in new and existing structures. A contractor who understands the workings and benefits of such a system will be more likely to discuss this option with a customer who may otherwise be unaware that geothermal is even an option. ■

About the Author

Ron MacKinnon has a background in HVAC and energy management and expertise in the broad range of renewable energy options. But his passion is geothermal energy and he's committed to providing clear, concise and consistent information to United States consumers. "Who Knows This Stuff" is a consumer-friendly source of easy-to-understand information on renewable technology options and opportunities. Through video that takes visitors on site and uses drawings, animations and interviews with industry experts, "Who Knows This Stuff" simplifies the complexities of renewable energy to make it accessible to all.

Old & New Merge to Create Historic Energy-efficient Building

By Eric Escudero, Senior Public Affairs Specialist
U.S. Department of Energy

When people consider a large office building that potentially generates as much energy as is uses, they may assume it would require only the most advanced technologies. Wouldn't the building have to incorporate methods and technologies not available to the general public? Those assumptions are being proven wrong with the U.S. Department of Energy's (DOE) new Research Support Facility (RSF) on the campus of the National Renewable Energy Lab (NREL) in Golden, Colo. The RSF is expected to become the first U.S. office building to generate as much energy as it uses, thanks to a combination of old and new technologies used to achieve that goal.

The process of constructing a new building on the NREL campus began in 1995. Many DOE employees were in leased space in Golden.

"It started as effort to reduce the amount of money we were spending on rent so we could devote more funds to research," said Jeff Baker, the Director of Laboratory Operations for DOE in Golden. "We looked at cost of a lease compared to cost of constructing a new building. When we did the financial comparison, it was overwhelming that we should have our own building." Federal funding for construction was not obtained until 2006. Once funding was approved, the goals became more accessible.

"We wanted a walk-the-talk building, so we had to do the best we could to demonstrate our design and knowledge for energy efficiency that would display the latest technologies for energy efficiency in a commercial building," said Baker. "We were driven by a need for a mission. It had to financially look good. Also, NREL did not have a brand. We needed to establish that NREL was the nation's premier research and development organization and be recognized as such with investments that have been made."

About 800 employees are expected to work in the 222,000 square foot building, which was completed this past June (2010). It was a daunting task to design and construct an ultra energy efficient building that large. Yet some of the technology used in the new RSF to achieve this unprecedented level of energy efficiency has been available for hundreds of years.

"Many people are surprised when they walk into a cathedral on a hot day and feel how cool it is," said Tom Hootman with RNL, the design company responsible for this innovative project. One of the keys to efficiency is thermal mass, such as large amounts of concrete, masonry and stone. Those elements in the RSF lead to a large amount of heat absorbed, which is the same concept used in very old cathedrals," he explained.

Thin Design

A very "thin" building design is another old concept used to save energy in the RSF…

"Each wing is only 60 feet wide," said Byron Haselden, President of Haselden Construction, the builder DOE chose to do the construction. "Many buildings before World War I were built using this same strategy. They had to be easily and naturally ventilated. Both sides of the RSF are connected so the building can breathe," Haselden said.

This narrow building design also enables day lighting. Building orientation minimizes east and west glazing, and reduces unwanted heat losses and gains.

The sun played a major part in making the RSF so energy efficient. Most of the lights stay off during the workday because 100 percent of the workstations are day-lit. This is possible because each workstation is no more than 30 feet from a window. Daylight enters the upper portions of the south-facing windows and is reflected to the ceilings and deep into the space.

"We wanted to use every bit of free energy from the climate that we could," Hootman continued. "To do that, we were interested in getting the day lighting to work for the entire building."

"Open Windows" Architecture

Perhaps the most popular feature among employees working at the RSF is that they have the option to open and close many windows. This is a feature rarely offered in most office buildings yet it helps cool the building and eliminates the need for air conditioning. The RSF also has a 1.6 megawatt roof solar system, which combined with the building's energy-efficient technology and design, creates the opportunity to generate as much energy as is used.

A labyrinth thermal storage space, which looks like an underground maze of concrete, occupies the RSF's lower crawl space. The labyrinth stores thermal energy and provides additional capacity for passive heating of the building.

Advanced technology also played a major role in creating the RSF. During the warm summer months, windows will open automatically at night to vent excess heat. As a result of the cool nighttime air, the concrete walls lose their heat. This is a process that repeats itself throughout the warm months. It's one of the reasons the ultra-energy efficient building has no need for a traditional forced air system.

The western side of the building typically gets the most direct sunshine throughout the year. As a result, there was a concern that the excess sunlight could provide an additional need for cooling. To counter this challenge, electrochromic windows were installed. The electrochromic windows automatically tint to reduce heat, which makes a big difference in reducing electricity. The RSF also features advanced elevators that use magnets instead of electricity to stay ready for use and further reduce energy consumption in the building.

Recycled Beetle Boards

Another aspect of the building that makes it unique is the amount of recycled materials used in the construction. Reclaimed natural gas pipes are used as building columns so materials used for traditional energy sources are being used to reduce energy use in the futuristic building. Wood from trees killed by a beetle infestation in the Rocky Mountain forests is used in a decorative lobby entry and recycled materials from Denver's closed Stapleton Airport were used as aggregate in foundations and slabs. Haselden Construction recycled 75 percent of the building's construction waste.

The Funding Challenge

Getting funding for this ambitious project was quite a challenge; delivering the vision for one of the most energy efficient office buildings in America was even harder. It took an entirely different approach to design and construct.

"It's one of the most challenging projects we have ever done," said Haselden. "Energy usage was considered in every step of the design and construction. We had to take a design and build approach in which we created (energy) performance goals, then design and build to meet those performance criteria."

One of the major goals for the RSF was to create an ultra-energy efficient building that can be easily duplicated. If energy use in buildings across the United States is reduced than businesses can reap the economic benefit. However, when a one-of-a-kind-building is created there are challenges to documenting the entire scope of innovation and development.

"The reason it was a formidable challenge to document everything during the RSF construction and design process was that we were innovating every step of the way," said Baker. "Documenting everything is essential in a ground-breaking project like this because creating a how to manual for future project managers was one of our goals so similar buildings could be created."

The RSF is considered a "living laboratory" because its energy usage will be studied and adjusted as part of DOE's unrelenting efforts to improve energy efficiency across the United States. The early verdict on the building is it potential could change how new office buildings in America are constructed.

"What we have shown by completing this project is that it's possible to create an office building that is ultra-energy efficient with advanced and older technologies," said Baker. "More importantly, this building demonstrates that this can be done at costs comparable to traditional office buildings."

Byron Haselden is just as optimistic in how the new building could affect the future of ultra-energy efficient construction...

"Some people have called the RSF the first of a new classification of real estate. I think that is accurate. This building is making history from the standpoint of size and different types of components used to make it so energy efficient."

More detailed information is available on the DOE's new RSF on the Internet. NREL has several feature stories detailing many more building aspects that make it so unique at www.nrel.gov/news/rsfnews/.

About the Author

Eric Escudero is a Senior Public Affairs Specialist at the U.S. Department of Energy's office in Golden, Colorado. DOE-Golden, the lead organization under DOE's Office of Energy Efficiency and Renewable Energy, plays a pivotal role in advancing and deploying clean energy technologies across the nation through laboratory collaboration, industry partnerships and business support. DOE-Golden also oversees the National Renewable Energy Laboratory (NREL), the only national lab dedicated to the research and development of energy efficiency and renewable energy technologies.

Smart Grid: The Intelligent Network Behind Electric Vehicles

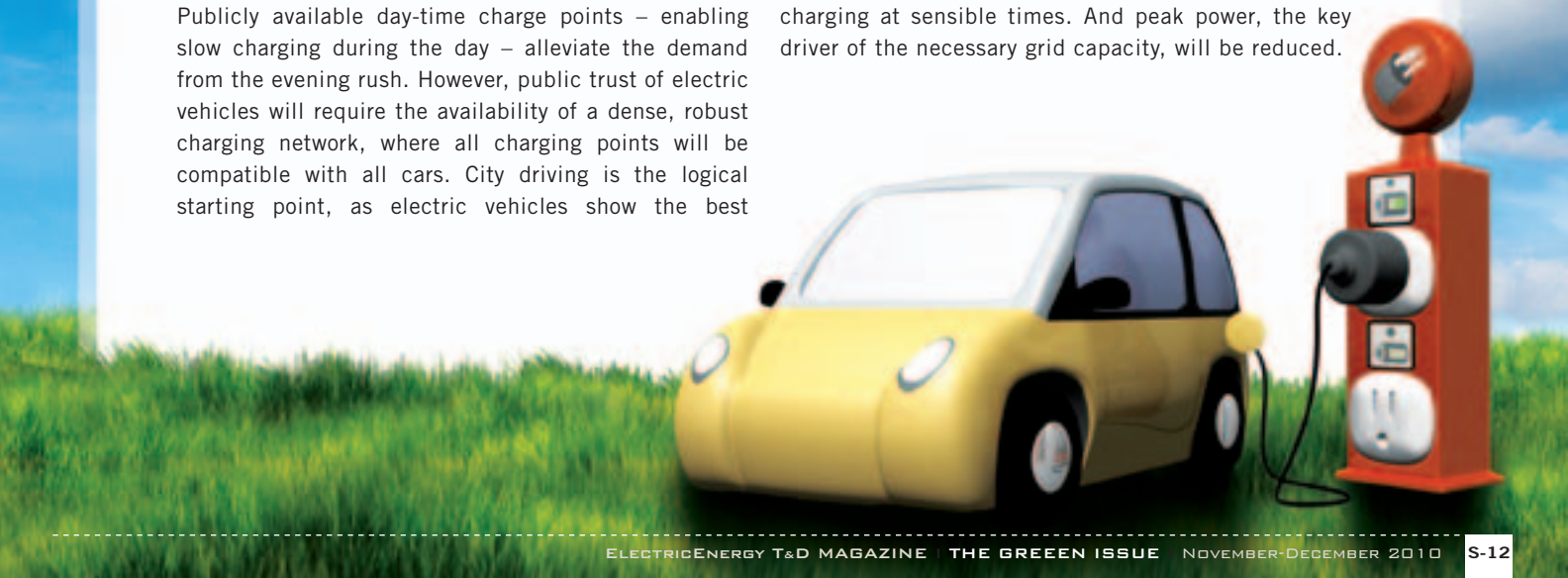
By Dr. Mark England, Sentec

With governments under mounting pressure to meet radical targets on carbon emission reductions, the search is on for new clean technologies that can improve energy efficiency and reduce consumption. In some countries – such as the UK, for example – where government is incentivizing electric car users with an exemption from both road taxes and London's congestion charges. But many potential customers are far from convinced that an electric car will ever be as convenient to use as a conventional vehicle. Dr. Mark England, CEO of Sentec, explores the infrastructure that will be required and explains the role Smart Grid technology will play in putting electric cars on the road.

With most major car manufacturers parading their latest eco-friendly vehicles, it seems that the electric car is on the verge of achieving a long-awaited breakthrough. The rapid progress in vehicle design must be met by improved infrastructure, and intelligent charging provides a raft of possibilities for environmental efficiency. An electric vehicle used for around 20 miles per day consumes about the same amount of energy as an average house over the same period. The grid is not designed for the rapid addition of the equivalent of several houses to each substation, and without careful management of when the charge is delivered, an electric vehicle could cause more problems than it solves.

Publicly available day-time charge points – enabling slow charging during the day – alleviate the demand from the evening rush. However, public trust of electric vehicles will require the availability of a dense, robust charging network, where all charging points will be compatible with all cars. City driving is the logical starting point, as electric vehicles show the best advantage over combustion in stop-start scenarios, and charging points can be relatively close together. Charging posts outside cities must follow, enabling longer journeys that are always within range of a charge.

Public posts can be commissioned and maintained easily, and the cost of the charger and groundworks is effectively spread across the many users. The greater challenge comes from domestic charging; here, forward-thinking utility companies have the ability to appeal to a new market. Smart meters allow them an interface into the home, and a potential gateway for electric vehicles to manage their charging patterns. Customers will have far greater control over energy consumption, and tariffs will be offered that favor charging at sensible times. And peak power, the key driver of the necessary grid capacity, will be reduced.



With a dynamic and responsive smart grid forming the backbone of the electric car infrastructure, renewable energies will be better positioned to do much of the recharging. Until now, a major sticking point for many would-be electric car owners is that most of the electricity used to charge their cars is generated by coal-fired power stations, meaning that only negligible CO2 savings are generated relative to a comparable conventional car. However, electric cars can be compatible with energy produced from intermittent sources like wind power. Wind tends to be stronger and more frequent at night, which coincides conveniently with the extra grid capacity needed for charging vehicles at off-peak demand.

Because cars can store energy it is possible to match their charging regime to short term forecasts on the availability of intermittent forces, and then draw the energy from their batteries either to travel or, if the consumer does not need it, to power other domestic appliances or even as a source of electricity for the local grid.

Burgeoning vehicle-to-grid technology means that groups of vehicles can also be used as energy storage assets by utility companies. When the grid is short of energy, a signal would be sent to the car via its smart connector, causing surplus energy stored in the car's battery to energy to pass back to the grid from the vehicle. This means that the owner can sell this surplus energy back to the electricity company, smoothing fluctuations between supply and demand.

These types of use mean that the battery itself is no longer just a means of powering the car, but a valuable asset with its own identity. One implication of this is that energy companies may need to consider the supply of energy to an electric vehicle as a separate account, with separate tariffs and options. Because cars will be charged and discharged at many different locations, the battery's identity must be tied to the owner's energy account across a potentially huge network. A positive side effect of this is that battery manufacturers, working closely with utility companies, will be able to use smart grid technology to identify batteries with their owners remotely, giving them the ability to detect and investigate any performance problem.

A less positive side effect (at least for consumers!) is that accounting for electric vehicle energy use separately allows policy makers to tax the revenue from these accounts to fund road building and improvements. While it's unpalatable, there is no denying that phasing out the use of fossil fuels for transport will eventually leave government with a large revenue hole that will need to be addressed.

A wide-scale roll out of electric cars is still some way off. But as technology continues to improve, and prices edge within the reach of the average consumer, these vehicles will play an important part in helping the nation achieve its carbon-reduction targets. Making electric cars a success needs a coordinated, joined-up effort among policy-makers, scientists, car manufacturers and utilities to ensure that smart technology and appropriate business models are in place to support this low-carbon technology in delivering its full environmental promise.

They also need to work together to secure full buy-in and engagement from the world's increasingly carbon-conscious consumers. Smart meters – the heartbeat of the fast-approaching Smart Grid architecture – will enable car owners and utilities to monitor power demands in real time, creating a far more efficient system of electricity pricing and supporting a long-term change in the way we consume it.

About the Author

Dr. Mark England joined Sentec in 1998 and has been responsible for setting the strategic roadmap of the company and the development of the broad and deep commercial relationships necessary to grow the business. Mark's experience includes the full cycle of product development from the initial creation and nurturing of ideas, identification and protection of key intellectual property, right through to high-volume product manufacture. He has also taken a leading role in developing and maintaining relationships with key partners in the energy sector, with a significant improvement in the quality and quantity of license partners over the past six years. Mark holds a PhD in Physics from Cambridge University in Cambridge, England.

Electric Vehicles & Demand Response: How Utilities Are Beginning to Prepare

By Jeff Meyers, Smart Grid Executive
Telvent

The prospect of large-scale deployment of electric vehicles (EVs) raises significant issues for electric distribution utilities and service providers. Certainly, the commercial implications of EVs are significant, but the industry has yet to determine how EV charging will occur, how the cost for charging will be handled, and how the true cost of the energy – including carbon footprint –will be determined. Leaving aside those questions for a moment, the potential impact of EVs on local distribution networks is the current focal point for some utility engineering and operations personnel.

Most interested observers have gotten over the early hype-cycle view that a rapid deployment of EVs could shock the transmission and generation capacity of the grid. But, that does not mean that in specific localities, high penetrations of EVs will not pose problems for the distribution system. So, while every distribution company would welcome the new source of revenue, and the potential to balance peak demand to improve system load factor, it would be a mistake to overlook the possible consequences of EV adoption.

The Potential Impact

There are two primary types of charging available or planned for consumer vehicles. Level 1 (L1) charging is based on 120 volts, the normal voltage supplied in a home or office. Under L1 charging, a consumer EV would require 10 to12 hours for a complete charge, with a peak-imposed demand of 1.4 to 2 kilowatts (kW). Level 2 (L2) charging at 240 volts would speed up the charging time to 2.5 or 3 hours, raising the peak demand to about 6.6 kW. Level 3 (L3) charging, sometimes referred to as 'fast charging,' will be made available as larger numbers of EVs are deployed.

A realistic example can help to illustrate the potential impact. For simplicity's sake, we can limit the discussion to an idealized substation feeder serving only residential customers. Suppose that a normal, 15 kilovolt (kV) feeder serves something like 1,000 homes, with a peak (diversified) load of 7 megawatt (MW). Suppose that 5 percent of those homes buy EVs, and that they all are willing to charge them at home after 9 p.m. Imagine that 25 percent of these EV owners are willing to employ L1 and the other 75 percent choose L2 charging, so that the average added load during peak could be as much as 5.5 kW per car. That could add up to 275 kW, or a very modest increase of 3.9 percent on our imaginary feeder. Not too daunting.

Now imagine that 80 percent of the new EVs all come to reside in a particular neighborhood, a scenario that is fairly realistic, when we consider the modern trends of neighborhoods with similar demographics.

Suppose that in one area served by our feeder, roughly 200 homes are connected from a branch, making a diversified peak of 1.4 MW. If 80 percent of new EVs connect in that area at 5.5 kW each, the added peak would amount to 220 kW, or a pretty hefty 15.7 percent increase.

That could strain the distribution system on a localized basis, overloading an already well-loaded transformer, or secondary cable segment. Some utility leaders have gone so far as to worry that EV-induced outages or other problems in the early stages might blacken the eye of EVs and inhibit deployment.

Penetration Anticipation

Utilities need to forecast and monitor the rate of EV adoption, which will vary considerably from one region to another, driven by a number of factors. That is why expectations regarding load growth from EVs and plans to coordinate with customers to optimize their impact can vary widely from one utility to the next. Conversations with some key utility personnel are revealing in terms of the factors associated with anticipation of high rates of EV penetration.

Albert Saenz is Sr. Electrical Engineer at Silicon Valley Power (SVP) in Santa Clara, Calif. Saenz anticipates good EV penetration.

"With the popularity of Hybrids in our area, we expect consumers to switch over to electric vehicles," he said.

Saenz thinks penetration rates in Santa Clara will generally follow industry projections for California of 35 percent penetration of EVs by 2025, with 2 percent growth each year up to 2015, and 5 percent growth after that, through 2025.

Bruce Hamer, Principal Power Engineer at Burbank Water and Power (BWP) in Calif., intends to make a more detailed analysis of where and how many EVs his utility will serve.

"We expect and welcome early adoption which will occur in pockets in specific residential areas of the city, at specific employers, at some retail business locations and perhaps in one or two commercial districts in the city," Hamer said. BWP has already received "a few calls for powering up a Nissan Leaf" and is putting work into an EV charging request processes. "Bottom line is we will better serve our customers if we are proactive in planning for the coming of EVs."

Tom Suggs, VP of Engineering for Middle Tennessee Electric Membership Corporation (MTEMC) in Murfreesboro, Tenn., has an up-close-and-personal view of the EV revolution, given that MTEMC serves the North American headquarters for Nissan. MTEMC is a member of 'The EV Project', a partnership of auto manufacturers, utilities, and EV-related technology companies dedicated to creating infrastructure for the EV ecosystem.

"Some areas will see much more activity than others based on federal, state or local tax incentives and environmental concerns and regulations in certain areas," said Suggs. "Since our utility serves the assembly plant where the Nissan Leaf will be built, we will most definitely see the impacts earlier than most areas due to our participation in the EV project."

Liz Soria, EV Project Director at ENMAX Corporation, serving Calgary, Alberta, is utilizing a relatively conservative EV penetration curve in Alberta due to several factors such as the cold climate, and the tendency of Albertans to prefer larger vehicles. Additionally, Alberta does not offer any government incentives for EVs at this time. But that does not mean that ENMAX is not preparing for the potential demand; the utility is aggressively pursuing a 100-vehicle pilot to learn more about EV impacts and benefits and develop market products to promote adoption of EVs.

Wayne Longcore, director of Enterprise Architecture and Standards for Michigan utility Consumers Energy, also expects some neighborhoods to have relatively high adoption rates.

"There will be '(Nissan) Leaf' neighborhoods, just like there are '(Toyota) Prius' neighborhoods today," said Longcore.

Doing some high-level math, Longcore quickly estimated that if the projected 1 million EVs are deployed by 2020 each state could average 20,000 vehicles. If the majority of those are clustered around environmentally-aware, affluent neighborhoods, Longcore also sees the potential for localized overloads, especially at the transformer level.

Localized Issues

All of the thought leaders in this conversation agreed that any problems in the early adoption timeframe of the next five years would be localized. Saenz, of SVP, commented that impact could be fairly immediate at the transformer level. He added that notification and the permitting process were likely to be significant barriers in the early adoption cycle. Tom Suggs (MTEMC) agreed, indicating that although there are no bulk power problems anticipated, there will be situations where, due to social interaction, groups of neighbors end up influencing each other to adopt EVs.

"This clustering effect can, and likely will, result in damaged transformers and small outages," said Suggs.

Longcore (Consumers) was in alignment with that thinking, stating that he anticipates isolated transformer outages "within the next five years" due to clustered EV charging requirements.

Perhaps because of his California location, Hamer (BWP) expects the timeframe for impact to be fairly short. Southern California is an ideal place for early adoption of EVs and BWP welcomes the transition, which will substantially improve local air quality. BWP also sees promise for working with their customers to effectively manage EVs using vehicle-to-grid technology designed to help integrate renewables, distributed generation, and provided improved demand response.

"It will not take a lot of L2 chargers (240 volts ac) or L3 chargers (450 volts dc) on the same feeder to cause loading problems on distribution transformers," he said. "Therefore we may have some minor problems on specific feeders in the next two or three years."

Li (ENMAX) is projecting a longer timeframe for issues, but similar results, commenting that, "We don't expect any impacts prior to 2015 but by 2020 we do expect to see local impacts at the transformer and substation level due to EV clustering."

Wayne Longcore added a second dimension to the discussion regarding the nature of EV charging.

"There are three different interested parties in the charging equation, each with different objectives," according to Longcore. "The battery manufacturer wants the car to be used as close to the end of a full charging cycle as possible, to prolong the life of the battery. The utility wants to distribute the location of charging vehicles around the system and to diversify the time that vehicles are charging in order to prevent a localized or a system peak. And the consumer wants to charge their car in the most cost-effective way with reasonable convenience."

Those objectives are in some ways opposed to one another and could lead to different charging patterns.

Mitigation Strategies

Given the localized nature of impending distribution problems, it is not surprising that each of these utilities is focused on knowing where EVs will plug into their networks.

Tom Suggs summarized the problem: *"How are we notified that a customer has added an EV charging station at their home; how do we determine transformer and service adequacy; who pays if the service needs to be upgraded; what happens if two or three EVs are suddenly charged from a common distribution transformer and the transformer fails?"* he asked.

Solving the problem will require changes in both process and technology. Most utilities today have or are developing EV charging permit requirements. A lot of thought and work is going into work flows and processes to get a permitted charging station available to the consumer, with locational data that can be used by network engineers and operators to identify trouble spots.

A good network and asset model, with accurate and up-to-date data about line and transformer capacity will be key. Advanced analytics, including implementation of advanced distribution management systems (DMS) will be critical to this solution. Coupled with intelligent line and transformer sensors, DMS can help operators to understand in real-time where the network might be in trouble, and smarter meters could be a huge benefit, providing end point data to more effectively manage the network.

Albert Saenz identified the key technologies in SVP's strategy…

"We plan on utilizing an advanced metering infrastructure (AMI) and integrated system model (ISM) to better manage our changing distribution environment," he said.

But knowing where and when charging will occur is only the first step. Service providers will also need tools to help manage EV charging loads, incentivizing consumers to charge EVs in a more distributed, diversified pattern.

"Ultimately, we can add more data points, like smart meters and line sensors, and more broadly applied real-time monitoring to understand the extent of the problem," Bruce Hamer adds that BWP will develop a demonstration program with the goal of testing the whole value chain of EV charging.

"We envision demonstrating one or more charging devises that communicate with EVs and determine battery storage status, then transfer that information to the utility DMS. This would enable the utility to either proceed with charging the EV, cycle the charge, or schedule the charge for later," Hamer said. "The idea is to charge only the EVs with near depleted battery power, when the utility is having a peak energy event."

Not content waiting for technological advances, Soria and ENMAX are striving to mitigate any potential EV demand issues by actively trying to stimulate EV growth through its pilot project.

"ENMAX Corporation is taking steps that will accelerate the adoption of EVs in the province by developing pricing plans, products and services to make it easier for Albertans to bring home an EV," said Soria. "The impact of ENMAX's pilot on EV adoption will be felt immediately by more than doubling the number of EVs currently registered in the province."

In summary, it is safe to conclude that EVs will have an impact on utilities with greater emphasis in some specific locations within their service territories. Along with their potential environmental and commercial benefits, EVs will bring localized distribution problems. Knowing where those loads will occur, having the data and tools to analyze their impacts, and providing incentives for network-friendly charging patterns will be key to both consumers and utilities realizing the potential of electric vehicles. ■

About the Author

Jeff Meyers currently serves as a Smart Grid executive for Telvent. In this role, Jeff provides support to Telvent staff and customers regarding the business value and approaches to smart grid implementations. Since 1987, he has worked on more than 50 GIS development projects for gas, electric and other utilities, based on the developing and evolving technology of ESRI and Telvent. Jeff can be reached via email at *jeff.meyers@telvent.com*.

Electric Vehicles and the Smart Grid: Charging Forward!

By Scott Lang, Chairman, President & CEO
SilverSpring Networks

Electric Vehicles (EVs), with their potential for gasoline savings and emissions reductions, are generating significant consumer and political interest, particularly in the wake of the recent Gulf of Mexico oil leak. However, given the sizable amount of electricity they require for charging, EVs are also generating concern among utilities tasked with supplying that electricity on the nation's aging grid. The next two years are expected to bring a significant shift in the electrification of transportation as nearly 20 automakers introduce battery-powered EVs or plug-in hybrid EVs. With consumer pre-orders for the vehicles already in the tens of thousands and researchers expecting millions of EVs to be on the road by 2020, utilities must act now to develop a strategy on integrating EVs.

The most serious concern for utilities is controlling *when* EV charging stations (known as EVSE, or Electric Vehicle Supply Equipment) will apply load to the grid. A high percentage of consumers will instinctively charge their EVs when they get home from work, likely having a serious impact on peak demand on the grid. With EV home charging stations typically drawing an electricity load of 6.6kW (240V and 30 amps) - roughly the equivalent to the load of an entire house at 7kW – a single EV can double a home's peak load, and even low levels of EV adoption in a particular neighborhood can strain existing power infrastructure. In fact, data released by the Electric Power Research Institute (EPRI) suggests that if two customers on the same transformer plugged in 6.6 kW charging stations during a peak time, their charging load, in addition to existing load, may exceed the emergency rating of roughly 40 percent of today's distribution transformers.

However, the growing EV trend will not necessarily require utilities to add new generation capacity or make extreme infrastructure upgrades. According to the Pacific Northwest National Laboratory (PNNL), approximately 160 million vehicles in the U.S. could be powered solely from existing off-peak generating capacity. This means that many utilities could initially support EV charging by better managing existing generation.

The Smart Grid is the key to smart EV charging. The Smart Grid provides the visibility and control needed to mitigate the load impacts and protect components of the distribution network from being overloaded by EVs thus ensuring electricity generating capacity is used most efficiently. With a Smart Grid, utilities can manage when and how EV charging occurs while still adhering to customer preferences.

Smart Grid integration of EVs also enables utilities to provide consumers with greater insights into their EV experience – allowing their customers to better understand cost of "fueling", positive impact on the environment and ability to set charging preferences. A Smart Grid also allows utilities to collect EV-specific meter data, offer specific rates for EV charging, engage consumers with information on energy transmission, and collect data for greenhouse gas abatement credits.

Because of the robust communications infrastructure offered by the Smart Grid, utilities can remotely monitor charging stations and allow for the comprehensive management of EV charging. Utilities can also troubleshoot charging issues without unnecessary on-site service calls and manage when connected EVs are charged.

With the Smart Grid, utility back offices will be able to support, integrate and optimize EV charge management as part of an integrated Demand Side Management (DSM) operation. This approach requires systems that not only manage EV charging, but also optimize it with respect to other Demand Response (DR) programs, such as A/C Cycling.

The Smart Grid also allows utilities to seamlessly integrate an EVSE meter with the Advanced Metering Infrastructure (AMI) system. This allows a utility to break out EV charging from the primary meter and bill for EV charging at a separate rate. AMI integration can also make it easy for utilities to track and report EV charging usage for greenhouse gas credits and use data to predict local reliability issues.

While EV integration poses numerous challenges, it also presents utilities with a significant opportunity: by planning now, utilities can maximize their existing infrastructure, create closer relationships with customers and leverage communications investments to enable the adoption of EVs. Those that don't prepare to integrate EVs risk being perceived as bottlenecks and will find themselves with an over-taxed grid and the potential for reliability issues. ■

About the Author

Scott Lang is the Chairman, President and CEO of Silver Spring Networks, a leading Smart Grid solutions provider. Silver Spring is working with EV charging station manufacturers to integrate communications and metering into EVSEs, and developing software to enable load management, helping utilities better manage EV-related demands.

Electric Vehicle Technology in the IEEE

By Dr. Russell Lefevre, IEEE Fellow
Adjunct Professor of Physics & Electrical Engineering
at the University of North Dakota

One of the earliest gasoline-electric hybrid vehicles was developed by an important IEEE member, named Victor Wouk. He and his partners converted a Buick Skylark into a hybrid automobile that was shown in 1974. His primary motivation for pursuing hybrid technology was to reduce green house gas emissions, and the automobile was capable of obtaining 85 miles per gallon of gas. In that time frame, gas was inexpensive and emission controls weren't a concern, and his funding eventually ran out. Wouk continued to promote hybrid vehicles throughout his illustrious career as an electrical engineer and entrepreneur, including the submission of many articles in IEEE conferences and IEEE Spectrum magazine. Victor Wouk is often referred to as "the Godfather of the hybrid car."

Looking Back

Dr. Wouk's vehicle is known as a forerunner to today's hybrid plug-in electric vehicles, and he, along with many other IEEE members, have been involved from the beginning of electric vehicle development. The earliest related document in the IEEE Electronic Library (IEL) entitled "Petro-Electric Motor Vehicles" by JBG Damoiseau was written in 1913. The IEL itself holds an excess of 4000 articles related to Electric Vehicles and more than 1,800 articles on batteries for EVs.

Electric Vehicles Today

Many major automakers, including Toyota, Audi, BMW, Coda, Fisker, Ford, Hyundai, Mitsubishi, Nissan, Rolls Royce and Volvo, have recently announced that they will introduce electric vehicles in 2011. Although this indicates confidence that there will be demand for electric vehicles, and there are surveys supporting that confidence, there still remains skepticism as to whether the Obama Administration's stated goal of 1,000,000 Plug-In Hybrid Electric Vehicles (PHEV) by 2015 can be met.

One reason for this skepticism is the recognition that light cars and trucks tend to stay on the road for many years. As such, in order to achieve this lofty goal, there will likely have to be incentives to move to EVs or PHEVs more rapidly than has historically been possible. The Electrification Coalition, a consortium of 14 influential business leaders, released an Electrification Roadmap in November of 2009, setting a goal that 75 percent of light duty Vehicle Miles Traveled (VMT) by 2040 will be electric.

The Roadmap envisions a federal initiative to establish Electrification Ecosystems (EE) in several American cities – meaning cities or regions in which each of the elements necessary for the successful deployment of Grid Electric Vehicles (GEV) would be deployed simultaneously in high concentrations.

The Roadmap envisions the establishment of six to eight EEs for the deployment of 700,000 GEVs by 2013 using a combination of government subsidies for consumers and utilities, installation of a public charging network and other measures of support.

These ecosystems would allow participants to learn which business models work for supplying, selling, and servicing GEVs and help create economies of scale. The lessons learned would then be exported to other communities thus lowering the cost of deployment and accelerating national deployment rates.

The Roadmap was so influential that the US Congress took up its main recommendation in two bills. In the Senate, the bill was "Promoting Electric Vehicles Act of 2010" S. 3511, which was passed out of the Energy and Natural Resources on July 21 by a vote of 19-4, indicating strong bipartisan support. Much of the bill language was then taken up by the Senate Majority Leader, Harry Reid, and introduced into the "Clean Energy Jobs and Oil Company Accountability Act of 2010" S. 3663, the major energy bill currently under consideration by the Senate.

In the House of Representatives there is legislation similar to S. 3511, the "Electric Drive Vehicle Deployment Act of 2010", H.R. 5442. This bill with bipartisan sponsorship has been referred to the appropriate committees.

From a global perspective, there are at least 18 countries including the European Union that are involved in Electric Vehicle development and expansion. For example, France has set a goal of 100,000 electric vehicles sold by 2012 and Spain has a goal of 1,000,000 by 2014. China has targeted electric vehicle manufacturing as a strategic industry, and many other countries have programs with varying degrees of focus.

As worldwide interest in deploying electric vehicles grows, IEEE has organized its intellectual property – articles in journals and magazines and papers presented in our conferences – to better serve the electric vehicle community. This article is intended to identify areas of expertise that will move that process forward.

Batteries

One of the most important technologies in the electric vehicle industry is the battery. Historically they have been large, heavy, and expensive, with limited lifespan. IEEE members have played a major part in their development, beginning as early as the 1900s. Ongoing battery technology advancements have subsequently reduced many of these problems.

In the 2010 Transactions on Vehicular Technology, A. Khaligh and Z. Li presented the State of the Art of electric vehicle storage systems. The paper entitled "Battery, Ultracapacitor, Fuel Cell, and Hybrid Energy Storage Systems for Electric, Hybrid Electric, Fuel Cell, and Plug-In Hybrid Electric Vehicles: State of the Art" addresses the battery situation but more importantly looks at the broader issue that encompasses the full energy storage system technology.

A report on the results of testing batteries for the National Renewable Energy Laboratory entitled "Evaluation of Lithium Iron Phosphate Batteries for Electric Vehicles Application" by FP Tredeau, et al in the Proceedings of the Vehicle Power and Propulsion Conference 2009, discusses the testing of Lithium Iron Phosphate batteries for Electric Vehicles. 160 batteries were extensively tested and evaluated. The results indicated that lithium polymer cells show very good performance and may become the preferred battery type as manufacturing improves.

Battery Management Systems (BMS)

Although the battery itself is a dominant technology in EV deployment, BMS also has a major role. A BMS controls the charging and discharging of the battery while guaranteeing reliable and safe operation. One critical element in the design of the BMS is a model of the complicated hardware, software and algorithms that determine how the BMS operates. A new modeling approach can be seen in "Algorithms for Advanced Battery Management Systems," by N.A. Chaturvedi, et al in the June 2010 IEEE Control Systems Magazine.

Power Electronics

Electric vehicles put much greater demand on power electronics technology than conventional fossil fuel powered automobiles. In many cases (e.g., hybrid internal combustion/electric drive vehicles), optimized power electronics suites are essential. Significant advances in power electronics have helped reduce the cost and improve the efficiency of electric vehicles. "Power Electronics Intensive Solutions for Advanced Electric, Hybrid Electric, and Fuel Cell Vehicular Power Systems" by A. Emadi in May 2006 IEEE Transactions on Power Electronics shows how the integration of intensive power electronics solutions within advanced vehicular power systems achieves that goal.

Emadi's assessment shows how the present automotive electric system is inadequate for the more electric environment of future systems due to expense and inefficiency. In more electric vehicles (MEV) there is a trend toward expanding electrical loads and replacement of mechanical and hydraulic systems with more electrical systems. The list of functions to be carried out and controlled by the power electronics system is very long. The MEVs will need highly reliable and fault-tolerant electrical systems to deliver high quality power from the source to the electrical loads. His paper notes that there remains significant room for improvement to reach an optimal design, and touches on advanced power electronic converters and motor drives as potential means of improvement.

Impact on the Grid

A very important consideration in the deployment of EVs is the impact on the current electrical grid and ultimately on the Smart Grid. IEEE has published papers addressing many elements of this issue including the requirement for new hardware and software by utilities and users, how time-of-use electricity rates affect consumer behavior, the impact on regional electricity supply in countries including Canada, the United Kingdom, Portugal, Belgium, Spain and other aspects of the problem. One very important issue is how the evolution of the current grid structure to the Smart Grid will enable solutions to potential problems.

Many of the studies addressing this issue have focused on specific areas of interest or concern. Since EVs and PHEVs are not yet in the fleet in large numbers, the studies are based on analyses and simulations using what is known about EVs and PHEVs and the capacity of the present grid as inputs and using the inputs and models to make projections of future capability to predict future situations. These are then used to help develop solutions that are robust and flexible enough to meet the projected influx of significant numbers of EVs and PHEVs.

An indication of the level of uncertainty of how the introduction of EVs and PHEVs will affect the grid is shown in "Speed Bumps Ahead for Electric-Vehicle Charging" by P. Fairley in the January 2010 *IEEE Spectrum* online. Important leaders in the utility industry demonstrated a concern that the present grid will show major problem areas that may not crash the grid but could cause local problems. Southern California Edison and Pacific Gas & Electric are working with the Electric Power Research Institute to predict likely problem areas to help the utilities prepare for the future.

"Impacts of Plug-in Vehicles and Distributed Storage on Electric Power Delivery Networks" by P. Evans et al in the Proceedings of the Vehicle Power and Propulsion Conference 2009 reports on the results of a study funded by the Department of Energy National Renewable Energy Laboratory. It is demonstrated that potential adverse impacts from charging batteries in PHEVs can have significant local effects. However the conclusion reached is that when such a situation is identified it can be readily managed.

A paper that presents the trends in analysis, design and evaluation of PHEVs in the future smart grid environment is "Challenges of PHEV Penetration to the Residential Distribution Network" by S. Shao et al in the Proceedings of the Power and Energy Society General Meeting 2009. Here the authors identify enabling technologies including bi-directional charging units and bi-directional meters, communication between the vehicle and the energy management center, intelligent on board power management unit and intelligent energy management center. These technologies are envisioned as an integral part of the smart grid.

Vehicle-to-Grid (V2G)

As electric vehicles become widely deployed the concept of allowing plug-in vehicles to be capable of vehicle-to-grid operation where the power electronics allows for bi-directional capability becomes an important technology. That is, it must be capable of taking power during charging and providing power while discharging from and to the grid. There is a worthy summary of the technology and a brief note of the economic implications in "A Review of Plug-In Vehicles and Vehicle-to-Grid Capability" by B. Kramer, et al in the Proceedings Annual Conference of IEEE Industrial Electronics in 2008. The article is based on work at the US National Renewable Energy Laboratory. The authors also note that wide spread use of V2G could be a significant enabling factor for increasing use of wind energy.

Conclusion

IEEE has had an emphasis on technology research, collaboration and advancements related to electric vehicles since the early 20th century, and its involvement to date still matches Victor Wouk's original enthusiasm for the advancement of the electric vehicle. Many IEEE members across the globe are at the forefront of research and development of the technologies mentioned above, while others are helping drive the manufacturing and delivery of technology for deployment, while still others are dedicated to ensuring interoperability standards. This article has provided a very abbreviated level description of the depth and breadth of the IEEE participation. Interested parties are encouraged to contact the author. (NOTE: David Goldstein, an IEEE member and President of the Electric Vehicle Association of Washington, DC, alerted me to the contributions of Victor Wouk.)

About the Author

Dr. Russell Lefevre has a B.S. and a M.S. in Physics from the University of North Dakota and a Ph.D. in Electrical Engineering from the University of California, Santa Barbara, and is a Fellow of the IEEE. He is Adjunct Professor of Physics and Electrical Engineering at the University of North Dakota. Dr. Lefevre is a Past President of IEEE-USA and the IEEE Aerospace and Electronic Systems Society. He is Chair of the IEEE Steering Committee on Electric Vehicles. He can be reached at: r.lefevre@ieee.org.

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Volume 2 No. 4

The Bigger Picture

Bridging the Grid Gap: Renewable Energy Access

By Gregory K. Lawrence, Partner; McDermott Will & Emery LLP (Contributing Editor)

Integrating the energy output of wind, solar and other variable energy resources (VERs) into the wholesale electric power grid has significant reliability, stability and cost challenges. The highest energy value wind generation, for example, is often in the most remote areas far from the grid, customer demand, and states with robust renewable portfolio standards (RPS). The technical challenge is to bridge the gap between a geographically diverse resource and the grid. Doing this involves mastering the transmission access, finance and cost allocation process managed by the Federal Energy Regulatory Commission (FERC).

FERC in recent decisions has significantly modified its open access rules, allowing renewable generators to participate in and subscribe to transmission capacity without having to go through open bidding for the capacity. This reduces regulatory uncertainty and improves the prospects of certain renewable power developers. However, policy is still evolving as FERC works to find the best way to bridge the gap through transmission development incentives, cost allocation directives, VER operational accommodations, and transmission reservations for anchor tenants and participant funders.

Development Incentives, Cost Allocation and Operational Reforms

Under Federal Power Act Section 219, applicants for transmission development incentives must show that their facilities "either ensure reliability or reduce the cost of delivered power by reducing transmission congestion." Incentives involve the recovery of construction work in program, pre-construction and abandonment costs, regulatory asset and amortization treatment, and a boost to the return on equity. A rebuttable presumption exists that the test is satisfied if the transmission project is part of a regional transmission expansion plan or a state siting process considering these issues.

For incentivizing the massive capital necessary for interconnection projects, recovering construction costs remains the crucial issue. Cost recovery associated with greater development risk depends on a higher return on equity, which in turn depends on dealing with amortization and depreciation issues. One innovative proposal for cost allocation would be construction work in progress (CWIP) financing, which allows utilities to recover the financing costs, including rate of return, from ratepayers during the construction of new facilities. In essence, CWIP encourages utility management to pursue transmission construction that it otherwise might not because of undue financial risk.

Importantly, FERC lately has interpreted these requirements more broadly, such that incentives have been made available to transmission projects that were not directly proposed to relieve congestion or meet a specific reliability need. In late 2009, for example, Otter Tail Power Company was granted incentives for a project to meet state RPS and ensure the project can meet regional load growth reliably – a more liberal Section 219 interpretation.

In June 2010 FERC went further, issuing a Notice of Proposed Rulemaking (NOPR), which seeks to reform its electric transmission planning and cost allocation requirements for public utility transmission providers. Among other provisions, the NOPR provides equal treatment for incumbent and non-incumbent transmission providers. An incumbent provider would not be allowed to have a right of first refusal with respect to facilities that are included in a regional transmission plan and subject to FERC jurisdiction, and both incumbents and non-incumbents would share similar benefits and obligations commensurate with their participation, including the right to construct and own a facility sponsored in a regional transmission planning process.

This builds on the 2007 Commission Order No. 890, which sought to remedy the potential for undue discrimination in transmission planning activities by requiring each public utility transmission provider to develop a transmission planning process that satisfies nine principles of openness and transparency. The NOPR uses this opening to address current regulations for allocating costs of new transmission facilities, where the transmission provider that builds a new facility must open it up to companies that have not paid for its construction.

Under the NOPR, the cost of transmission facilities must be allocated to those within the transmission planning region that benefit from those facilities in a manner that is at least roughly commensurate with estimated benefits.

Those that receive no present or likely future benefit from transmission facilities must not be involuntarily allocated the costs of those facilities.

For VERs, such cost allocation considerations go to the heart of their ability to secure grid access in a way such that they are not treated in an unduly discriminatory manner. From the VER perspective, much of FERC's current regulatory structure reflects an outdated power resource picture from the one emerging under state RPSs.

Equal access can be facilitated by faster power system dispatch and scheduling, larger and more geographically diverse balancing areas, and promotion of region-wide load following markets and ancillary services markets – particularly where Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs) do not include VERs. In the NOPR, FERC therefore proposed to require each RTO, ISO and public utility transmission provider that is not in an RTO or ISO region to establish a method, or set of methods, for allocating the costs of new transmission facilities that are included in the regional transmission plan. Cost allocation methods may distinguish among facilities that are driven by needs associated with maintaining reliability, relieving congestion and achieving public policy requirements.

"Innovative Proposals"

Such innovative policies alone may not be enough to address the major challenge at hand: how to get geographically diverse wind and other resources to market while encouraging the development of large, inter-regional transmission projects. In recent orders FERC has addressed this issue by showing its willingness to entertain a more flexible approach to open access to the extent it supports transmission financing than it has in the past to facilitate the construction of needed transmission facilities.

For example, in *Mountain States Transmission*, FERC emphasized its commitment to the development of new transmission infrastructure, and stated that it remains "flexible" in evaluating new proposals for transmission development and pricing. FERC acknowledged the need for "innovative proposals" to develop new transmission projects, especially in regions with potential to deliver renewable energy to load centers, but added that this flexibility cannot "compromise consumer protections."

The 2009 FERC decisions in the *Zephyr* and *Chinook* cases provided an impetus to the development of new transmission. In these cases, for the first time, FERC permitted up to 50 percent of the capacity in a transmission line still in the planning and development phase to be pre-sold to an anchor customer. The anchor customer was a wind developer that negotiated a rate covering a 25-year term for 50 percent of the project's total capacity. FERC allowed the anchor customer to be established before an open season in order to demonstrate financial viability of project. Both projects committed to giving other customers the same rate, terms and conditions as the anchor customer. Prior to this order, FERC had required merchant transmission developers to sell all of a prospective transmission line's capacity through an open-season process. This hindered project development because of a chicken and egg effect: potential subscribers were unwilling to commit significant resources until a transmission developer could show that the project had commercial support.

In the *Milford* case, Milford Wind Corridor, a developer of phased-in wind generation, filed a request to confirm its priority with respect to 1,000 MW worth of capacity on the 88 mile, 345 kV Milford transmission line connecting the generation to the grid. The wind generation was to be constructed in five phases, but the entire transmission would be available all at once. Rates were negotiated (i.e., not cost-of-service).

FERC granted the request, reasoning that Milford had specific plans and milestones for construction, with demonstration of material progress towards meeting the milestones for phased development of its generation. However, FERC indicated that Milford would have to make the unused capacity available to requesting third parties until Milford was ready to sue it for its generation, and to expand the line's capacity to meet demand if sufficient capacity is not available.

Northeast Utilities Service Company (Northeast) and NSTAR Electric Company (NSTAR) requested a declaratory order approving the structure of a transaction involving a cost-based participant-funded transmission project that included a long-term bilateral transmission service agreement. FERC approved the transaction, explaining that the proposal did not contravene the Commission's open access requirements in Order 890 and was not anticompetitive.

The Commission also found that providing for participant funding of a transmission facility with priority rights to use that facility is fully consistent with its long-standing open access policies. Importantly, FERC determined that Northeast and NSTAR, as owners of a non-merchant, cost-of-service rate line, could enter into a transaction granting another, unaffiliated entity priority rights to the first 1,200 MW of capacity on the new line without holding an open season and did not have to comply with the test set out in *Chinook* and *Zephyr* for merchant transmission proposals.

Clear Support

When taken together, FERC's decisions in *Otter Tail*, *Mountain States Transmission*, *Zephyr* and *Chinook*, and *Northeast* and *NSTAR* indicate a clear pattern of support and regulatory innovation for VER access to the transmission grid. By endorsing regional transmission planning processes and cost recovery/allocation approaches that open the playing field for VERs, the Commission is on record as supporting the broader goals of eliminating unnecessary barriers to VER grid and market access and increasing the efficiency of VER utilization.

More "innovative proposals" to further this goal and link geographically diverse renewable power resources with the grid are sure to come including different financing incentives and transmission reservation structures. ■

About the Author

Gregory K. Lawrence is a partner in the Energy and Derivatives Markets Group of global law firm McDermott Will & Emery, and leads the firm's Global Renewable Energy, Emissions and New (GREEN) Products group. Mr. Lawrence focuses his practice on regulatory proceedings, negotiations, governmental affairs and agency litigation relating to the wholesale and retail electricity and natural gas industries.

SECURITY SESSIONS
Volume 2 No. 7

With William T. (Tim) Shaw, PhD, CISSP

Who's afraid of the big bad worm?

Welcome to the final installment of *Security Sessions* for 2010. Another year has passed, but the perennial challenge facing the engineers and IT folks tasked with providing cyber security for our industrial infrastructure is the still-lingering belief – mainly within upper management – that nothing bad has happened so all this effort must be just a waste of time and resources. Too many managers still think their automation systems are too isolated or far too complex to be the target of a cyber attack. They may pay lip service to cyber security to keep regulators off their backs, but they don't truly believe that they are 'at risk'. This could be a big mistake; read on, and you'll learn why... – ***Tim***

The industrial automation cyber security forums have been ablaze lately with comments, thoughts and theories about the STUXNET worm that was recently released onto the computer automation world. That particular piece of software is a marvel of sophistication and frightening in its specificity and capabilities. It is also interesting in that it was apparently designed to be delivered via infected thumb drives, rather than propagating between systems using network-based attacks against vulnerable applications as is the case with most worms. It's almost as if the designers wanted to keep it from spreading too widely!

The STUXNET worm specifically targets Siemens PLC-based automation systems and infects their Microsoft Windows based operator or engineering workstations by exploiting a known vulnerability. I say it targets Siemens systems because it specifically looks for Siemens PLCs[1] as part of its design. Once ensconced in such a PC/workstation, it apparently communicates with the system's PLCs – using the native Siemens communications protocol – and manipulates the program logic, just as you could if you were running the Siemens programming tools in those workstations yourself.

This worm required a lot of detailed technical knowledge about Siemens systems and PLCs as well as general understanding of the PLC logic functions that are important for controlling high-speed rotating equipment. In my view, the really scary thing is that by altering the payload to use other popular PLC communications protocols and programming commands, this malware could be converted to attack a much broader base of industrial automation systems.

Because they were designed to be general-purpose automation building blocks, PLCs support a range of communication functions that include logic/program downloading as well as data acquisition, plus command and control. Thus, it is not necessary for a cyber attacker to actually infect the PLC with malware. In fact, that would be quite difficult to do since the communication functions don't provide access to the main processor's programming. But, the attacker can re-task the PLC by sending it program logic changes.

[1] Programmable Logic Controllers

This behavior has already been demonstrated with Siemens PLCs, but the same approach could probably be used with virtually any PLC on the market today. We can patch the specific vulnerability used by the worm to infect the MS-Windows workstations, but there are several other well documented vulnerabilities that could be used just as easily. Worse yet, a new vulnerability is found practically every day – most often by the bad guys.

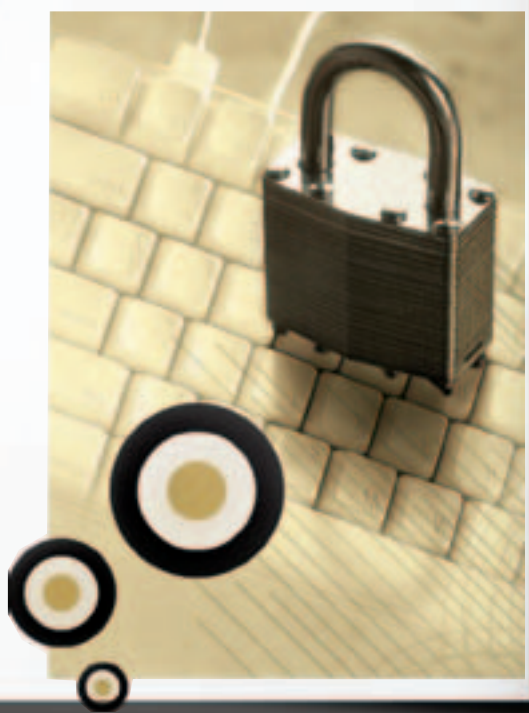
So, we now have seen the first – but probably not the last – malware specifically designed to attack industrial automation systems. This is not the run of the mill malware that attacks any type of system running a version of Windows or Linux that has the specific vulnerability it is designed to exploit whether an accounting system, an operator workstation on a distributed control system or even your own PC. Instead, this malware was highly targeted and specifically crafted for a specific purpose.

Its ability to spread via infected USB thumb drives is especially pernicious since many industrial control systems are "air gapped" in order to (supposedly) keep them safe from attack. In other words, they are not hard-wired into off-premise networks like the Web. Unfortunately, 'sneakernet' – so called 'back doors' into the system used by employees, operators, maintenance staff, etc. to get around firewalls and other security measures – trumps an air gap any day of the week. I have personally seen too many plants where everyone is walking around with a thumb drive in their pocket, and there is no procedure for certifying or scanning them. I have also been told by well-meaning (but poorly informed) plant engineers that the thumb drives were safe from infection because they were encrypted. This just shows that cyber security was not a priority at that plant and that only a token effort was being made to train and educate plant personnel on cyber security issues.

On a related note, I had the opportunity recently to attend an advanced industrial cyber security training course run by the Idaho National Laboratory. This course is an intensive, highly-technical, in-depth look into how hacking occurs and the tools and strategies employed by hackers. From a strictly educational viewpoint, the course is highly informative. It is designed to take the student through a series of lectures and hands-on exercises that demonstrates just how powerful the available tools are for attacking computer systems and how skilled attackers can use known vulnerabilities and security breaches to sneak into even well-defended networks.

The lab has created a simulated chemical company that has an actual web presence, a simulated corporate network, a simulated plant IT network and an actual industrial automation system complete with controllers, workstations and mixing vessels. The simulation includes typical enterprise firewalls at the connection point to the Internet, intrusion detection systems and additional firewalls isolating the plant networks from the corporate network and the plant network from the automation system. In other words, the setup is a surprisingly high-fidelity simulation of what an attacker would see and face if trying to invade and attack a real chemical plant automation system. They even simulate a range of Windows and Linux platforms with differing levels of patching and operating system versions – everything from Windows/NT servers to Ubuntu Linux, just as you might find on a real corporate network.

During the week various exercises allowed the students to try out various hacker pen-testing [penetration testing] software tools and to seek out vulnerabilities and exploit them. A great deal of time was spent playing with the Metasploit framework tools, one of the most powerful penetration testing platforms available today (to both the good and bad guys!). We also played with Nessus and learned about how to be stealthy in order to avoid triggering an intrusion detection system detection threshold.



It was quite a shock to realize how easy – and automated – the process was to locate, scan, fingerprint and attack computers using the available tools. Make no mistake, you have to be a reasonably competent programmer to devise your own tools and 'payloads', even using the Metasploit framework. But using the hundreds of exploits and payloads already in the database merely required knowing a few simple commands… and very little else!

The course included discussions about how to break through the Internet-facing corporate firewall and how to establish a covert communications connection through such as firewall. We learned about exotic payloads, which are bits of executable code or full programs that are inserted into the computer under attack. Such payloads can include powerful hacker tools that let you remotely use the computer you have infected and a platform for attacking deeper into a corporate network. (The term 'pivot' is used to describe a compromised computer being remotely used in this manner.)

We witnessed an attack that first compromised an internal PC by sending a spear-phishing email to multiple corporate personnel with a link to an evil website that planted malware on their PCs. One of those PCs – already inside the firewall – was then loaded with hacker tools and used to scan the internal corporate WAN. The attack continued by compromising a data historian that was allowed to communicate through another internal firewall to its mate on a control system LAN. That led to compromise of an operator console.

The eventual result was that the attackers recorded OPC messages on the control system LAN from controllers to operator consoles and then 'replayed' those messages while attacking the controllers. It was unnerving to see a split-screen display showing tanks overflowing while the operator consoles showed everything to be running normally. Sure, in the real world hard-wired safety/shutdown logic ought to have prevented a disaster, but within the limits of such safety logic you could severely degrade or compromise a batch of pharmaceuticals.

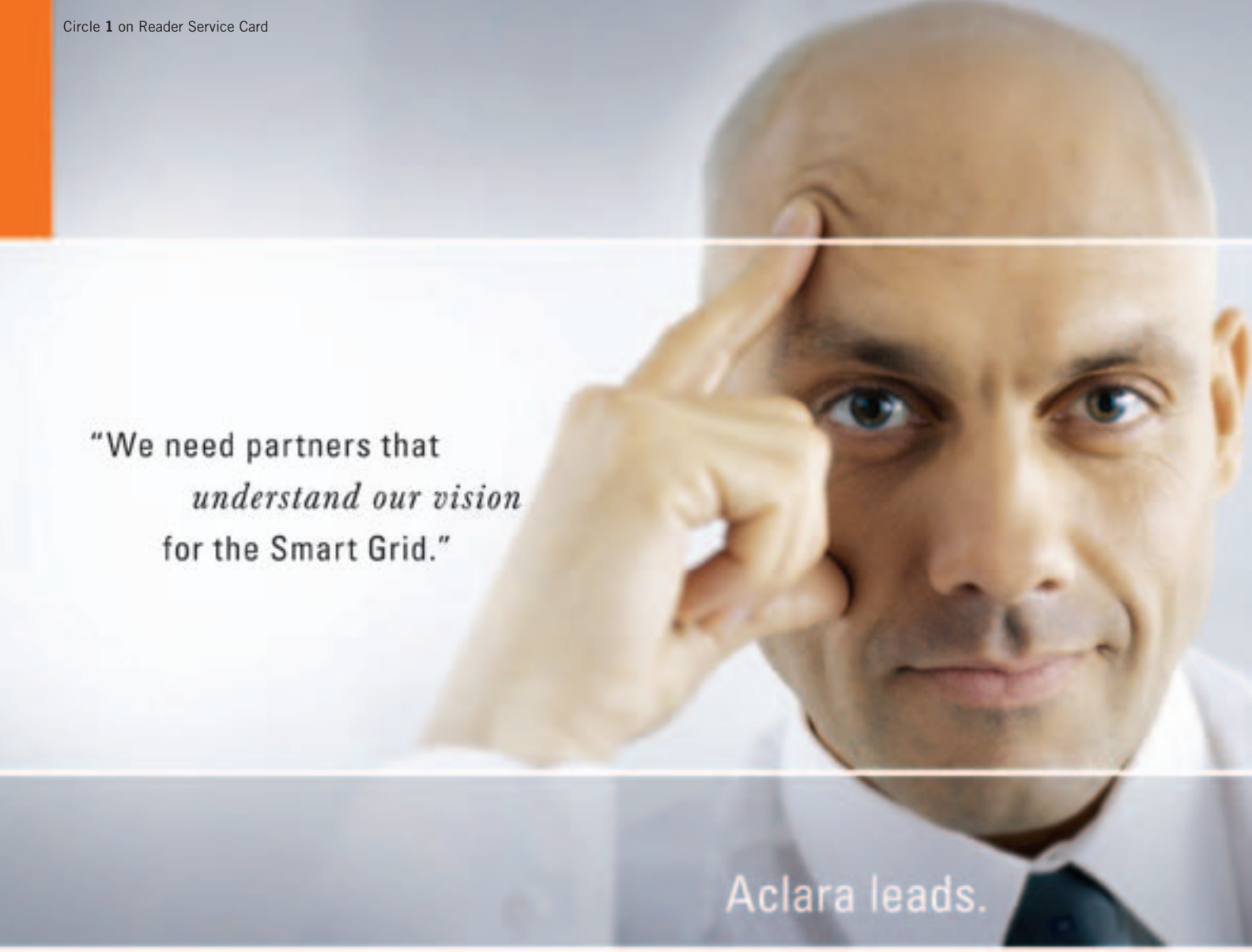
On the last day of the course we were divided into two teams: the RED team was to attack the corporate network and try to compromise the plant automation system. The BLUE team was to defend the corporate networks and systems. I was fortunate to be the leader of the RED team. We had some incredibly skilled people on that team, both from the U.S. military and from the IT world. I got to participate in what could only be called cyber war. The defenders fought with every mechanism they had available to them. In the end the RED team managed to out-score the defenders. It was quite a battle.

The point I am making – and the point INL is making with this course – is that the bad guys have very powerful tools and extensive knowledge of networks and system vulnerabilities. The STUXNET worm underlines this fact. And the moral of the story is that treating industrial automation cyber security as a secondary issue is a huge mistake, and one that could be quite costly. Let me be clear; I'm not a doomsayer, and I don't believe that the bad guys are painting cyber bulls-eyes on all of our industrial facilities. One can safely assume that a plant that makes cat food is less likely to be intentionally targeted than a refinery or a power plant. But that cat food plant could be opportunistically subject to attack by a variation of the STUXNET worm in the future. Would you want to be the owner of that plant with "worms" in your cat food? No, I didn't think so.

To effectively defend yourself and your assets from these threats, you'll need to implement good cyber security policies and procedures, including providing defense-in-depth and comprehensive training of your personnel. As you might expect, there are many ways to protect yourself and maintain a high level of cyber security. But that will have to be the subject matter for a future session… see you in 2011! – ***Tim***

About the Author

William T. "Tim" Shaw (PhD, CISSP) has been active in industrial automation for more than 30 years and is the author of Computer Control of BATCH Processes and CYBERSECURITY for SCADA Systems. Tim has contributed to several other books and is a prolific writer and presenter on a range of technical topics. He is currently a senior security consultant for SecuriCon, an information security solutions firm, based in Alexandria, Virginia. Tim has been directly involved in the development of several DCS and SCADA system products and regularly teaches courses for ISA (International Society of Automation) on various topics. Inquiries or comments about this column may be directed to Tim at *Tim@electricenergyonline.com.*



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