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Electric Energy Magazine is published 6 times a year by: Jaguar Media Inc.
1160 Levis, Suite 100, Terrebonne, QC Canada J6W 5S6
Tel.: (888) 332-3749 • Fax: (888) 243-4562
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Post Publication mail agreement #40010982
Account #1899244

COVER PAGE IMAGE: www.istockphoto.com

Electric Energy T&D MAGAZINE

IN THIS ISSUE

GRIDLINES™

Michael A. Marullo, Editor in Chief

Welcome to the January/February 2009 issue of *Electric Energy T&D* magazine! And, with the beginning of this new year comes lots of new developments and both regular and special features for you, our valued readers.

First of all, you've probably noticed that I've assumed the role of editor-in-chief, effective January 1st. It is both an honor and a privilege to accept the expanded set of responsibilities that go along with providing editorial guidance for such a widely subscribed and universally respected publication. Please know that in my view, the most important of those broader responsibilities is to continue to deliver the high quality content, clear focus and readability you have come to expect from *EET&D* over the years.

As 2009 progresses, you'll be seeing several other changes that I feel certain will deliver an even greater value as both an educational vehicle as well as a way to stay abreast of the latest in electric energy products, systems and services and the companies that provide them. In each issue, we will strive to keep you current regarding the latest business and technological developments while informing you about the various elements that are the foundations and the future of our industry.

So, without going into all of the nuances here, I'll just mention a few of the most pertinent ones, some of which you'll see in the pages of this issue and others that will become more pronounced as the year rolls on…

As we face the simultaneous challenges of an aging workforce and a declining infrastructure, we believe that automation/IT solutions will become more vital than ever and can deliver many of the tools needed to make the 'Smart Grid Initiative' a reality. Therefore, you'll notice that every issue – starting with this one – has a new Smart Grid feature that is broad enough to address the ongoing grid transformation from top to bottom from both business and technological perspectives.

Today and for the foreseeable future, electric utilities are facing what may prove to be the biggest engineering challenge of the 21st century, just as it was at the beginning of the last one. It is undeniably the most onerous task this industry has seen since the initial creation of the power grid roughly a century ago.

With unprecedented demands being placed upon an increasingly outdated, outmoded design, compounded by a substantially 'under-invested' set of assets and equipment, grid transformation really IS a big deal – that much is clear. But how we get there is an entirely different matter – one that will require innovation, initiative, imagination and, of course, lots of time, money and other resources. As things progress, be assured that you can count on *EET&D* to help point the way forward.

In this issue, we jump start our Smart Grid focus with articles about such pertinent, top of mind issues as Security (Part 2 of our 2-part series, initiated in the Nov/Dec 2008 issue); Interoperability & Advanced Network Management; Phasor Measurement Units (PMUs), leading the way toward vastly improved state estimation and grid stability; and an eye-opening piece on how to avoid communications violations, which can result in hefty fines if FCC licensing rules are not followed properly and precisely.

Another new dimension of *EET&D* for 2009 is the *LightsOn*™ feature, which focuses on companies and technologies that are making tangible contributions to improving reliability and sustainability – the things that are truly instrumental in keeping the lights on! We have some other things planned for this feature in 2009 and beyond that will be introduced in the coming months, so please stay tuned. Meanwhile, an article on Advanced Metering Infrastructure and Demand Response headlines this first installment of *LightsOn*™.

We are also embarking on the third year of our popular Automation/IT Leadership Series. My interview in this issue is with SAP and has a rather interesting twist that sets it apart from all of our prior interviews – check it out; it may surprise you.

This issue also contains the second installment of our Executive Directions series, which spotlights the various professional associations serving the electric utility industry. Wanda Reder, President of the IEEE Power & Energy Society, is featured in an interview that among other things, provides insights about the recent name change from "Power Engineering Society" to "Power & Energy Society"; how PES is helping to deal with aging workforce issues and the role of IEEE-PES in the transformation to a smart grid, plus a whole lot more. I think that PES members and non-members alike will gain valuable insights about the Society from Wanda – clearly one of the most dynamic, knowledgeable and dedicated power engineering executives of our time.

I'd also like to mention that *EET&D* sets the benchmark for editorial content, devoting more space to individual editorial features than any other publication serving the electric energy T&D marketplace. That means that when you read a story in *EET&D*, you can be assured that you're not just getting an abbreviated version that leaves out important details due to space limitations. Instead, you'll always get an in depth treatment of the subject matter at a level that is easy to read and comprehend and augmented by eye-catching visuals designed to support and enhance the written word.

Finally, we have also completely redesigned our online eNewsletter. If you're not already among the 50,000+ readers that receive their cutting-edge news, job information and key industry events from *ElectricEnergyOnline.com* twice weekly (Monday & Wednesday), you can quickly and easily gain access by setting your browser to *www.electricenergyonline.com*.

I'll save some other exciting announcements for our next issue, but you can be sure there's a lot more in store. As always we welcome your comments, ideas and suggestions. Have a great year! **– Mike Marullo**

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Electric Power Utilities Plan to "Stay the Course" with Projected Capital Spending Plans for Transmission and Distribution

The views of more than 110 leading utilities in 37 countries remain largely upbeat for continued investment in electric power infrastructure and "smart-grid" related automation projects.

Ellicott City, Maryland – In spite of the weakened economic conditions in countries around the world, electric power utilities are proceeding with investments in both their infrastructure and "smart grid" automation programs. The majority of the surveyed large public and private utilities are poised to continue their long-term capital investment programs as had been originally planned in January of 2008.

In a new study released today by the Newton-Evans Research Company, a significant majority of the 110+ officials from 38 countries participating in the just-completed study indicated that capital spending for control systems, substation automation, smart gridrelated programs, distribution management, advanced metering rollouts, and infrastructure equipment for transmission and distribution grids will remain as originally projected a year ago. The one area with the outlook for most significant downward change in capital expenditures was "distribution infrastructure." On the upside were planned increases for advanced metering infrastructure (AMI) initiatives and for new or upgraded grid control and monitoring systems.

The total amount of capital spending for transmission and distribution of electricity by electric power utilities around the world is currently estimated by Newton-Evans to be in the range of $90-$105 billion. The 2009 outlook overall is trending toward that same range of spending.

Four key reasons for the continued relatively strong investment in transmission and distribution of electricity are: 1) regulatory pressure and mandates for service reliability improvements; 2) smart grid initiatives aimed at modernizing the power grid infrastructure and enabling energy efficiencies; 3) obsolescence of existing equipment; and 4) long-term investment view being necessary to accommodate future growth in electricity consumption. Frequently, utility capital projects are complex and multi-year in nature, so project deferrals are often out of the question, even when the overall economic outlook is poor.

The study includes feedback sections on investment plans for seven key areas and is further detailed by world region and by utility ownership type and size. Operations and maintenance budget plans are also reviewed. The 85-page report is priced at $395.00, and can be ordered online and downloaded from the Newton-Evans web site.

Additional information about the report "Global CAPEX and O&M Expenditure Outlook for Electric Power Transmission and Distribution Investments: 2009-2010" is available from the Newton-Evans Research Company's web site (*www.newtonevans.com*)

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Manitoba Hydro hosts 3rd annual CIGRÉ Canada conference

Bob Brennan (President & CEO), member of CIGRÉ Canada Executive, gives opening remarks at the international conference which was held in Winnipeg.

This year over 260 delegates from across Canada and from countries such as South Africa, Italy, Russia, Mexico, Poland, Japan, China, Sweden, Portugal, and Germany attended the CIGRÉ Canada Conference held in Winnipeg, October 19 to 21.

CIGRÉ (Conseil International des Grande Réseaux Électrique) is a French acronym that translates to International Council on

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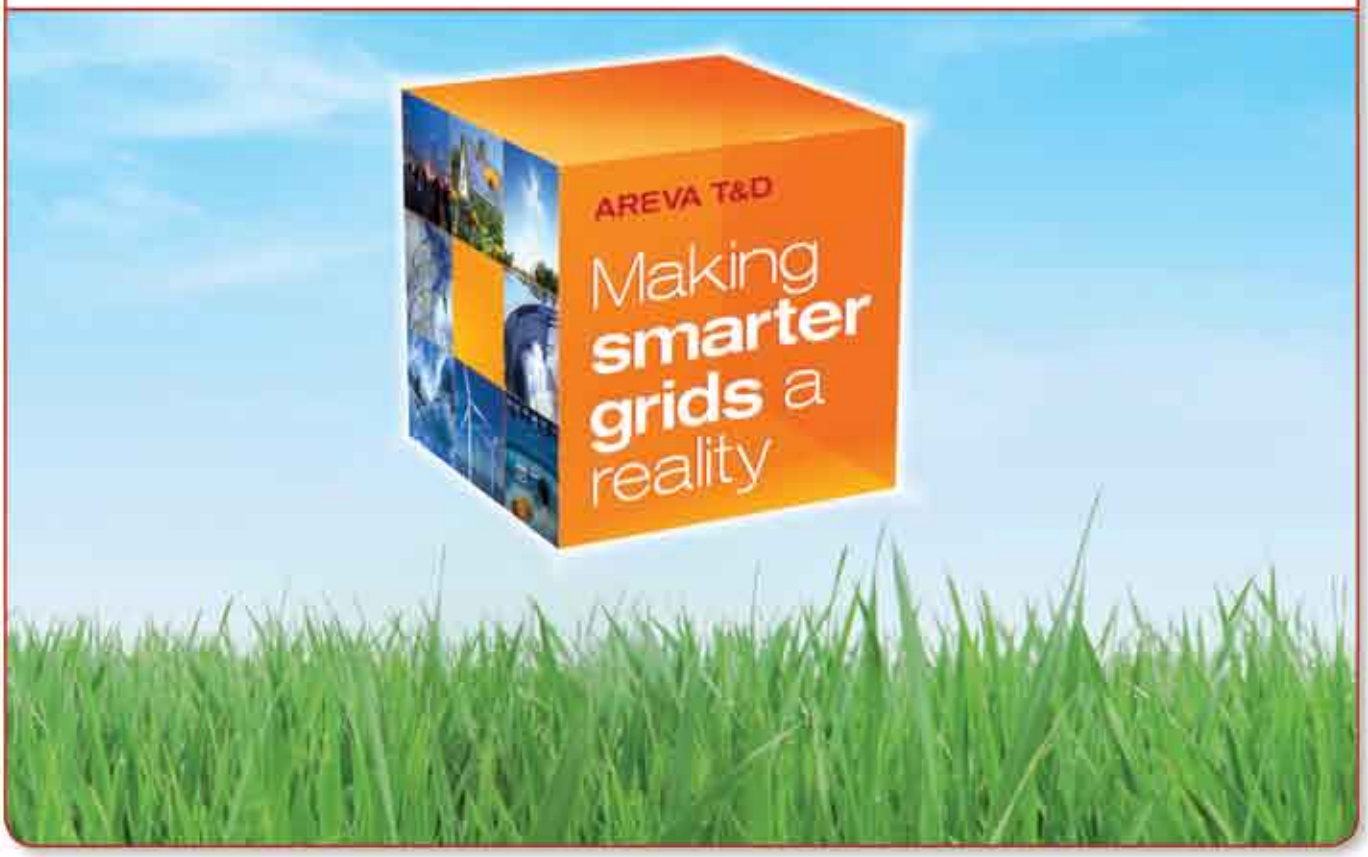

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Large Electric Systems. It is an international association based in France with members in over 80 countries. Its aim is to facilitate and develop the exchange of engineering knowledge and information between all countries with regard to generation and high voltage transmission of electricity.

Delegates to the conference participated in a program that focused on the technology and innovation in the Canadian power grids of the future. The conference opened with a panel of executive leaders who shared their perspectives on the emerging Canadian power sector. Throughout the two days, over 70 technical papers were presented on a wide variety of topics ranging from wind reliability and forecasting to substation equipment and design. A technical exhibition hosted by Hydro was also part of the event.

"Our industry has changed so much over the last 10 to 15 years," said John McNichol (Division Manager, HVDC) who is chair of the organizing committee. "It is the responsibility of the electric utility industry to remain in synchronism with these changes, and in fact try to stay ahead of them — this conference was intended to be a step in that direction."

Delegates participated in a program that focused on the technology and innovation in the Canadian power grids of the future.

Manitoba Hydro employees were instrumental in organizing this highly successful conference. Apart from John McNichol, organizing committee members include David Jacobson and Hilmi Turanli (both System Planning), Zibby Kieloch (Transmission & Civil Design), and Kelly Monkman (HVDC).

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ABB Inc. appoints new executive to key sales and marketing position in Canada

Montreal – ABB, the leading power and automation technology group, - announced that Greg Farthing recently assumed the position of Vice-President, Sales and Marketing, Power Products and Power Systems. He replaces Jean Guay, who has been appointed Vice-President, General Manager of the Power and Industrial Systems business.

"Greg possesses an extensive portfolio of expertise and experience," said Sandy Taylor, President and CEO, ABB Inc. "His vast knowledge of ABB's utility and industrial customers, together with his experience managing transmission, distribution and power generation projects, will serve as a vital asset to ABB and will help boost our business to new levels."

"I am delighted to be joining a multinational organization like ABB, which is recognized as a world leader in providing transmission and distribution solutions," emphasized Mr. Farthing. "I fully support ABB's aggressive growth strategy, particularly in Western Canada where we are actively expanding our presence and capabilities. My goal is to continue building on our strong relationships with utility customers and to demonstrate to our industrial customers how our proven integrated solutions can help them increase productivity and energy efficiencies.

Mr. Farthing brings over 20 years of professional experience providing technologies and services to the energy sector to ABB. He will report directly to Mr. Taylor, and will be based at ABB's corporate office in St-Laurent, Quebec.

Mr. Farthing is an active member of the Institute of Electrical and Electronics Engineers, the Canadian Institute of Mining, Metallurgy and Petroleum, and the Canadian Wind Energy Association.

ABB (*www.abb.com*) is a leader in power and automation technologies that enable utility and industry customers to improve performance while lowering environmental impact. The ABB group of companies operates in some 100 countries and employs approximately 120,000 people. In Canada, (www.abb.ca) ABB employs over 2,400 people in 40 locations from coast to coast.

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Thomas & Betts Appointments

Mr. John Sencich, Vice President, Utility & Other, Thomas & Betts Canada is pleased to announce the following appointments:

Jean-Marc Théorêt
National Sales Manager, Utility Products

As National Sales Manager, Utility Products, Jean-Marc's role has recently been expanded to include sales and marketing for Joslyn™ Hi-Voltage and Homac® protection and control products in Canada.

In addition to these products, Jean-Marc will continue to be responsible for sales and marketing of Elastimold® switchgear and pre-molded connectors, Fisher Pierce® distribution products and Hi-Tech® high-voltage, current limiting fuses.

Jean-Marc can be reached at (450) 466-1102, ext. 234.

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Steve Santek

National Sales Manager, Protection & Control Products

Reporting to Jean-Marc Théorêt, Steve Santek has assumed responsibility for Canadian sales of Thomas & Betts Protection and Control products including the Elastimold® and Joslyn™ Hi-Voltage brands. Steve can be reached at (514) 631-6145, ext. 226.

Rick Humphrey

Manager, Sales & Market Development – Steel Structures

A member of the Thomas & Betts family since 1976, most recently as Industrial Sales Representative. Rick is now responsible for sales and marketing of Meyer® steel transmission structures in Central and Western Canada. Rick can be reached at (905) 286-3782

Peter Donaldson will continue to cover Quebec and Eastern Canada and can be reached at (514) 952-5558.

Frédéric Bougard

National Sales Manager - Communications

In this newly created position, Frédéric will be responsible for all aspects of sales and marketing of the Thomas & Betts product offering to the growing Canadian CATV, telecom and security markets.

Prior to this new appointment, Frédéric was Sales Representative – Communication Products. Frédéric can be reached at (450) 466-1102, ext. 424.

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Sensus Launches New Brand Identity

Overhaul reflects global leadership position

Raleigh, NC – Sensus has announced the release of a new brand identity to better demonstrate the company's global leadership position in providing a full range of technologies and services to help the utility industry be more efficient.

"Sensus has a long history of leadership in service to the utility industry, an industry that is changing fast and has higher expectations of us than ever before," said Peter Mainz, CEO and President of Sensus. "This new brand identity helps us better define for our customers how we will help them measure up to their future challenges."

The "marble" logo and the words "metering systems" are gone, leaving only the word "SENSUS." This will be accompanied by three horizontal bars above the "E" of Sensus to reflect communication and transmission of information. The colors used are blue and green. Blue is a traditional Sensus color and represents the company's long history of service to the utility industry. Green represents Sensus' role in and commitment to sustainability and resource conservation.

"As the utility industry has evolved, so have we," Mainz said. "We long ago moved beyond simply being a meter manufacturer and are a leading technology provider to help utilities build and implement smart grids and other measures that help make them – and their customers – more energy efficient. Our name and logo represent the kind of technological leadership that is needed to transform the utility industry: Information-driven solutions, clarity, vision and precision."

A new tagline paired with the graphic element – The Measure of the Future – also reflects Sensus' position in the utility industry as a global leader aggressively pushing the boundaries of utility management with innovative technologies and communication systems that enable customers to intelligently utilize their resources with unprecedented efficiency.

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"This statement, 'The Measure of the Future' captures the potential of who we are and what our impact is on the industry," Mainz said. "We already are taking the concept of smart grid out of white papers and making it a reality today, and we will continue to develop advanced technologies into the future to benefit the entire utility industry and their end customers."

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Initial phase of a Smart Grid technology pilot project Complete

In January, OG&E Electric Services, a utility serving 765,000 customers in Oklahoma and western Arkansas, and smart grid infrastructure experts Silver Spring Networks completed the initial phase of a Smart Grid technology pilot project, Positive Energy® SmartPower, involving the deployment of Silver Spring Networks' advanced network infrastructure the Greenbox energy management web-based portal in 25 homes in northwest Oklahoma City. OG&E also installed meters connected to Silver Spring Networks' advanced technology in about 6,600 apartments to allow remote initiation and termination of service.

OG&E selected northwest Oklahoma City due to the area's historically high number of service calls, approximately 10,000 per year. Using Silver Spring Networks' networking infrastructure, OG&E was able to respond to service requests and remotely reconnect service during outages in under 10 seconds. Previously, the process required a field representative to visit the location to obtain a reading and complete maintenance on the meter. By partnering with Silver Spring Networks and Greenbox Technology, OG&E allowed participants to better manage their energy consumption by helping them view real-time information about pricing and energy demand and adjust habits accordingly.

"We are extremely pleased with the results," said Craig Johnston, OG&E Vice President of Strategy and Marketing. "We will present a plan to the Oklahoma Corporation Commission for a larger project that will help determine how our customers and OG&E can achieve maximum benefit from the Smart Grid."

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How Integrating Demand Response and AMI Impacts Utility Customers

By Kevin T. Cornish, Director of Technical Support
Aclara

Demand response has become a headliner in the current utility and regulatory lexicon for a number of reasons. State regulators are mandating that utilities examine how demand response programs can reduce or shave peak loads as opposed to building additional generation. Regulators are in turn being pressured by federal legislation to pursue time-varying rates and support smart metering and smart grid activities. What's more, utilities continue to be internally driven to improve efficiency through technological innovations such as demand response. Yet, the success of demand response programs rests extensively on residential and small commercial consumers who generally know little about their energy use, have not traditionally had tools to understand the link between their lifestyle and energy consumption, and cannot fathom what the difference between a kWh and kW is and why they should care.

So, why should they care? Simply stated, demand response programs are less expensive for customers than the alternatives. During peak system or regional loading events the increasingly deregulated electricity market will increase the price of energy, so it is less expensive for the utility to reduce load as opposed to buying energy on the open market. Demand response also can improve the reliability of electric service during times of peak loading when high demand can result in localized or widespread system failure. Whatever the reason, demand response can help society and the utilities meet the challenges of today's evolving utility landscape.

Much has been written on the actual definition of demand response, and although the specifics may vary, it is generally agreed that it incorporates pricing programs, customer-enabling technologies, or efforts to encourage short-duration load reduction during specific periods of peak energy usage. The demand response programs being designed today are either based on new critical-peak-pricing (CPP) tariffs or other technology-enabled pricing programs. Most discussion on the subject has been relatively academic or exploratory, as only a limited number of demand response programs have been fully implemented.

The limited experience does not mean that results are theoretical or unproven. There is a significant amount of available information from pilots, customer trials, and initial implementations that have all supported the position that mass-market customers -- given appropriate pricing signals and/or enabling technology -- will provide the demand reductions required by utilities to make these programs effective and reduce the need for operating or construction of expensive and environmentally impactful new generation assets. It should also be noted that when the narrow definition of demand response that is commonly used today is expanded to include traditional air-conditioning cycling and older demand-side management programs, the industry has significant experience in how customers respond to load-management programs.

One of the main differences between the core objectives of advanced metering infrastructure (AMI) initiatives -- as compared to automated meter reading (AMR) objectives -- is the ability to deliver timely high-resolution energy usage information to consumers, allowing them to understand their consumption patterns and the connection between appliance use or lifestyle decisions and cost.

One of the main differences between the core objectives of advanced metering infrastructure (AMI) initiatives -- as compared to automated meter reading (AMR) objectives -- is the ability to deliver timely high-resolution energy usage information to consumers, allowing them to understand their consumption patterns and the connection between appliance use or lifestyle decisions and cost. This information is normally in the form of hourly data for residential and small commercial customers and 15-minute data for large commercial and industrial users. After being provided just a single monthly usage value and corresponding bill for so long, it is imperative that utilities not underestimate the enormous transition that consumers be facing when they are asked to modify or reduce their energy consumption as well as react to pricing changes from the utility.

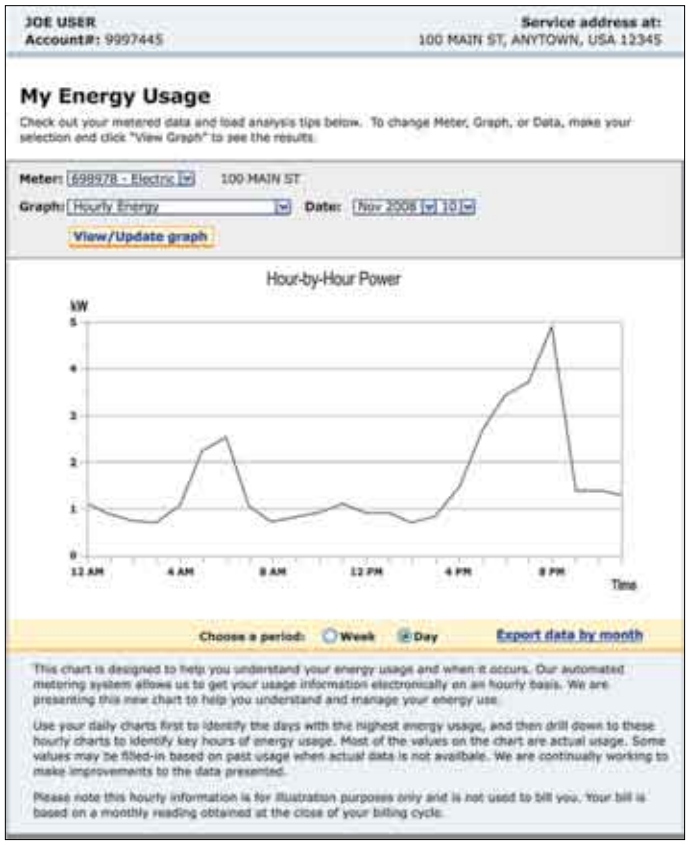

Figure 1: Aclara software presents hourly usage rates to customers of PPL Electric Utilities.

Success Requires Customer Participation

Demand response programs all depend on utility-customer participation to deliver the benefits that are envisioned. Yet, how involved does the "average" residential customer wish to be? Is the average residential consumer more concerned with reducing monthly energy cost or being environmentally conscious by reducing their carbon footprint? How intrusive can the enabling technology be without impacting the consumer's comfort? Do consumers want the utility to control the operation of the demand response devices or have control over their consumption reduction? The customer's acceptance will ultimately determine the success of the programs, which could well be based on regional demographics.

Given the significant emphasis that utilities and regulators have placed on getting AMI programs implemented, one would expect to see a significant amount of demand response programs in existence that are based on using the available AMI interval data to support CPP programs or similar innovative alternatives. Unfortunately, this is not yet a widespread reality. While there are CPP programs being implemented by investor-owned utilities such as Southern California Edison, Pacific Gas & Electric Company, and Dominion, the large scale and industry-wide launch of these programs is waiting for the availability of the smart meter systems required to collect and manage the interval data.

Presenting Customers with Usage Data

Interval data, which is the core deliverable of AMI, is essential for customers to participate in demand response programs. Interval data provides customers with information on their consumption patterns and shows them the impact of their actions. A noteworthy example of the use of interval data, and the largest effort of its kinds to date, was undertaken by PPL Electric Utilities of Allentown, Pennsylvania, which recently announced that it is making interval data available to its 1.4 million electric customers. The data is presented on a website using software from Aclara that helps them understand how they are using energy.

Figure 1 illustrates the presentment of the hourly data that a residential customer of PPL Electric Utilities might receive when a smart meter is installed and the data made available to the customer via the utility's web portal.

Usage data can be presented in several formats. Data can be shown in actual energy-consumption values such as kWh. Most people in the energy industry like this approach because it is more common and traditional. However, energy-consumption values are generally meaningless to the average residential customer. Unless they understand energy units and can convert these units to dollars and then compare against their perceived benefits, the ability for the average residential customers to make intelligent decisions using this data is nominal.

One way to help consumers understand energy usage is to describe it in dollars – a measure that the consumer can understand and evaluate -- as opposed to engineering units, which are far less meaningful or relevant to the average consumer. It also provides a direct connection between the information being presented and the eventual bill the customer will pay.

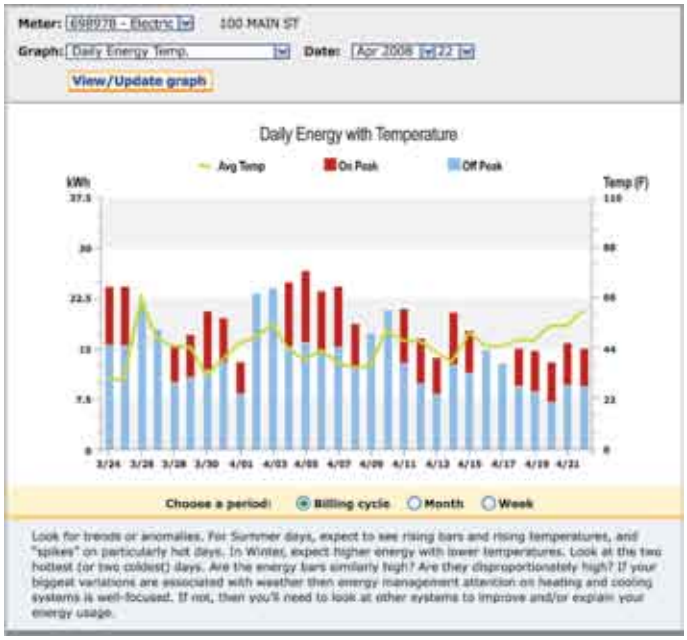

Figure 2: Consumers understand consumption better when given time-based information as well as usage data.

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Usage data also needs to be matched with the appropriate rate structure to which the customer is assigned. Traditionally, most residential electric customers are on flat or inverted-tier rate structures. As the industry transitions to more appropriate time-based rate strategies and interval metering data is available to support these strategies, the presentation of the data must match the customer's rate profile. **Figure 2** adds the date, or time of use (TOU), to the underlying interval data, highlighting periods when the customer experienced the highest cost for energy. **Figure 3** adds CPP to the TOU rate structure.

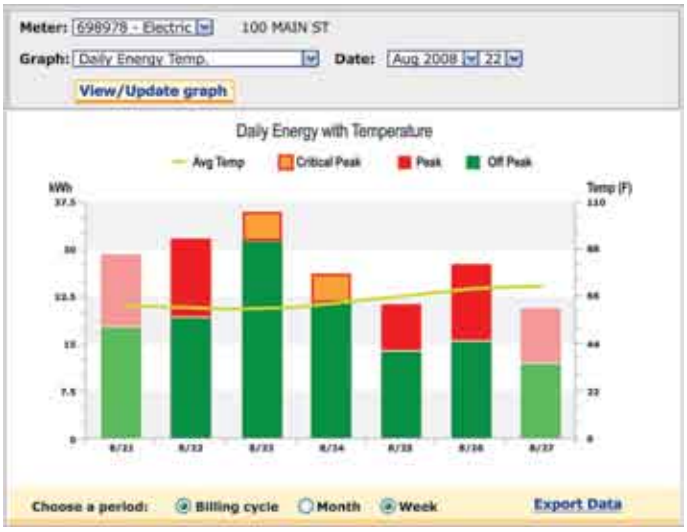

Figure 3: The most common rate approach that utilities are examining in support of demand response combines CPP and TOU rate structures.

Rate design is critical to modifying consumer behavior. Program results have shown that improperly designed time-based rates do not send the appropriate signals to customers, nor do they provide the financial incentives to encourage reduced energy consumption. However, it is difficult to create rates that are not punitive but do reflect the anticipated costs for electricity generation in various time categories. Many regulators also want new rates to be revenue neutral, which could be counterproductive to the ultimate goal of incenting consumers to reduce load during peak periods, since revenue neutral rates may not accurately reflect the true cost of energy being consumed during high-demand periods.

Analytical Tools Necessary for Acceptance

Since industrial and commercial customers have enjoyed the availability of interval metering for many years, an entire industry has developed to assist the plant and facility management business with obtaining, analyzing, and understanding their energy use and providing effective options to reduce costs through equipment replacement, lighting retrofits, and other energy-reduction techniques. Residential and small commercial customers do not need this level of sophistication, but they do require interval data and analytical tools to make effective choices.

Studies have consistently indicated that when consumers are provided with detailed energy-consumption information and tools to understand their use, there is a statistically significant overall reduction in load. This energy-conservation effect should be repeated in the area of demand reduction by further educating consumers about their usage patterns during peak periods and by providing analytic tools and technology to reduce their demand.

Many utilities have been using bill presentment programs that provide powerful yet easy-to-understand analytic tools for customers to disaggregate their energy consumption into specific usage buckets. This provides the end-use consumer with the ability to understand the components of their bills and make energy conservation choices, as in **Figure 4**.

Over 240,000 customers of PPL Electric Utilities have taken advantage of this tool to better understand their energy use in preparation of being exposed to time-based rates once the rate caps in Pennsylvania are removed in 2012. The next step is likely to be the use of the actual customer interval data to provide more refined profiles and analytics as well as an extension of the analytic tools to highlight activities that will have the most impact on demand response efforts.

Enabling Technologies for Demand Response

There has been a tremendous amount of work in the industry related to the technology enabling systems required to support demand response. Home-area networks (HAN) are envisioned to enable controllable thermostats, consumer display devices, load- management nodes and other customer-premise devices that will automatically take actions to reduce load. Much has recently been written about the impact that these technologies could have, and pilots have conclusively shown that automated controls triggered by pricing signals may have a significant impact on load. However, industry should not have to wait for the ubiquitous availability of the HAN-based devices in order to enable innovative customer-focused demand response programs.

Figure 4: Analytical tools utilize load profiles and specific user appliance and home data to translate monthly consumption into disaggregated usage components.

Effective solutions exist today that combine interval usage data available from AMI systems with load-control devices. In these systems, the AMI networks create technology-enabled pricing programs. The consumer can choose which appliances to enroll in the utility-managed programs and enable the utility to manage these loads during critical periods to both reduce the utility system load and the impact on the consumer's bill. One example of this synergy is a recent analysis by Rappahannock Electric Cooperative, Fredericksburg, Virginia, that concluded the cooperative had saved more than $50 million for the utility as well as generated savings for their customers with a hybrid load-management system. In this system, customers signed up to have the utility place a load-control device on their water heaters that could be remotely controlled by the utility through the AMI solution.

In addition to providing consumers with an understanding of their energy usage, interval data can be used to provide confirmation that the anticipated load reduction from the enabling technology was received. Rather than accumulating just device operating statistics, the reduction in actual load provides the "bottom line" answer to how the system is performing. In aggregate, the load data for all of the customers using a particular time-base rate or specific enabling technology will provide performance information to the utility for planning or future distribution needs. In particular, the interval data provides important information to individual customers on how they performed during CPP events or other specific periods. This feedback is extremely important in terms of both demand response system performance and customer satisfaction.

There are many questions to be answered and program designs that require more investigation. The industry does not yet understand what level of involvement most people will want to have in the management of their energy use. Will the average consumer, once they have a better understanding of how they use and what demand-reduction changes that they are willing to undertake, pay attention to the available information or be interested in continuing to tweak their energy use? How will the desire to reduce carbon footprint impact both energy conservation and demand reduction? What are the most effective ways to communicate with consumers? The key to all of these and other issues is that the industry must ensure that the focus of the debate is on the customer – for it is this group that will accept the challenges in understanding the information presented and take the actions on which society is depending. ■

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About the Author

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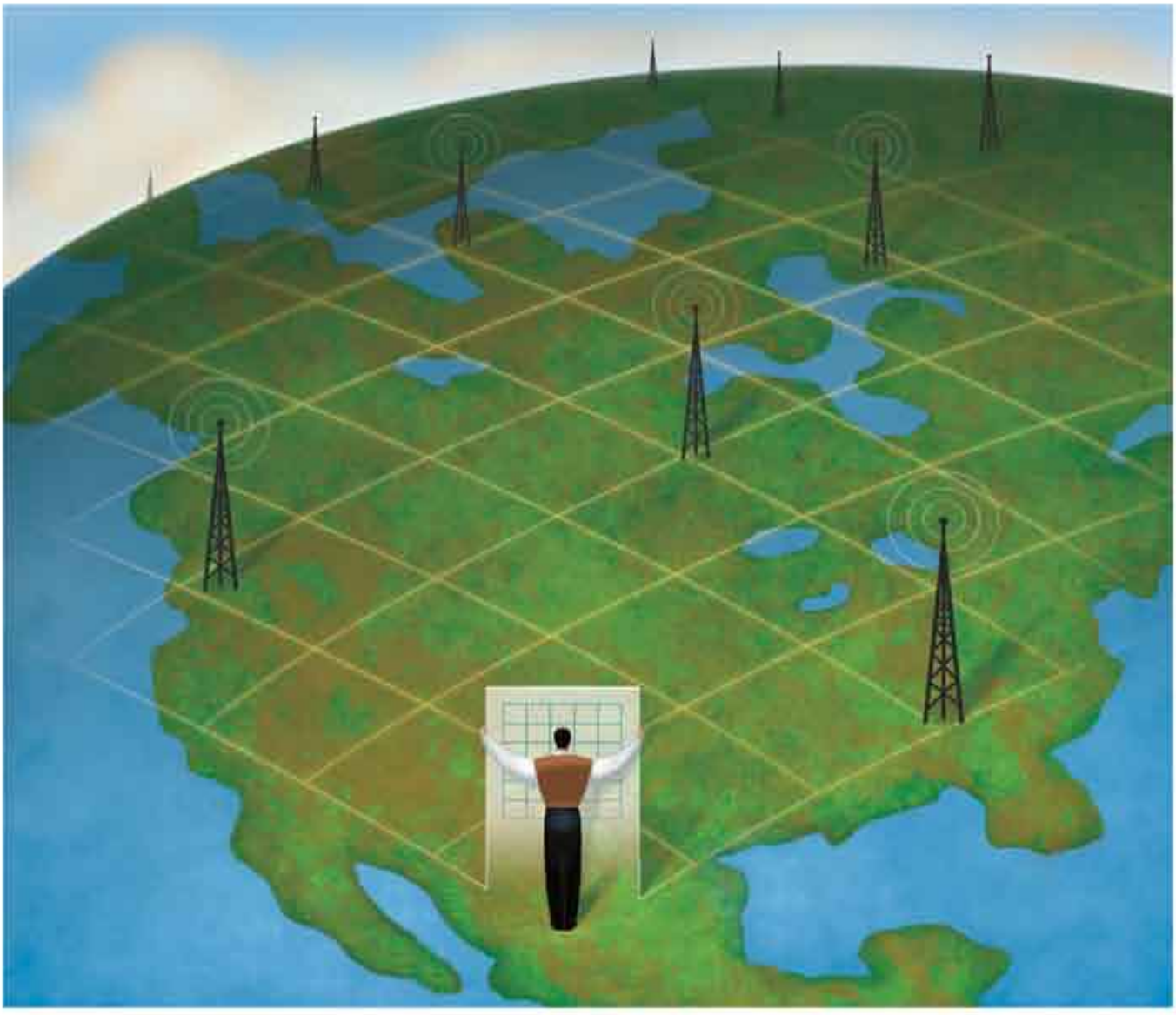

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SENSUS

Maureen Coveney

The 2009 Automation/IT Leadership Series

SAP

Maureen Coveney
Industry Director, Utilities; SAP America Inc.
Cathy Tough
National Director, Utilities; SAP Canada Inc.

Cathy Tough

As we enter into a new year, we also cross into new domain of sorts. For the first time since we began the Automation/IT Leadership Series in January 2007, both of the featured executives are women. Besides underscoring the increasing accomplishments of women in business, SAP's North American Energy & Utility strategy and execution is effectively divided between them, presenting a unique opportunity to better understand what we might expect from this prominent industry leader in the coming year.

– Mike Marullo

EET&D: Much has been written about the aging workforce issues this industry faces. Among the most formidable problems bearing down as Baby Boomers retire is the severe shortage of qualified power industry engineers and computer scientists. As two women that have achieved significant stature in what has historically been a male-dominated industry, what advice would you give to women contemplating a career in the energy/utility sector?

Coveney: I would advise anyone considering this sector to seek a position that challenges them. There is so much going on in utilities today and so many areas of focus – it is certainly a "buyer's market" with respect to roles women could and should consider in a utility. To reinforce this notion, for the past few years, SAP has hosted "Women in Utilities" networking sessions at SAP-led events such as SAPPHIRE (SAP's annual customer conference) and the SAP for Utilities North American Conference, as well as industry trade shows like CS Week. Women from utilities and utility suppliers flock to these events to establish industry connections and to share how they have approached problem-solving in the world of utilities. It is wonderful to look around those rooms and see women working together to their mutual benefit and to the benefit of their utilities.

Tough: I have worked in the utility industry for over 25 years, the first 15 in the industry and now on the supply side. The face of the utility industry has undergone tremendous change – we now see more women having key decision-making roles in utilities. Today, it is not uncommon for a CEO, CFO, or CIO within a utility to be a woman. Similarly, within SAP Canada, you will find women at all levels of the organization, working within the utilities sector.

I believe utilities are focused on finding people with the right education, skills and passion to drive the changes to ensure continued growth and success – regardless of gender. It is an exciting time to work in the utility industry. We are at the beginning of the transition to the utility of the future and women will find challenging and rewarding careers in this sector.

EET&D: Obviously, there is a tremendous amount of change already ongoing, and there seems to be more on the way. Some people see these as exciting times while others see it as a crisis, and utilities are certainly included in that mix. Would you say that utilities have fundamentally changed the way they run their businesses today compared to a decade ago?

Coveney: Utilities are looking to deploy integrated, scalable, affordable and proven technology that can help them better manage their business processes, reduce costs, achieve regulatory and environmental compliance and support their growth. That part is nothing new, but I think they see greater value today in deploying an "enterprise" solution versus a "best-of-breed" solution. Customers are looking to simplify their business and information technology (IT) landscape and are putting greater pressure on their supply chains to support their business needs as standard product versus going the route of custom-build that has been so prevalent in the past.

Both large and small utilities alike are looking to standardize their business processes and IT landscapes as a means to lower their operating costs and total cost of ownership. Smaller utilities are thinking out-of-the-box to lower costs and mitigate risks by leveraging industry best practices and sharing services and infrastructure costs with their peers.

EET&D: Cathy, would you like to add anything to that?

Tough: Yes, utilities today also have more aggressive market demands from regulators looking to increase consumer transparency to energy prices, from consumers looking for new and expanded service channels to fit better with their lifestyles (e.g., self-services) and from investors looking for a better rate of return. To help utilities meet these demands – whether in a regulated or deregulated market – utilities need smarter technology such as advanced metering infrastructure (AMI), mobile workforce management, customer self-services and intelligent network management.

EET&D: What kind of solution attributes should utilities be looking for to help solve these problems that are perhaps different from those we've seen employed in the past?

Tough: Utilities should be looking for a holistic set of business solutions that support the critical business processes of electricity, gas, and water utilities in regulated, in-transition and deregulated markets. Moreover, they should be built on a solid foundation of core utility-specific applications for enterprise resource planning, enterprise asset management and customer relationship and billing management, as a minimum. The platform employed should embrace an open integration model that integrates disparate software systems to reduce IT complexity and that leverages existing IT investments/infrastructure to lower the total cost of ownership. The platform must also be highly scalable and able to support utilities as their needs change and their businesses grow.

EET&D: Are there any new kinds of solutions that you see gaining momentum in North America?

Coveney: In particular, we're seeing increased focus on applying the existing portfolio of enterprise solutions in different and beneficial ways. A good example of this among utilities in the U.S. is an area we call rate lifecycle management (RLM), the process by which utilities maximize rates of return by aligning corporate strategies with rate strategies.

EET&D: Could you please elaborate on exactly what you mean by this term, Rate Lifecycle Management?

Coveney: Sure. As we see it, RLM encapsulates three principal activities, which include:

- assessing the utility portfolio of potential capital projects and determining which projects are in the best interest of utility customers, what the cost recovery mechanism will be and over what time frame (building the case and determining the correct rate);
- managing the process of taking the case from the idea stage through formal approval by a regulatory body (defending the case); and,
- implementing the approved rate, which includes monitoring and reporting on the project and the associated rate throughout the life of the rate (monitoring the rate).

EET&D: What are some utility pain points that can be addressed by RLM?

Coveney: Utilities face a constant balancing act trying to manage a portfolio of competing projects and external pressures and determining how to spend money wisely. For example, utilities have significant capital expenditure initiatives such as laying the architectural groundwork for the Smart Grid, provisioning alternative energy supplies, building out the transmission and distribution network, as well as performing asset refurbishments or replacements.

They must translate these initiatives into rates that their customers and their regulatory agency (e.g., local PSC/PUC) will support. The lack of a centralized and integrated framework prevents optimal decision-making. The RLM process draws on a complicated set of data (e.g., enterprise data, operational data, spreadsheets, etc.)

that can prevent utilities from developing adequate models and performing "what if" analyses most effectively. This, in turn, can limit the potential for the case and, ultimately, the rate.

Often, this means that utilities end up with actual earning levels that are below their targeted rate of return. Because utilities have a limited number of resources to prepare and manage cases and report on rates once implemented, it is imperative that they get it right the first time. A well-articulated RLM process leverages a utility's investment in financial tools, enterprise resource planning, document or record management, as well as billing and business intelligence.

EET&D: That sounds like a lot of work and invested resources, so it seems like there would have to be a big payoff at the end to justify it. What are some of the key business benefits of a well articulated RLM business process?

Coveney: The rewards are actually quite significant. With RLM, a utility can prioritize capital projects and reduce costs by aligning business strategy and execution. It can maximize business visibility with clear insight into key processes while also increasing agility by optimizing the RLM process. It can also improve rate model accuracy by automating and controlling rate lifecycle processes and enhance relationships with regulators and other key stakeholders by providing electronic documentation to facilitate the review process. Finally, RLM allows a utility to make faster, more incisive strategic decisions based upon a foundation of consistent and reliable enterprise data.

EET&D: How do you view RLM in the context of the "Utility of the Future"?

Coveney: For quite a few utilities, RLM is a necessary step on the road to transforming into what many are calling a "utility of the future." The utility of the future is doing the things we discussed at the start of this conversation – they have large initiatives like implementing advanced metering infrastructure (AMI) technologies. To get there, they must consider how best to fund these transformative projects. To the extent practical, the streamlined RLM process will serve as a business and project accelerator.

EET&D: You bring up AMI as a case in point, Maureen. Assuming that a utility can successfully recover its costs through an RLM process, how do Canadian utilities think about AMI as a transformative initiative, Cathy?

Tough: Canadian utilities are increasingly focusing on advanced metering infrastructure (AMI) technologies, which enable automated, real-time communication between back-office solutions and the field. AMI helps utilities innovate business processes for sales and customer service while optimizing revenues and demand. AMI delivers cost-effective customer service and increases efficiency. With AMI, utilities can send price signals to the meter in the home so consumers know the price they are paying for energy at any point in time and can adjust their consumption patterns to take advantage of lower prices.

AMI also enables utilities to read meters remotely on demand, eliminating incorrect readings and reducing travel time and costs. It can help utilities design pricing programs and bill services based on actual consumption data, which can be gathered in small time increments, enabling time-of-use pricing programs. Finally, AMI automates the transfer of energy data and better manage customer service inquiries and disputes by accessing up-to-date customer data. While AMI is certainly not unique to Canada, the Ontario Smart Meter Initiative has certainly moved things forward aggressively toward goals that might have otherwise taken many more years to achieve.

EET&D: What types of solutions should utilities moving towards AMI look for in this new – and economically uncertain – year?

Tough: Utilities should look for solutions that will enable them to perform on-demand reads of a customer's meter through a call center, manage remote disconnects and reconnects to support the dunning process and outage reporting, and implement time-of-use rates. Additionally, the software should provide integration of processes between the meter and back-end systems to reduce a company's total cost of ownership for AMI infrastructure. They should also look at the vendor's commitment to delivering new innovations to the utility market and its capacity to invest significantly each year in the development of new utility-specific capabilities to ensure that they can benefit from their investment in the long term.

EET&D: AMI represents a big chunk of a utility's investment. Do you expect the current financial and credit market turmoil to have a big impact on utilities and their ability to continue their capital investment projects?

Tough: I don't think the impact will be as pronounced for Canadian utilities as it could be in the U.S. or globally, where utilities are primarily investor-owned. Canadian utilities have always been conservative in their spending due to the public regulatory review process in place in most provinces. However, we do expect that utilities will learn to do more with less. For example, capital spending towards modernizing aging energy infrastructure and/or legacy IT landscapes will undergo greater scrutiny by the utility management boards and public utility review boards alike. Any new technology or business application will need to be leveraged across the enterprise to achieve the expected rate of return to justify any new capital spending.

EET&D: Would you like to add anything to that, Maureen?

Coveney: As a major North American supplier, SAP recognizes this shift in decision-making, so we are focusing our efforts on solutions that address the business needs of various business groups within the utility – creating greater integration (and lowering total cost of ownership) across utility processes (both commercial and operational) and systems in an effort to hold down costs and improve efficiency.

EET&D: Where do you think the focus of companies like SAP needs to be in 2009 to best serve utilities?

Coveney: In the backdrop of today's volatile economic environment, the pace of technological change in the utility industry

continues to steadily increase. Technology will help utilities meet many of the challenges facing them in the years to come. Dealing with an increased number of retirees (many of whom are taking a wealth of self-taught expertise with them) and the pressure from customers to deliver more and differentiated products and services to an increasingly web-savvy customer base will likely be central themes.

In the U.S., we will focus in 2009 on customer care as utilities look at migrating from old, legacy CIS systems with minimal risk to service and billing operations. AMI, another focus, will give utilities a single view of the customer across departments to improve response and customer satisfaction. Enterprise asset management is a concentration with operational excellence and high performing assets, as utilities increase asset utilization across their operations. Financial analytics will also be important to streamlined financial reporting and supplier collaboration and the overall management of the utility's portfolio.

Tough: In Canada, the focus in 2009 for our customers is on the renewal of legacy business systems such as enterprise resource planning, customer information systems, workforce management, enterprise asset management and geographic information systems; integration of customers' AMI assets to their back-office systems; and enterprise and operational data consolidation and reporting. Utilities are increasingly looking to move away from best-of-breed environments to integrated solutions that will deliver a lower total cost of ownership and shorter time to value. We are finding our customers are seeking new-generation solutions that deliver end-to-end process transparency, integration across the enterprise and that enable easy, cost-effective adoption of new technologies such as AMI.

EET&D: What do you see as some of the more onerous challenges going forward?

Coveney: The next-generation infrastructure of energy assets hinges on the successful integration of information and processes across a multitude of systems and applications within utility system operations, planning and engineering and customer services. Coupled with the aging workforce issues mentioned earlier, technology will play an increasingly significant role in the solutions. I think Cathy would agree that this part of the equation knows no geographical boundaries or limitations.

Tough: In order for utilities to fully leverage the benefits of new technologies, their back-office business and operations systems will need to be upgraded or replaced to be able to accommodate the increased volume in data to be processed, enhanced business processes that will now be automatically triggered by the intelligent interpretation of the incoming data and the need for integration with other back-office applications such as geographic information systems or outage management systems. And it won't really matter if those facilities are in Canada, the United States or elsewhere. At the end of the day, we're all in this together. ■

Smart AMI Network Solutions Enable the Smart Grid

By Srini Krishnamurthy, Vice President, Corporate Development
Eka Systems

Introduction

On a continuous basis, utilities are challenged to meet the growth of peak energy demands, soaring costs, along with managing the operational risks of resource location combined with unprecedented environmental constraints. Since 1990, electricity demand has increased approximately 25 percent in the United States. Simultaneously, transmission construction has dropped by almost one-third. Losses in the U.S. economy due to power outages and power quality disturbances are estimated to be between $119 billion and $188 billion annually[1].

The Department of Energy estimates that over 280 gigawatts of new generating capacity will be needed by 2025. To meet this projected capacity, 937 new 300-megawatt power plants would need to be built which are not currently planned. The need for new plants, maintaining overburdened infrastructure, coping with an aging workforce, complying with regulations, and environmental concerns are the critical issues facing the energy industry today.

Since its inception, the energy industry has rightfully focused on the supply side of this challenge, but sophisticated technologies such as wireless mesh networking now exist, which can significantly impact the demand side of the equation. When used as the backbone of an Advanced Metering Infrastructure (AMI) solution, wireless mesh networking enables two-way intelligent networked communications with smart meters that enables command and control for value added services like demand response and demand side management, besides meter reading. Interoperable networks and systems across the entire power infrastructure aid in the management and control of energy consumption, improve operations management, conserve the environment, and adhere to evolving regulations.

The potential of Smart Grid and its market benefits are essential for achieving energy efficiency and maintaining the competitive state of utility services. Data collection, monitoring and control, data analysis and information communication infrastructure enables Smart Grid solutions that cost-effectively protect revenues today, while laying the foundations for future services.

Improving Energy Efficiency

Smart AMI Networks are the building blocks for an efficient and interoperable Smart Grid, delivering valuable grid information for better energy-management decisions by utilities. With Smart AMI Networks, utilities can analyze frequent interval data to offer time-based rates and demand management programs, which allow them to deal with ever increasing demand and stretched system capacities. When offered these energy alternatives, consumers become aware of their own carbon footprints and are eager to participate in energy efficiency and conservation programs.

A long list of benefits emerge when utilities leverage interoperable network solutions to monitor the grid and automate distribution system equipment. For instance, AMI networks can identify chronically overloaded or underutilized assets, so utilities can upgrade where needed and redeploy as necessary. The ability of such networks to assist in data tracking and analysis of usage patterns opens the door to sustainable generation and procurement programs that directly boost utility profits.

Likewise, AMI network solutions permit early detection of outages before they spread and help to identify system balancing needs and power-quality problems such as voltage sags or spikes. They also assist in identifying and prioritizing asset management initiatives while improving overall workforce efficiencies. The asset monitoring, energy management and diagnostic capabilities of Smart AMI networks, when combined with innovative customer services, lead to the primary goal of a Smart Grid - a robust, self-healing energy infrastructure.

Regulatory Compliance With Economic Gains

Smart Grid policies, tax-incentives, and legislation continue to drive deployment of AMI Network solutions independent of economic justifications. Regulators have many good reasons for directing utility actions, including fairness, customer value, and quality of service.

The energy act of 2007 is a policy statement motivated by the broad interests of America as a whole. The act makes it official policy of the nation to encourage time-based pricing and other forms of demand response. To that end, state utility commissions are mandated to

[1] "The Value of Electricity When It's Not Available"; NREL, 2003

consider implementation of time-based rates and advanced metering solutions.

Not surprisingly, there is increased interest in demand response programs that could cut peak loads and reduce the need for peaking capacity. Many utilities, without any regulatory imperative, will continue deploying AMI Network systems simply because they reduce costs and improve the quality of service to consumers. The recent flood of advanced metering proposals across all utility segments is a direct testament to this positive trend.

Regulated utilities in California are preparing to deploy large scale AMI networks with full realization of costs and benefits as shown in **Figure 1**. This data was compiled and published by the California Energy Commission in the "Meter Scoping Study" report. The analysis includes four different perspectives in addressing the cost/benefit equation from least cost and savings to profitability and as a competitive enabler for future services.

The discrete benefits, depicted in **Figure 1**, provide additional opportunities beyond the meter with integration of new found 'data' that flows across all utility functions as shown in **Figure 2**.

New cost savings result by eliminating the need for expensive and duplicated or parallel sources between operating units to deliver existing and new services. Even the low-benefit level provides a net reduction per month in system costs, regardless of the contract term, as per the study.

This revealing study and the regulatory initiative by California is an aggressive and innovative step, seeking to promote customer awareness of peak load periods and positively influencing their response to peak-sensitive pricing, thus reducing the recurring likelihood of the rolling blackouts of year 2000. It is policy, developed in a consensus process with legislators, utilities, regulators, businesses, and consumer advocates, that is driving this effort forward. However, there is more than just policy pushing Smart Grid initiatives into overdrive.

Foundations of Smart AMI

The Meter Scoping Study illustrates the value and potential of Smart AMI Networks – a solution that benefits the consumer, the environment, and the power grid. Strategic commitment and investments in smart meter networks are needed now to enable the Smart Grid. With AMI technology, utilities will be prepared for a new way of improving their businesses tomorrow.

In meeting these challenges, Smart AMI Networks have emerged as the solution of choice across all utilities. Proven in implementations around the world, smart networks are an integrated AMI solution that includes all the hardware, software, and tools needed to quickly and economically deploy an advanced metering platform. Smart network solutions employing an intelligent wireless mesh technology offer significant economic and technological advantages for advanced metering and energy infrastructure automation applications. They are cost-effective and scale by design from thousands to hundreds of thousands of endpoints without intervention, hierarchy or complexity.

Interoperable architectures deliver the benefits of Smart AMI Networks. Built on a "system of systems" approach, Smart AMI Networks integrate and interoperate across Home Area Networks (HAN), Wide Area Networks (WANs), and Enterprise Networks. Each of these networks operates independently within its functional environments and still delivers end-to-end interoperability with open standards and technology.

End-to-end interoperability is achieved across three distinct levels – Services, Applications, and Networks. Services are end to end in nature and touch multiple systems. For,

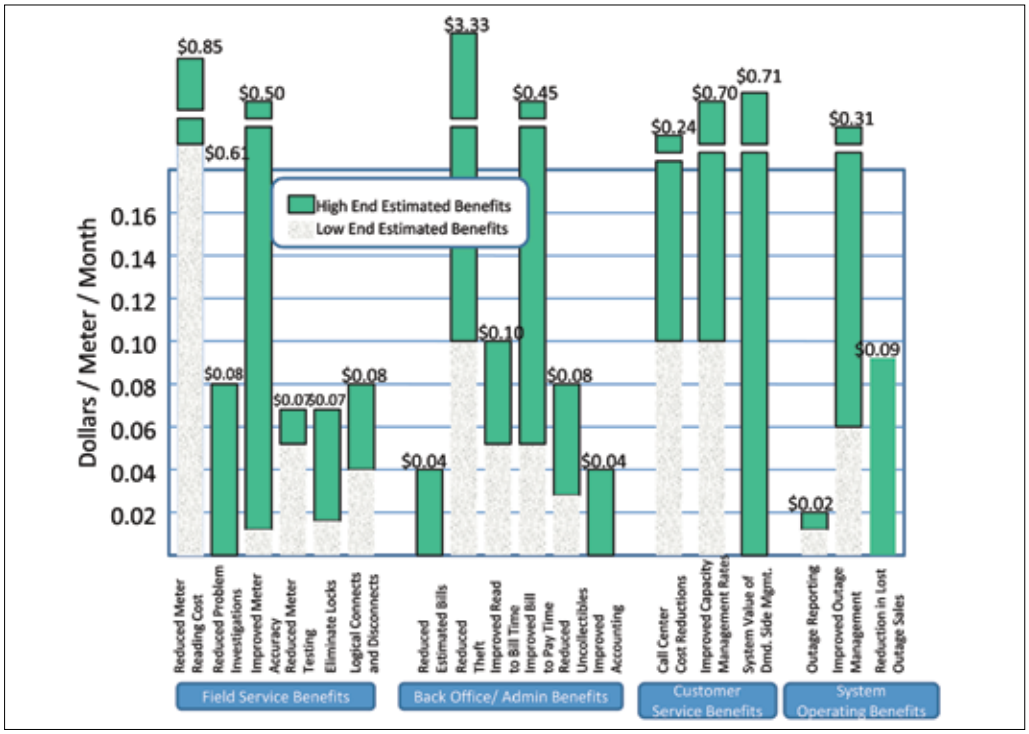


Figure 1: Typical AMI Systems Benefits **Source:** California Energy Commission, Meter Scoping Study

example although HAN services interact with devices in the home, they may still need data from the AMI network and from Enterprise Networks both utility owned and/or third party networks. Applications are specific programs within a service domain. In the case of HAN, Demand Response, Load Control, Plug-In-Hybrids, etc. are specific applications. Likewise, meter data related applications fall under the AMI service domain. Interoperability across networks is achieved at the 'cloud' level.

The Common Information Model (CIM) framework is the guiding principle across systems within an AMI network. ZigBee/HomePlug Smart Energy Profile is the emerging standard in the HAN. WAN technologies are very mature and sophisticated to accommodate universal IP across multiple media technologies. At the enterprise level, SOAP, XML, Web Services and MultiSpeak are being deployed. Transmission & Distribution, Distributed Automation and Substation Automation systems will also be integrated for interoperability as the Smart Grid matures. Network Management interoperability is also achieved at multiple levels across the various networks through open standards and application level management data. Interoperability standards also support the future application layering necessary to serve evolving utility and customer needs.

The Smart AMI Network Solution

With ongoing advances in communications, cost-effective smart networking is the key driver for expanded AMI deployment throughout utilities. But technology is only an enabler; the true value of AMI lies in its abilities to improve a utility's operations, forecasting, and demand management while simultaneously providing alternatives to consumers in managing energy usage and budgets.

Smart AMI Networks expand the technology of electrical grids by adding components such as self-managing and self-healing mesh networking, intelligent meters, and bridging to Home Area Networks (HAN) for connectivity with energy consuming appliances. Smart meters communicate in near real-time with the utility, providing detailed usage data while also receiving and displaying Time-Of-Use (TOU) pricing information, and offering other on-demand abilities such as remote connect/disconnect, unrestricted monitoring and control, etc. These capabilities provide customers with the precise data needed for tailoring consumption and minimizing energy expenses while helping balance overall network demand.

Utilities value Smart AMI Network solutions as an avenue to forecast and manage energy usage during peak demand periods and also as an essential tool in maximizing operational efficiencies to boost bottom line performance with its:

- **Low cost of management and maintenance** - Smart AMI Networks are self-organizing and require no manual address/route/channel assignments. It is simple to manage thousands or millions of devices resulting in the lowest total cost of ownership.

- **Scalability, flexibility and lower costs** - Smart AMI Networks are self-organizing and allow true scalability. Nodes and Gateways are easily added at a very low cost with:
  - · No limitation on number of hops
  - · No network address configuration
  - · No managed hierarchical architecture
  - · No hard limitation on number of Nodes per Gateway

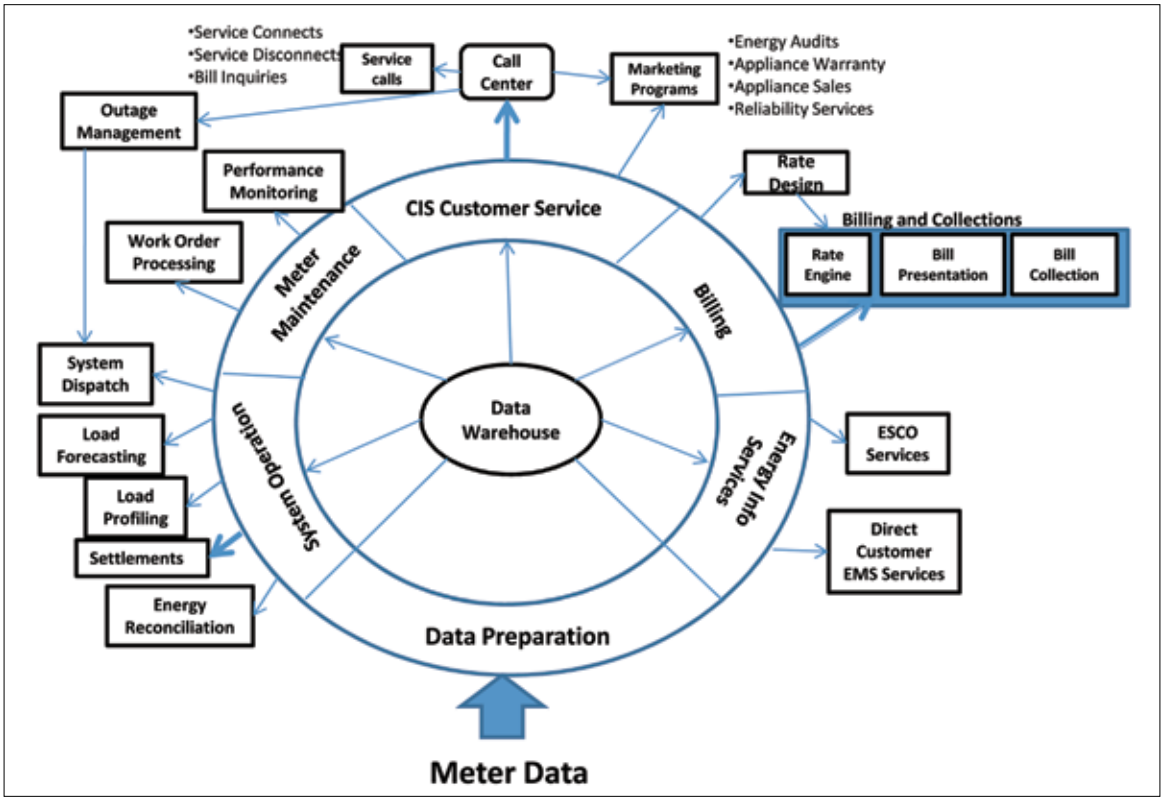


Figure 2: Interoperable Utility Operations **Source:** California Energy Commission Meter Scoping Study

- **Near real-time network means speed and efficiency** – Smart AMI Networks enable on-demand data reads, outage notifications, and other applications. In addition, the technology supports automated "over-the-air" firmware upgrades that are self-spreading to increase efficiency and dramatically lower operations costs.

- **Robust security** - All communications in a Smart AMI Network are protected by mutual device authentication and derived per-session keys using high bit rate AES encryption. This hardened security approach allows for authentication as well as confidentiality and integrity protection in each communication exchange between every pair of network devices – Smart meters, Relays, or Wireless Gateways.

- **Open Systems and standards-compliant network** – Smart AMI Networks support industry standards, which offer expanded capabilities, simplified management and enhanced security. Compliance with open systems standards gives users interoperability, better performance, and more flexibility, both now and in the future.

Customer Benefits

Regulated utilities traditionally operate as monopolies with an "obligation to serve" for the benefit of shareholders and customers. Smart AMI Network solutions generate significant financial benefits and have the power to enhance customer satisfaction to new levels.

Multiple demand response and utility operations initiatives can be met with a Smart AMI Network's capabilities to:

- Integrate water, gas and electric meters into one intelligent, bi-directional smart network
- Perform on-demand reads, deliver software downloads, and perform remote testing
- Remotely control and upgrade smart meter firmware to support network connectivity to/from and management of Home Area Networked appliances
- Broadcast TOU pricing to customers and load management signals to smart appliances through HAN interfaces in support of demand response strategies
- Store selective monthly usage details in smart meters and avoid erroneous trend estimates and inaccurate readings
- Control operations expense by minimizing field calls, truck rolls, and associated expenses
- Use the smart network for distribution automation and distributed generation and control
- Employ open standards protocols to interface with multi-vendor in-home networks
- Support response communications for smart thermostats and load control devices over the Smart AMI Network
- Enable remote connects and disconnects for service order work in transient areas
- Provide customers online access to hourly interval usage and the interactive ability to manage energy related expenses
- Assist in identifying sources of non-technical revenue losses

The most pervasive improvement of a smart meter-based AMI solution is accurate and timely bills, based on interval data. One must also consider the way integrated Smart AMI Network technology can enhance call center operations. With easy access to current and historical data, call center staff will have the information needed to quickly and easily resolve queries with faster and smarter responses. Another example is timely and pro-active notification of outages, a life saving service for millions of senior citizens in the country. Additionally, secure web-based access to energy data, like that planned by utilities, can educate customers about their energy use and help them make better energy decisions.

Summary

The most significant benefit of smart metering network solutions is their ability to assist in the delivery of integrated Smart Grid applications like AMI. AMI technology combined with customer participation allows utilities to use automatic controls to curtail energy use at peak times, reduce customer bills and conserve energy. This process is environmentally friendly, efficient, and reduces the need to build new facilities.

Interoperable Smart Grid systems restore the demand and supply balance while creating efficient energy markets. When it comes to improving resource management, revenue opportunities, and customer service through the use of Smart Grid strategies, Smart AMI Networks provide utilities with numerous ways to help achieve their goals. Engineered to truly enable interoperable infrastructure that delivers the functions and benefits of the Smart Grid by overcoming complex technological challenges – Smart AMI Networks:

- Equip utilities to more effectively manage their increasing infrastructure demands and growth requirements
- Provide the capacity, controls and self-managing architecture to handle the complex and massive data demands for next generation utility services
- Reduce traditional IT management for faster ROI
- Are proven reliable and fuel new services and support evolving standards for customer service. ■

About the Author

Srini Krishnamurthy *is the Vice President for Corporate Development at Eka Systems, a leading provider of communication and networking solutions for the Smart Grid and Smart Meter markets. Srini is a serial entrepreneur and has over twenty-five years of distinguished career in telecommunications, software, and networking with executive positions in business development, marketing, product management and product development. He is known for his thought leadership and technology expertise.*

Srini has a patent to his credit and has authored several marketing and technology papers in industry publications. He is an invited speaker in major conferences and trade shows on wireless data networking strategy and solutions. Srini holds an MS in Computer and Information Science and an MS in Electrical Engineering.

Wanda Reder

Executive Directions

PROFESSIONAL ASSOCIATION SPOTLIGHT

Institute of Electrical & Electronics Engineers - Power & Energy Society (IEEE-PES)

Wanda Reder, IEEE-PES President

In this second installment of Executive Directions, readers are afforded the opportunity to gain valuable insights into one of the most influential professional associations shaping the future of the electric power industry. Wanda Reder is president of the IEEE Power & Energy Society (PES), which as the many PES members among our readers are already aware, was known as the 'Power Engineering Society' until last year. The interview explains some of the key reasons behind the name change as well as the future role of PES in changing the power and energy field from what it is today to what it will need to be to meet the needs of a rapidly evolving energy future.

As the transformation to what we now commonly refer to as the 'Smart Grid' drives us ever closer to the modern, intelligent network needed to serve the power delivery needs of the 21st century, PES will surely be at the forefront of that transition. Despite being a longtime member of PES myself, I must say that I learned a lot from this interview – and I suspect that you will too. **– Ed.**

EET&D: When you assumed your current position as president of the newly renamed IEEE-Power & Energy Society, change was already emerging as the order of the day. I know that as a seasoned veteran of the power engineering business you saw many of the rapidly evolving changes coming, but did you experience any major surprises when your term as PES president began?

Reder: When I became IEEE-PES President in January 2008, it was clear that the power and energy field was entering an era bursting with excitement and opportunity. While IEEE-PES was ideally suited to provide technical leadership for a global economy interested in becoming "greener" – our contribution, involvement and capabilities in related emerging technical areas needed to become more visible. As a result, we began a journey of re-branding and image building, which started with a new name for the Society.

EET&D: You provided an interesting and insightful presentation of how and why this name change from "Power Engineering Society" to "Power & Energy Society" came about at the 2008 IEEE-PES T&D Conference in Chicago last spring. However, I think it would be helpful to recap some of the salient points you outlined there for the benefit of readers who may not already be PES members.

"When I became IEEE-PES President in January 2008, it was clear that the power and energy field was entering an era bursting with excitement and opportunity."

Reder: Sure. I think most people would agree that it's not usually a good idea to make a major change like this as a kneejerk reaction. So, after considering trends in the industry, survey findings, and membership feedback, the process began in June of 2007 and concluded with an overwhelming positive membership vote in March of 2008. In this case, the name change was well thought out and – we believe – both necessary and appropriate, especially given the changes in the industry.

EET&D: I think a bit more background on the IEEE-PES organization itself may be useful to put this into proper context. Perhaps you could explain where PES ranks within the broader IEEE organization and also how the PES membership is distributed geographically for readers that may have only limited knowledge of IEEE and PES...

Reder: First, IEEE is the world's largest non-profit, technical professional association offering standards, publications, educational venues and conferences with more than 375,000 members around the world. PES is the third largest of the 39 technical societies within IEEE. About 70% of the PES membership is in the U.S. and Canada, but that has been changing as we've grown. In 1995 it was 80%; since then we've seen most of the growth coming from other regions, with the Asia-Pacific region having the greatest membership expansion between 1995 and 2007 – a pattern we expect to continue going forward. Another key demographic involves our aging workforce. Like the industry we serve, in recent years, the number of members who are under age 50 has been declining.

EET&D: We've all heard and read a lot about the aging workforce issue lately. Just how critical is that for your organization and in the broader industry perspective?

Reder: This is quite a significant issue for PES as well as the entire power engineering field. A recent survey produced by the Center for Energy Workforce Development, forecasts 46% of the power engineering jobs in the US could be vacated by 2012. And academic power engineering programs have also weakened as a result of minimal faculty hiring to replace those who are retiring. Because of these trends, we are working to attract and retain young professionals, be relevant worldwide and rebuild the power and energy educational infrastructure.

EET&D: You seem to have a very well calibrated picture of your organization that a lot of other associations would probably envy. How did you come to have such a detailed assessment of the IEEE-PES demographics?

Reder: We knew that our demographic footprint was changing, so we conducted a survey in 2007 to determine what we were dealing with before launching into a change strategy. That survey proved to be very revealing, providing a tangible set of issues we needed to address. Some of the results were exactly what we expected, but there were also a few surprises.

EET&D: What were some of the more noteworthy or unexpected findings?

Reder: Probably the most enlightening for me were responses from students, who found the career possibilities in Energy and Power Engineering exciting, critical and relevant to the society at large – a positive image that we need to build upon to shift our demographic position. Additionally, 48% of survey respondents indicated that they were "more" interested in participating in the society as "Power & Energy Society" as compared to "Power Engineering Society". This finding was a significant factor in building the case to pursue our new name.

IEEE is the world's largest non-profit, technical professional association offering standards, publications, educational venues and conferences with more than 375,000 members around the world. PES is the third largest of the 39 technical societies within IEEE.

EET&D: What are some of the measures PES has undertaken to offset what seems like the virtual certainty that there will be severe labor shortages in the power industry?

Reder: To ensure an adequate workforce, PES has started the Power and Energy Engineering Workforce Collaborative, in partnership with the Center for Energy Workforce Development, the North American Electric Reliability Corporation (NERC), the National Science Foundation and the university-based Power Systems Engineering Research Center.

The Collaborative[1] aims to expand the number of students in the pipeline who are interested in engineering careers in power and energy by ensuring pre-university students are prepared for a post-high school education. It will also address how to build, enhance and sustain university power engineering programs. PES also offers a complimentary career website[2] that connects engineering students looking for jobs in power and energy with prospective employers.

EET&D: What's the current status of the PES-Careers website, and what other kinds of job assistance are being made available through IEEE/PES?

Reder: PES-Careers began in September 2007. Today, there are some 473 student subscribers and approximately 135 employers using the site. The service has been so successful, that we are now expanding it to all other regions throughout the world. The society also plans to expand its continuing education programs by partnering with employers to offer stand-alone courses, increasing the number of IEEE Expert Now online courses, developing more tutorials targeting working engineers and boosting the number of Distinguished Lecturers, who travel to 180 IEEE-PES chapters around the world to share the latest in technical advances.

EET&D: With so many new programs already in place with more on the horizon, 2009 is going to be a very important year for the PES, isn't it?

Reder: Yes, it certainly is! Throughout 2009 we will be celebrating our 125th year of serving our members and the power and energy field. This is a very exciting time for us, and with so many challenges ahead – an aging workforce and a declining infrastructure in particular – the industry is clearly in need of a steady hand, fresh ideas and sound engineering practice. These are all things that IEEE-PES is focused on as part of our mission and that we are well equipped to address as an organization dedicated to advancing power and energy initiatives.

[1] More information is available at http://www.ieee.org/go/pes-collaborative.

[2] Visit: http://www.PES-Careers.org

EET&D: Can PES take on such a tall order with all of the changes taking place – and that will take place – in the next few years?

Reder: While PES is strong, there is little doubt that our industry is at a critical point, facing numerous challenges that include an increasing world population, growing demands for higher living standards and a pressing need to reduce pollution. Resource limitations are a reality, of course. But we must be ready to take bold steps to move forward rapidly with grid transformation and related energy efficiency, conservation and environmental initiatives.

EET&D: How would you characterize the role of PES during this ongoing transformation?

Reder: Navigating the power and energy industry through this complex maze will require new technologies that incorporate renewables, energy efficiency, clean coal technologies, carbon capture and storage techniques, nuclear power, smart grids, plug-in hybrids and more to meet future demand. There is no silver bullet; we will need all of these approaches and more. Clearly, the industry needs are changing, and PES will definitely be an important resource that is constantly adapting to better meet those needs.

"This is a very exciting time for us, and with so many challenges ahead – an aging workforce and a declining infrastructure in particular – the industry is clearly in need of a steady hand, fresh ideas and sound engineering practice."

EET&D: One would suspect that key among those is the rapidly growing emphasis on grid transformation, commonly referred to as the Smart Grid Initiative. While SGI is a pervasive topic that we can't comprehensively address in this interview, could you perhaps give us a few examples of how PES fits into that equation?

Reder: Well, you're definitely right about the SGI scope being pervasive – and it's growing daily. That's is one of the main reasons why an organization like PES is needed. With all of the challenges we are facing and all of the great ideas for addressing those problem areas flowing in, there needs to be an independent, centralized clearinghouse for sorting out the best ways to deliver viable solutions in both the short term and over the longer term. Our efforts related to the definition, drafting, development and publishing of standards stand out as being among the most important aspects of our work.

EET&D: During this period of unprecedented change, why is it important to be a member of the Power and Energy Society?

Reder: PES offers opportunities for creative involvement in the industry through participation in technical committees and conferences held throughout the world where members create standards, influence technical developments, and share best practices. As the power and energy world evolves, it is vitally important for participants to stay connected in order to develop professionally, and PES provides an ideal vehicle to accomplish that.

EET&D: What are some of the specific benefits and advantages of being a PES member?

Reder: PES offers distinguished lecturers, tutorials, on-line courses and stand-alone educational venues to facilitate professional development. Through publications in our digital library the most up-to-date concepts are exchanged, and we offer an award winning bi-monthly magazine and a monthly on-line newsletter to keep members abreast of emerging issues. Moreover, through PES participation, members can tackle broad reaching challenges, become recognized industry "thought leaders", develop an expansive network and become part of a community – all of which are so important, especially during a period of dynamic change.

EET&D: Have you seen any specific evidence yet that the changes you've made are resonating with the PES membership?

Reder: Yes, absolutely. For example, during the last year alone, we had nearly one million downloads of on-line documents, which consist of full text documents, conference proceedings and peer reviewed technical papers. We also had record attendance at our General Meeting and the T&D Conference & Exposition, which are two of our most prominent events. Furthermore, as most of the other IEEE societies have lost membership, PES now has nearly 24,000 members and continues to grow. It will take a while for members to digest all of the changes and assess their acceptance of them, but the early indicators are quite positive.

EET&D: Your term as president of the society certainly comes at a most exciting and challenging time. What do you see as your personal mission as president of PES, and what would you like your legacy to be when your service is concluded?

Reder: As the power and energy industry faces unprecedented challenges, our top priority is to remain responsive and to change with the industry we serve. Moving into the future with a new name, together with the entire organization, I am personally committed to maintaining our mission and core values while leveraging 125 years of heritage to address the challenges before us.

Under our new name, we will accommodate emerging technologies, collaborate to involve the other disciplines required to address the complex challenges before us, and appeal to the societal interests of potential members. We certainly welcome inquiries from your readers and the opportunity to serve them during this exciting period in the power and energy field. ■

In addition to her duties as IEEE-PES President, Wanda Reder is Vice President of the Power Systems Services Division at S&C Electric (Chicago, IL). She can be reached via email at w.reder@ieee.org.

Gary Roskos

Phasor Measurement Units - From Exotic to Everyday

By Gary Roskos, Electric Utility Industry
Open Systems International, Inc. and
Bill Robertson, Senior Principal Engineer
Salt River Project

Bill Robertson

Over the past ten years, direct Phasor Measurement technology has progressed from research and development to commercial availability. The development of open standards for measurement and communication has provided a solid foundation for device manufacturers. In addition, the availability of inexpensive and reliable measurement devices, secure communications and synchronous time sources have removed most of the barriers to widespread implementation of this important technology.

However, everyday use of measured synchronous phasor data has remained largely limited to research or pilot installations or for historical analysis. This is largely due to the perception that a large roll-out would require large, concentrated investments in phasor measurement unit (PMU) hardware, communications systems and application software.

SRP has developed a very simple approach to implementation of PMU technology. In 2006, as a result of the availability of PMU devices (a common feature in newer standard protective relays) a group was formed to plan and prioritize implementation of phasor measurement devices.

Salt River Project, Phoenix AZ (SRP) is working with Open Systems International (OSI) and Schweitzer Engineering Laboratories (SEL) to show that PMU technology can be implemented in a logical, simple and effective manner without significant costs. In addition to gathering and storing data for historical analysis, SRP is using PMU measurement data to improve the performance and results of existing real-time transmission applications, particularly State Estimation and Contingency Analysis.

The goal is to effectively and efficiently incorporate PMU technology to improve everyday operations.

Benefits

The promise of PMU data is that the actual state of the transmission grid can be measured in detail as fast as the data can be communicated. Currently, the determination of an estimated state uses scalar measurements taken over several seconds and the state-model processing times that are often in the order of tens of seconds. Reducing the time to determine an accurate system state could allow for accurate assessments of dynamic system conditions resulting in automatic stability control feedback and more useful presentation of system state and condition information to human operators.

Other benefits include the realization of a measured system connection and impedance model rather than using a calculated system model based on nominal construction and environmental assumptions. This detailed state model can be utilized in background analysis to determine system security and stability margins with a high degree of confidence.

At SRP, the short term goal is to utilize PMU data in an everyday manner to improve the quality and speed of the State Estimation process.

Field Installation Approach

SRP has developed a very simple approach to implementation of PMU technology. In 2006, as a result of the availability of PMU devices (a common feature in newer standard protective relays) a group was formed to plan and prioritize implementation of phasor measurement devices. Priorities were established by considering locations that were important for the utility and its neighbors (control area boundaries, generation sites, etc.), and coordinating installations with existing plans for maintenance and construction. Using this strategy, they are able to methodically add to the installed base of phasor measurement devices each year and now have PMUs installed on approximately 10% of their transmission system buses.

SRP also took advantage of concurrent projects to improve substation communications and automation, allowing them to immediately use secure and reliable, high-speed communications channels for the collection of PMU data. This benefit was a direct result of a successful philosophy in the application of automation investments. By choosing solutions for automation that utilize open architectures and "off-the-shelf" components, SRP is able to cost-effectively

meet specific current project needs while establishing basic infrastructure suitable for a wide variety of future needs. Making choices that take into account both current requirements and future capability allows the utility to roll out automation incrementally, building on the foundations laid by previous projects.

A small group meets regularly to maintain the implementation plan, coordinate installation between departments and to help promote the PMU program within the company.

Central Operations Implementation

Initially, PMU data was stored in a local historian and forwarded to the Bonneville Power Administration (BPA), another federal bulk power producer, like SRP, serving the Pacific Northwest.

SRP updated their system control center in 2007 and in 2008 a project was begun to utilize PMU data in their real-time systems alongside traditional data sources.

This project includes a new interface to the real-time system database that can collect streaming PMU data. This interface includes a clear and simple way to add devices and map the data to the real-time database, taking advantage of the self-describing features of the IEEE C37.118 protocol. This new application creates a time-aligned vector of input points from the incoming data stream which is written to the real-time database in a single write operation.

SRP also took advantage of concurrent projects to improve substation communications and automation, allowing them to immediately use secure and reliable, high-speed communications channels for the collection of PMU data.

SRP is then able to utilize features available within their new OSI State Estimator that allows use measured phase angle data along with traditional sources. It was important that the advantages of this new data were realized even without a full system deployment and that changes in performance could be measured over time as more PMUs were installed.

Initially, PMU data was stored in a local historian and forwarded to the Bonneville Power Administration (BPA), another federal bulk power producer, like SRP, serving the Pacific Northwest.

A diagram of the SRP PMU data collection system is shown in **Figure 1**.

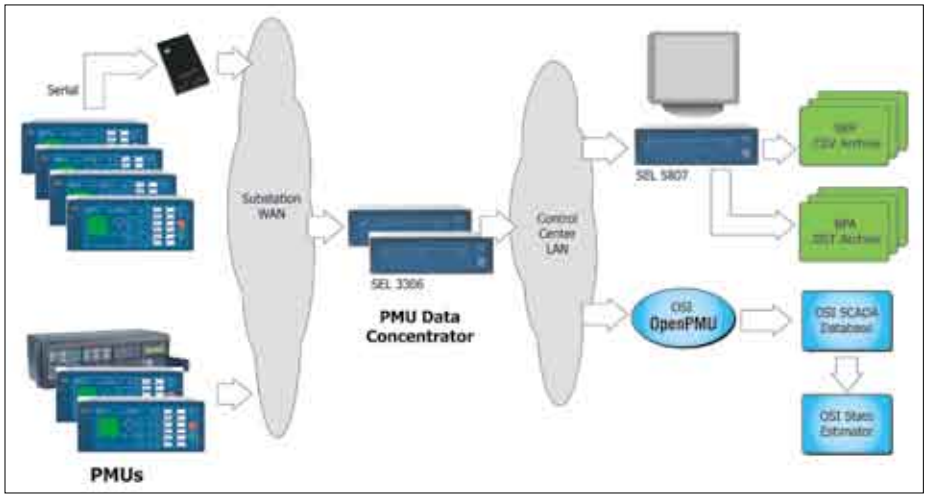


Figure 1

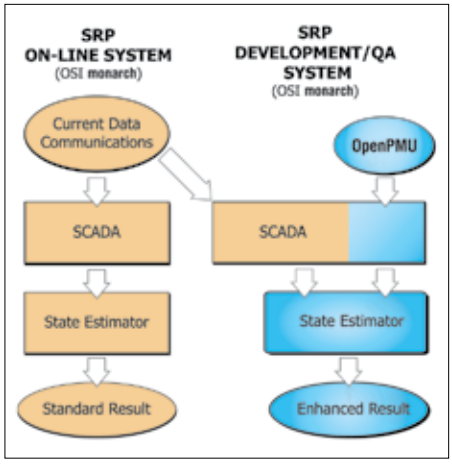


Figure 2

As shown, the data is concentrated and presented to various systems in a common protocol format. One path leads to the SRP data historian, one leads to a BPA data collection system, and the third path leads to the real-time database interface application.

To evaluate the effects of the new data and to verify deployment strategies, SRP is running two State Estimation processes in parallel.

The first is their legacy process without any synchronized phasor data input. The second process substitutes PMU data for traditional measurements where it is available. See **Figure 2**.

With this configuration, a side-by-side comparison is available where solution results, estimation errors, and solution times can be compared.

In addition to providing a simple interface to the PMUs utilizing the standard IEEE 37.118 protocol, the OSI PMU application time-aligns incoming data and provides a deterministic write time to the real-time database so that other applications can avoid reading the data while it is being written. This application is very scalable, handling existing requirements at a reasonable cost with provisions for long-term future needs.

Within the State Estimation application, magnitude and angle data is used as input along with traditional non-synchronized

scalar measurements and a level of confidence is assigned to each measurement. Where magnitude and actual angle measurements are available contiguously, the observability of the system is increased and the State Estimator solution is improved.

If fully deployed, the State Estimation process reduces to a state measurement process removing the need for a traditional Weighted Least Squares or Similar Givens Rotation algorithm. Power flows can be calculated in one step and branch impedances could be further refined based on accurate real-time phase measurements.

SRP updated their system control center in 2007 and in 2008 a project was begun to utilize PMU data in their real-time systems alongside traditional data sources.

Central Operations Project Schedule

The project began in the second quarter of 2008 with the development of the PMU communications interface. It also included development of deterministic methods for handling specific-time data within the Energy Management System. In October, OSI installed the software on a parallel production system, the SRP "Development and Quality Assurance (QA) system." The system will be fully functional before the end of 2008.

These development and deployment initiatives at OSI and SRP were generously supported by Schweitzer Engineering Laboratories, which provided development hardware advice.

PMU Deployment Strategies

As SRP evaluated deployment priorities, they worked with their partners to determine simple strategies for prioritizing future deployments. These ideas, along with their current planning considerations, help SRP realize the benefits of gradual installations more quickly.

In making these analyses, some questions to consider include:

- **What data is needed by regional organizations and my neighbors?** In many cases, Regional Operating, Planning and Reliability organizations require that PMU data be collected and stored at critical system locations such as control area boundaries, generation sites, etc.

- **Where do I have poor system observability or the high estimation/ measurement errors?**
  By reviewing error results for State Estimation solutions at different times, locations can be identified where additional high quality data will have the most impact on the quality of the solution results.

- **Where do I have elements with varying impedance models?**
  - LTC Transformers or Regulators?
  - Phase Shifters?
  - Varying or Switchable VAR Sources?

Analysis of these elements in the State Estimation application involves an inherently inaccurate impedance model or relies on more complexity in modeling and in the estimation algorithm. The benefit is found in the simplification of these processes, which contributes to solution accuracy and speed.

Once these early considerations are satisfied, it is best to deploy in a growing contiguous pattern, segregating the system into "calculated" and "estimated" areas, rather than using a "shot gun" installation approach. This results in an ever-smaller system that still requires an estimation process.

A complementary strategy is to begin at the highest voltage levels. For example, a measured system model can be established for the 500kV system while the rest of the system is estimated. Then, as one deploys to lower system voltages, the size of the calculated system is increased and the portion of the system that requires estimation is decreased.

Other Data Collection Strategies

PMUs can be effectively deployed even without a dedicated communications channel. Many PMU devices allow the user to select sample rates slow enough to allow for polling from a central site as part of a standard SCADA data stream. It is also important that the protocol used supports the measurement time stamp. Although the sample and collection rate of this data is no better than traditional data, the samples can be coordinated to coincide with samples taken anywhere in the system, and given the sample time, the data can be properly aligned with other data available from other sources. This method will not increase the cycle time of the state solution, but will contribute to the quality of the solution.

The Future

As PMU technology is fully deployed and as communications latencies are reduced, accurate system state models can be determined very rapidly. This will lead to advances in distributed real-time dynamic stability control applications. Using the PMU derived state of the power system in faster time domain than a few seconds, would allow detection of unfeasible operating conditions, and would lead to development of control algorithms for isolation and islanding of the network components to preserve the integrity of the overall Grid.

In addition, problems with development of accurate large system models will be greatly reduced through the ability to directly measure and refine the models in real-time. These models can be three-phase or phase-independent models as both sequence and phase models are measured.

At the same time, advances in contingency and other dynamic analysis applications are allowing systems to analyze many more "what if" scenarios in a considerably reduced time-frame and visual presentation applications are being developed to enhance operator situational awareness. Using the PMU generated data as RADAR sweep for the operator to be able to operate the power system and delineate any impending dynamic problems in the Grid.

The coincidence of improved information and application tools is leading quickly toward the promise of enhanced reliability, security and survivability of the grid.

The coincidence of improved information and application tools is leading quickly toward the promise of enhanced reliability, security and survivability of the grid. Smart Grid technologies are on the horizon which will use such advances to create truly self-healing networks, true fast identification of impending problems and isolation of sub-networks and re-routing of power through alternate paths.

With clear goals, thoughtful and creative planning and with focused execution, these benefits can be realized successfully with little fanfare and without exorbitant investments today. ■

About the Authors

Gary Roskos *has over twenty five years of direct engineering experience in the Electric Utility industry. Roskos is an industry expert with a wealth of practical knowledge regarding grid design, operations, maintenance, protection and automation. He specializes in advancing fields such as next-generation Remote Telemetry, Substation and Distribution Automation, Outage Management, Metering and Smart Grid Design. Mr. Roskos has a Masters Degree in Electrical Engineering from the University of Minnesota and is a member of IEEE and NSPE.*

Bill Robertson *is a Senior Principal Engineer with Salt River Project. He supports Network Applications functions including State Estimator within the Energy Management System. Robertson received a MS degree in Electrical Engineering from New Mexico State University in 1987. He joined SRP in 1987 and has worked in support of Network Applications and Energy/ Transaction Scheduling.*

Securing Utility Assets

THE WAYS AND MEANS OF CRITICAL INFRASTRUCTURE PROTECTION (PART 2)

By Electric Energy T&D Magazine Editorial Staff

This is Part 2 of our annual feature on security, initiated in the latter part of last year. As an issue of importance throughout the coming year, we believe that security deserves special attention. With an overwhelming need to protect critical infrastructure continuing to build from growing levels of physical and cyber threats emanating from myriad sources, security is an issue that must be solved in a pragmatic yet economical way. A follow up to this article is planned for the Nov/Dec 2009 issue as well, so if security is on your radar, we want to hear from you! – **Ed.**

Tony DiMarco
Intergraph Corporation

Tony DiMarco is director and global industry manager for the Utilities & Communications business unit at Intergraph Corporation (*www.intergraph.com*). DiMarco has more than 30 years of experience in utilities and software solutions, responsible for consulting, professional services and business development for several Fortune 500 firms providing software and services to the global utility market. He previously held senior management roles at Oracle Consulting, Autodesk and GE Energy.

DiMarco began his career in R&D and applied computer applications at Con Edison of New York where he implemented the company's first GIS and infrastructure management system for the electric, gas and steam distribution system in New York City, NY. DiMarco holds a bachelor's degree in mechanical engineering and master's degree in business administration from New York University. He is a member of GITA International and the American Society of Mechanical Engineers.

Ellen Libenson
Symark International

Ellen Libenson is vice president of marketing and product management at Symark International (*www.symark.com*), a leading provider of security administration solutions. Ms. Libenson has over twenty years of experience in product marketing, product management, and marketing communications for hi-tech companies. She has held management positions at leading providers of enabling technologies and enterprise software applications that have focused on delivering solutions to major corporations in the Energy, Consumer Goods, Healthcare, Financial Services, and Manufacturing industries.

Kass Aiken
Ceelox

Kass Aiken is the Vice President of Sales for Ceelox (*www.ceelox.com*). Founded in 2003 and headquartered in Tampa (Florida), Ceelox is an established developer of biometric security software solutions for multiple vertical markets and businesses of all sizes. Ceelox's logical access biometric solutions provide affordable, innovative and fresh ways for customers to securely access mission critical applications. Mr. Aiken's core competencies and experience range from business strategy consulting to overall delivery of client engagements through all stages of acquisition, design and development. With a long tenure of senior management experience, he has been at the forefront of where cutting-edge technology meets practical creativity. Mr. Aiken began his professional career at Wang Laboratories and most recently held the position of Vice President of Professional Services at Intelladon Corporation, a learning management software company.

Gregg Larson
Sensus

Gregg Larson is R&D Director of System Software & Operations for Sensus Conservation Solutions (*www.sensus.com*) where he is responsible for the field installation, operation, maintenance and customer training for the company's FlexNet product line. Larson is also charged with software development for its backend data collection suite. Larson joined Sensus in 2006 following the acquisition of Advanced Metering Data Systems (AMDS), where he had served as Operations Director. Prior to AMDS, Larson held various positions over the span of a decade at CellNet, the final being Vice President of Network Operations. Larson holds a Bachelor of Science degree in Electrical Engineering from the University of Minnesota and has completed study at Kansas University in pursuit of a Masters in Business Administration. He also is a certified information systems security professional, awarded by the International Information Systems Security Certification Consortium.

More Perspectives On Security…

The first part of this article appeared in our Nov/Dec 2008 issue with information and viewpoints expressed by members of the Special Security Panel convened at the Smart Grid RoadShow in Toronto, Canada (October 6-7, 2008). This second installment adds additional perspectives and commentary from representatives of four more companies involved in various facets of security products, systems and services.

Intergraph's **Tony DiMarco** states that the events of Sept. 11, 2001 have had a profound effect on security considerations for utilities. As a leading global provider of spatial information management (SIM) software, Intergraph Corporation fuses geospatial technology to security, helping some of the world's largest government, military, and industrial organizations in more than 60 countries better manage their operations and safeguard their infrastructure.

"There has been both an over-reaction and an under-reaction by some companies with regard to their overall security posture," DiMarco observes. "While there has been a strong reaction to cyber-security issues, including much attention now being paid to compliance with the NERC-issued guidelines for cyber-security, the pursuit of technologies to improve critical infrastructure physical security has gotten substantially less attention – at least so far."

Physical security, like cyber-security, is intended to mitigate the impact of threats through deterrence, prevention, detection, limitation and corrective action. While cyber-security has been primarily focused on preventing intruders from commandeering or threatening utility control systems, physical security measures have remained relatively unchanged. Utilities continue to use physical barriers, increased security personnel, access control systems and occasional video monitoring as their main lines of prevention and defense.

"It has been said, 'security is always excessive until it's not enough'," DiMarco reminds us. "The terrorist events of 9/11 are a grim reminder of complacency. Keeping this in mind, utilities can dramatically improve their 'situational awareness' and enhance their security posture with changes that are possible in the utility operations control center and control room."

"Today, there is technology available to design and assemble a comprehensive video monitoring and alarm network around identified critical infrastructure to improve overall 'situation awareness'. Such a security network can be designed to monitor substation internal and external areas using intelligent video cameras, as well as monitor intruders crossing certain paths, such as transmission towers and easements, using wireless fences."

"This physical security monitoring of critical infrastructure can be directed to a central command center where alarms can be integrated into the same operations control center display where the central monitoring and control of the electrical transmission and distribution systems is focused. Integrating physical security systems alarms with systems operations and control provides improved situational awareness and heightens the security posture by integrating physical security monitoring and alarms with electrical operations."

To further illustrate the point, DiMarco invites us to consider the following scenario…

"When operating the electrical system, a change in operating status at a substation may be considered an isolated event. That same change in electrical substation operating status, when combined with a security alarm at a substation, has much greater significance and may be interpreted as a more significant threat in progress rather than an isolated system malfunction. This underscores the value of combining physical security systems technology with operations technology in the control room. The result is improved situational awareness and an improved ability to respond to a threat, take corrective action and mitigate the impact," says DiMarco.

Integration of physical security and control room operations systems is feasible today, providing a command-and-control environment for operations through a single user interface for a number of operating systems in the control room. The same technology being implemented for this control room environment allows the integration of physical security devices as part of the control room display.

Symark's **Ellen Libenson** stresses the importance of access control in meeting NERC-CIP guidelines and securing critical assets. Libenson maintains that to meet short-term NERC-CIP deadlines and develop longer-term "best practices" security and compliance measures, utilities must evaluate their infrastructures to ensure that core processes are in place, including a sound identity management system that allows only authorized users access to critical infrastructure systems and associated proprietary information.

"An effective role-based access control (RBAC) system will make certain that those authorized to perform various duties with elevated privileges and access will be

confined to what their role designates. Their activities will be recorded and an indelible audit trail will be created. In addition to helping guarantee the integrity of IT systems, this is invaluable for forensics and troubleshooting purposes – and often serves as a deterrent to malicious or unethical behavior. Role-based access can and should be granularly defined to meet CIP and data privacy requirements," Libenson asserts.

"If a utility works within the framework of these best-practices approaches, a robust access control solution will allow for an easier implementation and enforcement of security policy related to privileged accounts. These technologies serve as a centrally controlled application for password management for the hundreds – or even thousands – of systems typically running within a complex, heterogeneous Windows/UNIX/Linux environment," Libenson continues.

"By making it easier to authenticate users and automate access restriction, utilities will be a step closer to a secure infrastructure and complying with the multiple requirements within NERC's CIP regulations," Libenson concluded.

Ceelox is another provider of access control solutions serving the utility industry. The company's biometric security software solutions are used in multiple vertical markets and businesses including utilities.

"The use of fingerprint biometrics substantially reduces the chance that an unauthorized person could access your computer files, services or networks," says Ceelox's **Kass Aiken**. "Each user simply authenticates their identity via a fingerprint scanner. This provides a much stronger access authentication than user name and passwords that can be lost, stolen, forgotten or shared – whether accidentally or intentionally. The Ceelox identification solution offers convenient password replacement with the swipe of a finger," Aiken emphasizes.

The Ceelox sytem is very flexible and has been used by a Florida-based electric utility to create custom features, permitting multiple employees to access the same workstation with fingerprint biometrics while successfully logging into their individual SCADA sessions with different application-level access. In addition, the solution provided roaming user profiles, so that user settings "follow" each person from one workstation to another without the need for reprogramming.

Gregg Larson of Sensus Metering Systems contends that many of the communication systems deployed across the myriad of data conveyance applications in the utility environment use only a single method of encryption or authentication.

"While the method selected is usually closely tied to the level of complexity and standards set forth by relevant governing bodies for

Multi-layered Security Solution

(Image courtesy of Sensus)

each application, securing wireless communications is often left to a single element," Larson points out. "Use of a monolithic (i.e., 'single-layered') approach to security – though perhaps quick, easy and seemingly inexpensive to implement – sends a strong message to potential attackers that they need only breach one layer to completely compromise the security shield in place."

By contrast, some systems employ multiple communications security measures to provide a series of barriers to unauthorized access. In applications such as advanced metering infrastructure (AMI) networks, for example, large numbers of potential access points (i.e., meters) are routinely deployed in unsecure locations, thus providing numerous possibilties for security breaches. This is especialy true for two-way AMI networks where endpoints can freely communicate with the host, data concentrators or even each other on a peer-to-peer (P2P) basis, depending on the supplier and system architecture. In this increasingly common scenario, every node becomes a ready-made entrance into the network as well as potentially opening a path into every system deployed using that same technology – whether in the past or the future.

A sample multi-layered security shield is depicted in the diagram above. In many older and even some newer ones, only a few of these layers are implemented or available; in other cases, a single layer may be the only security protection there is. Moreover, some systems rely partially or even entirely on third-party security measures over which the user has no influence, control or recourse when cellular or other conventional media networks are employed.

By contrast, utilizing all of the layers simultaneously, means that penetration defenses are vastly improved. Indeed, it is the wrapping of one layer upon another that provides security thresholds that are otherwise unattainable. This is not to say that one encryption method is necessarily better than another (although one could argue that some are), but rather that all measures used in concert provide the most robust communications protection across an entire network, end-to-end and point-to-point.

"Putting the final elements under the control of the end user also means that every customer can be fully isolated from all others, which is paramount when considering the pace at which AMI systems are currently being deployed," Larson observes. "And without taking the necessary steps to protect these systems properly and comprehensively, we are essentially designing in new vulnerabilities that will inevitably have to be remedied after deployment – a much more costly and time-consuming path.

Conclusions

The companies represented here (and previously, in Part 1 of this feature) barely scratch the surface of the many types, technologies and sources of security solutions. However, it is hoped that by broadening exposure to security issues and heightening awareness of the potential threats as well as the available deterrents, users will be better equipped to make informed selections when the need arises, as it most certainly will at some point, if not already. (Remember to watch for our follow up report in the November/December 2009 issue!) ■

FCC Rule Violations Can Be Costly

Compliance with FCC guidelines helps protect against fines

By Wesley K. Wright, Associate | Keller & Heckman LLP

Many electric utilities use private Federal Communications Commission (FCC) radio licenses to support daily operations, including Supervisory Control and Data Acquisition (SCADA) systems, Multiple Address Systems (MAS) and Automatic Meter Reading (AMR). Electric utilities operating private FCC radio licenses must also ensure that these operations remain compliant with the rules and regulations of the FCC. This article outlines the Commission's enforcement procedure and provides general guidance to promote compliance with FCC rules. It is not an exhaustive list of potential enforcement actions, but instead identifies common FCC enforcement proceedings brought against electric utilities and other private licensees.

For example, an electric utility in Minnesota held four FCC radio licenses that expired in July 2004. The utility continued to these stations after the expiration date and requested that the licenses be reinstated in October 2006. In April 2007, the FCC's Enforcement Bureau issued a Notice of Apparent Liability proposing a fine of $20,800 against the utility for operating under expired licenses. The utility eventually paid $16,000 to settle the case.

The plight of this co-op is not an aberration. Electric utilities and other private FCC licensees have become increasingly ensnared in a variety of FCC enforcement proceedings initiated under the Commission's authority in 47 U.S.C. § 503 and 47 C.F.R. § 1.80. In 2007, the Enforcement Bureau levied a record-breaking $43 million in fines, forfeitures and monetary settlements entered into through consent decrees. The Bureau was on pace to surpass this total in 2008.

Enforcement Procedure Overview

In light of the Commission's increased emphasis on enforcement actions, it is critical for all licensees to understand the agency's enforcement procedures. The FCC's Enforcement Bureau typically initiates investigations after receiving a complaint, through an inspection of its own, or by a referral or as a result of a voluntary disclosure. After an investigation is initiated, the Bureau frequently contacts the subject of the investigation regarding any alleged rule infraction by issuing either a Citation or a Letter of Inquiry (LOI).

A Citation is issued to an entity that does not hold and has not applied for any FCC licenses, permits, certificates or other authorizations and alleges the recipient violated an FCC rule. Generally, the Commission does not impose a fine (also known as a "forfeiture") upon the recipient of a Citation unless the recipient continues to violate the Commission's rules after receipt of the Citation or engages in activities for which an FCC license, permit, certificate, or other authorization is required but was not obtained.

An LOI is issued to an FCC applicant or licensee and poses questions to company officials to elicit information and supporting documentation regarding an alleged rule violation. The recipient of an LOI is generally given 30 days to respond and usually can request an extension if additional time is needed.

If after reviewing the response to an LOI the Bureau believes that a violation has occurred, it may decide to discontinue the investigation and take no action, issue a Notice of Apparent Liability (NAL) or negotiate a Consent Decree with the recipient. A NAL alleges that a rule violation has occurred and finds the recipient apparently liable for a fine or penalty. The recipient of an NAL may pay the penalty or request that the penalty be reduced or dismissed.

A Consent Decree is a voluntary settlement between the entity and the FCC resulting in a finding of no wrongdoing and usually requiring the licensee or applicant to make a "voluntary" monetary contribution to the United States Government and to implement various corrective measures looking toward future compliance. (The co-op identified in the introduction entered into a Consent Decree and "voluntarily" contributed $16,000 to the U.S. Treasury as a result of its apparent operation of expired FCC licenses.)

The Commission computes the amount of a proposed penalty by following the baseline amounts contained in its Penalty Policy and recent decisions in similar matters while increasing or decreasing the proposed forfeiture or settlement amount depending on the presence or absence of various aggravating or mitigating factors.

A forfeiture amount may be increased if the Commission finds egregious misconduct; an intentional violation; substantial harm; prior violations of any FCC requirements; or a repeated or continuous violation. A forfeiture amount may be decreased if the Commission finds a minor violation; good faith or voluntary disclosure; history of overall compliance; or inability to pay.

The statute of limitations prohibits the Commission from imposing a forfeiture penalty for violations that occurred more than one year prior to the date of issuance of an NAL. However, the FCC may consider apparent violations committed more than one year prior to this issuance of an NAL when calculating an appropriate forfeiture amount for violations that occurred within the one-year period.

Following the issuance of the NAL, affected licensees or applicants are provided a reasonable period of time, generally 30 days, to respond and demonstrate why the forfeiture should not be imposed or should be reduced. If an enforcement matter is not resolved through payment of an NAL or a Consent Decree, the Commission may issue a Forfeiture Order requiring the fine to be paid in full or in part or canceling the proposed fine.

Recent FCC Enforcement Actions

- **Continued Operation After License Expiration**
  A licensee failing to renew a license prior to expiration may submit a renewal request up to 30 days after the expiration date. Renewal requests submitted more than 30 days after the expiration date may be referred to the Enforcement Bureau for further investigation. In addition to the co-op discussed in the introduction, several licensees recently have paid $6,500 for operating a single private radio station after the license expired.
- **Antenna Structure Registration Compliance**
  The FCC has established specific requirements governing the registration, marking and lighting of towers. Among other requirements, tower owners are obligated to conform the tower to the FAA's painting and lighting requirements and clean and repaint towers as often as necessary to maintain good visibility. One tower owner was recently fined $15,200 for failing to comply with the lighting, monitoring and notification requirements and another tower owner received a $13,000 fine for failing to paint its antenna structure to maintain good visibility and also failing to notify the FCC of a change in antenna structure ownership.
- **Corporate Mergers and Acquisitions**
  The Enforcement Bureau recently has expressed increased concern regarding mergers and acquisitions of entities holding FCC authorizations. Parties to a corporate merger or acquisition must secure the FCC's prior consent to an assignment or transfer of control of FCC licenses as part of any merger or acquisition. For private licensees, failing to comply with this requirement may result in a forfeiture calculated, in part, by the number of licenses involved in the transaction and the nature of the facilities. Private licensees recently have paid $24,000, $30,000 and $35,000 to terminate FCC investigations into allegations of failure to secure prior consent to the assignment of wireless licenses or transfer of control of wireless licensees as part of a corporate acquisition.

A licensee's or applicant's refusal to pay a Forfeiture Order cannot be used against the licensee or applicant in any future proceedings at the FCC. The FCC also has no authority to collect unpaid forfeitures on its own. Rather, unpaid Forfeiture Orders may be referred by the FCC to the Department of Justice (DOJ) for collection. The DOJ, in its discretion, may elect to file a civil suit to collect the fine in the district where the recipient has its principal operating office.

The suit will be a "trial *de novo*," meaning the DOJ cannot rely on the facts or legal findings in the FCC's Forfeiture Order but must prove the case on its own as if it were a "new" case. As a result, the FCC usually only refers to the DOJ for collection particularly egregious enforcement matters or ones involving serious issues of public policy.

Protecting Your Company

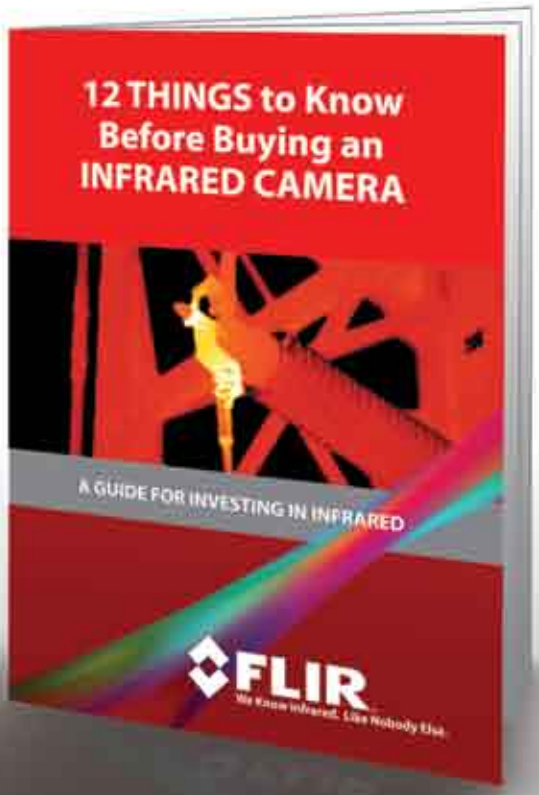
In light of the Commission's increased focus on enforcement, sound business practices require that your company be in compliance with all applicable FCC requirements. To promote compliance with the rules, private licensees should periodically review their physical facilities and compare them with all active FCC licenses. Any discrepancy between actual and licensed operations should be quickly corrected.

Mergers and acquisitions can also raise unique licensing issues at the FCC and require heightened awareness by all parties (See Inset). Only by closely tracking all FCC license assets and licensing requirements can companies involved in mergers and acquisitions ensure compliance with applicable FCC requirements.

A private licensee also should be prepared to investigate and promptly respond to all Commission inquiries. Private licensees having substantial investments in land mobile and microwave systems should establish an internal procedure to ensure that appropriate personnel are apprised of citations and LOIs so that internal reviews may be conducted, corrective measures may be taken, and a complete response to the citation or LOI may be timely filed with the Commission. ■

About the Author

Wesley K. Wright *is an Associate at Keller and Heckman LLP. Mr. Wright joined the firm in 2006 and practices in the areas of telecommunications and transactional law. His telecommunications practice focuses on assisting corporate clients and trade associations with various legal and regulatory matters before the Federal Communications Commission, Federal Aviation Administration, courts and various state agencies. His telecommunications practice involves a variety of telecommunications matters related to private wireless licensing, pole attachment issues and FCC enforcement matters. Mr. Wright can be reached at (202) 434-4296 or wright@khlaw.com.*



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