

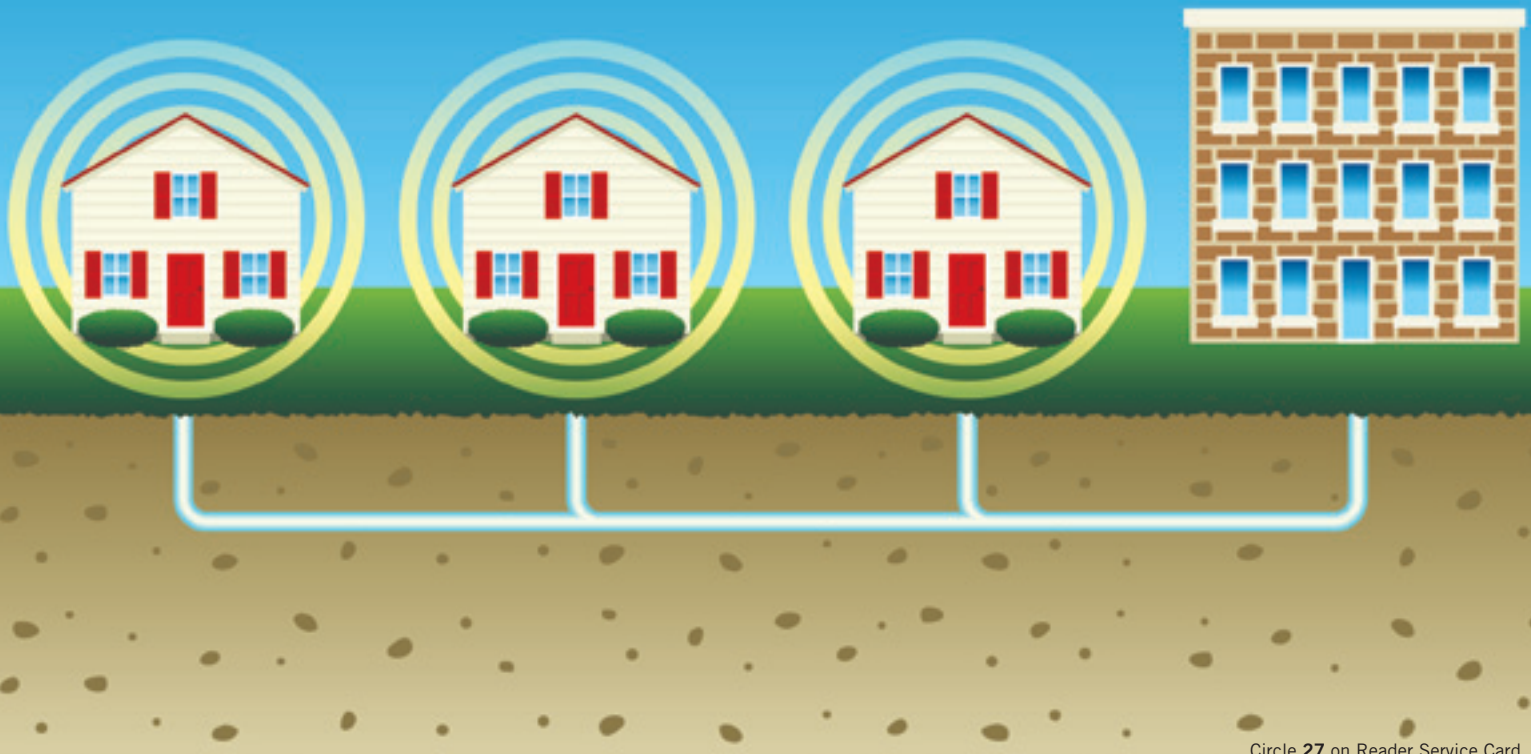


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KCP&L and Google: A Next Generation Partnership



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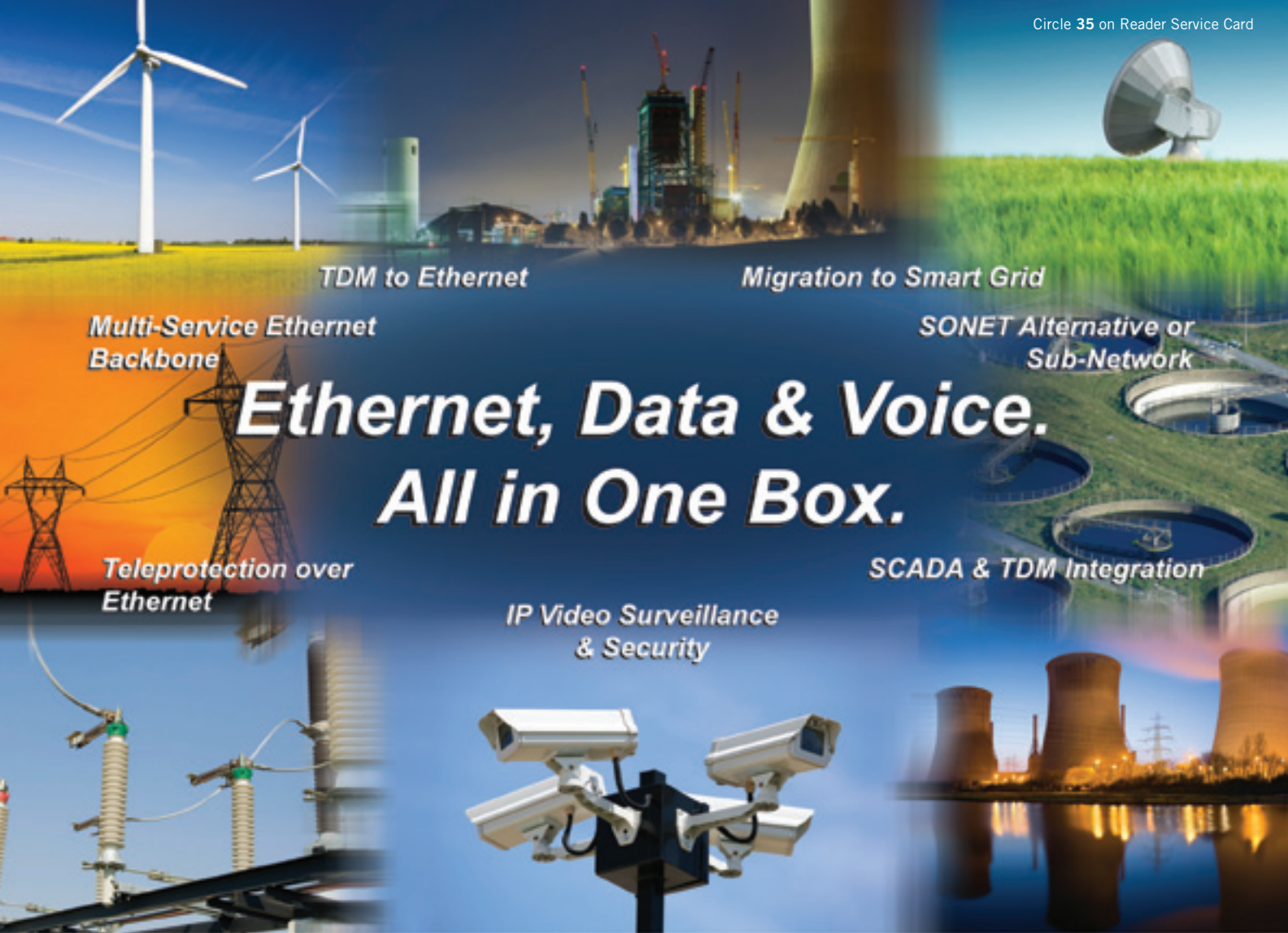
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The more things change...

In my May-June 2011 *GridLines* column I opened a broad-based discussion about change and whether the changes we're seeing today are – or need to be – evolutionary versus revolutionary. The fact is, we'll likely see a lot of both no matter what we think. The one thing you can count on, however, is that change will indeed happen. But even given that we will inevitably have change, something that we usually can't know very far in advance is exactly how fast that change will come. And we almost always seem to underestimate how much time change really takes.

Funny, but one thing that always takes me by surprise, even after more than 40 years of close personal observation, is that change rarely, if ever, happens as fast as “they” say it will; as fast as it probably could; or as fast as I think it will – and by the way, I know for sure that I'm usually in good company on that last miscalculation! Let me give you a personal example of what I mean...

When we sold the last SCADA company that I was involved with along with three other partners in 1983, we were on the bleeding edge of RTU (remote terminal unit) technology. Having just introduced the industry's first single-board RTU just a scant 3 ½ years before the company was sold, we had already designed, built and deployed two newer versions that were better, faster and cheaper than anything else on the market – including our own original design. In our minds (and those are key words), the world – meaning our customers and the rest of our target market – had moved on to the latest and greatest, making our original RTU a legacy product that we still supported but didn't try very hard to sell. We were on to the newer – and of course, far more exciting stuff – new models that were just starting to roll off the production line. (Man, we were proud!)

But then, through no fault of our own, the bottom fell out of our main market, which at the time, was pipeline SCADA systems. (Those of you who are old enough will remember 1984, the first time that oil prices dipped below \$10 a barrel – you know, what we now call the Good Old Days!) It wasn't good for our small company, however, since our biggest and most reliable customers just tightened their belts and stopped buying SCADA systems. Needless to say, that put us in quite a lurch since no amount of price-cutting or performance enhancement was going to change the status quo. It soon became obvious that this was way out of our hands.

As luck would have it, a company that had been sizing us up for some time and liked what they saw came forward with a purchase offer that we were hardly in any position to refuse. It wasn't really a bad offer at all, and under the circumstances, it was downright generous. So, we signed the letter of intent and off we sailed, into the sea of due diligence. For those not

familiar with that term, it simply means doing a lot of legal and financial investigation to determine whether things really are indeed as they appear to be. That involved turning the company upside down, ferreting out every record or scrap of paper with something scribbled on it to either prove or disprove what was presumed to be the reality upon which their purchase offer was based.

I'll never forget the words of their CFO when their team of attorneys and accountants descended upon us. He said, “By the time we're done, you'll learn things about your company you never even knew before.” I remember (smugly) thinking to myself: This is OUR company. We built it from scratch. There's nothing you can tell us that we don't already know. Boy, was I wrong! They slogged through mountains of financial records, project files and even our petty cash receipts. At one point they asked what we did with ten sacks of crawfish at \$30/sack. (That was for our annual company Crawfish Boil; something that buyers living 750+ miles from Southeast Louisiana, knew nothing about!) I know this is the long way around, but I'm getting to the point of all this.

When they finally finished looking at all of our records, one part of the results didn't mesh very well with what we'd been telling them. Most of our sales and technical discussions over the many weeks leading up to the due diligence exercise were dominated by our latest and greatest products. It was those products – and their future market potential – that had everything to do with why they wanted to buy us in the first place. Yet when they looked at what was paying the bills, it was almost entirely our earliest products providing the bulk of the income. Hmm, who knew? This was the quintessential ‘can't see the forest for the trees’ problem – and a real eye opener, I might add.

How could this have happened without our knowing it? Easy. It all revolved around being so focused on our next big thing, that we had failed to realize that our customers had only recently reached a point where they felt our earliest products were, well – safe. They'd been through all the sales pitches, the pilots, the factory testing, and if course, the critical field testing – all things that simply can't be rushed. Meanwhile, in our own minds, we were three years down the road; what had come before was ancient history, the way we looked at it. This was truly a teaching moment, and one that I'll never forget.

These days it's easy to get caught up in the hoopla with so many new things happening and so much change all around us. But sometimes it's useful to put the hype aside and focus on reality, because the more things change – almost inevitably – the more some things remain the same. – *Ed.*

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AEP to Attract Military Veterans Through Troops to Energy Jobs Pilot Program

Columbus, OH - American Electric Power (NYSE: AEP) announced its participation in a pilot effort to link veterans leaving military service to job openings in the energy industry. The new pilot program, called Troops to Energy Jobs, will last approximately two years and will be carried out by AEP and four other U.S. electric utility companies in conjunction with the Center for Energy Workforce Development (CEWD).

The program will establish an ongoing process of outreach, recruitment, career coaching, mentoring, education and training for veterans whose military skills and experience match up with the workforce needs of energy companies.

"Military veterans tend to have the technical training, experience and personal characteristics that make them a great fit for careers in the utility industry," said Robert P. Powers, president of AEP utilities and chairman of CEWD. "This pilot program will provide veterans with a pathway to job opportunities in our industry and allow AEP to continue its commitment to hiring those who have served our country for skilled positions such as power plant operators, chemical and maintenance technicians, and line mechanics."

Nearly 10 percent of AEP's roughly 18,700 employees have served in the military. AEP's military leave policy provides pay differential and benefits for up to two years for reservists and National Guard members who are called to active duty in emergency situations. The company's family military leave policy allows employees to take up to 10 days of leave to spend time with a family member who has been called to or returned

from active duty. AEP has been honored as one of the nation's top 100 "military-friendly" employers by G.I. Jobs magazine for eight consecutive years.

Other companies participating in the Troops to Energy Jobs program are Arizona Public Service Co., Dominion, Pacific Gas and Electric Co. and Southern Co. Troops to Energy Jobs is managed by the CEWD, a non-profit consortium of electric, natural gas and nuclear utilities; their associations (Edison Electric Institute, American Gas Association, Nuclear Energy Institute and National Rural Electric Cooperative Association); and the unions who serve these industries (International Brotherhood of Electrical Workers and Utility Workers Union of America, AFL-CIO.)

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PNM Resources' Texas Utility Receives Approval for Smart Meters

Albuquerque, NM - PNM Resources' (NYSE: PNM) transmission and distribution utility in Texas, TNMP, today received regulatory approval to recover the costs of installing an Advanced Metering System throughout its service area.

The unanimous approval by the Public Utility Commission of Texas is based on an agreement reached with all parties that will allow for the recovery of \$113.4 million, including \$66.3 million of capital, through a surcharge during the next 12 years. TNMP will install up to 240,000 meters beginning this year through 2016.

For more information, visit the company's Web site at www.PNMResources.com.

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SDG&E Signs Renewable Contracts for Nearly 200 MW of Green Energy

San Diego, CA - Since January 1, 2011, San Diego Gas & Electric (SDG&E) has added more than 1,200 megawatts (MW) of clean, green energy to its renewable portfolio. On July 8, the utility announced it has signed two more contracts: a 25-year power purchase agreement for 150 megawatts (MW) of solar power with Solar Gen 2 LLC and a one-year contract for 40 MW of geothermal power with Silicon Valley Power.

Solar Gen 2 LLC is a private solar development company based in Greenwich, Conn., with offices in Folsom, California. The 150-MW solar project will be built in three, 50-MW phases at separate sites on fallowed land in the Imperial Valley, California. Delivery of power from the first phase is expected by next summer.

"We continue to add more diversity to the mix of green energy in our renewable portfolio," said James P. Avery, SDG&E's senior vice president of power supply. "This latest solar project will be transmitted across Imperial Irrigation District (IID) transmission network to SDG&E and will get delivered to our customers and the Southern California region using the capacity of the Sunrise Powerlink and the help of the IID. With this agreement, we are broadening our partnership with the IID and helping to benefit the overall economy of the Imperial Valley -- a true win-win all around."

The project will use solar photovoltaic panels with single-axis tracking and is expected to generate about 361 gigawatt-hours per year on average over the length of the contract, which represents nearly 2 percent of SDG&E's renewable portfolio over a full year.

"With SDG&E's development of the Sunrise line, we and other renewable developers can take advantage of the Imperial Valley's vast solar resource to benefit all of California," said Steve Zaminski, chief executive officer of Solar Gen 2. "We are pleased and grateful for the confidence placed in us by both SDG&E and the IID. This

project would not be possible without the leadership and vision of SDG&E's and IID's board and management."

Silicon Valley Power (SVP) is a municipal utility that serves the City of Santa Clara, California. The one-year power contract for 40 MW of electricity generated by underground steam heat is expected to produce about 350 gigawatt-hours of electricity over the length of the agreement, which continues through June 2012. Starting July 1, SDG&E began taking delivery of the geothermal power, which comes from Silicon Valley Power's ownership share of the geothermal units located in the Geysers region of Northern California.

"This contract is an example of the efforts SDG&E is making to comply with the near-term requirements as spelled out in new renewable legislation (SBX1 2)," said Avery. "This contract would add 1 percent to our RPS portfolio in both 2011 and 2012."

"We are excited to be in a position to support SDG&E in their renewable efforts," said Larry Owens, manager of customer services for Silicon Valley Power. "The proceeds from this contract agreement will go directly into investments of new renewable power for our city."

Both contracts require approval by the California Public Utilities Commission. Since January, SDG&E has signed 14 new renewable contracts, for a combined total of 1,225 MW.

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NRECA's Smart Grid Demo Project Finalizes \$13.7 Million in Contracts

Washington, DC - By the end of July, 2011, the National Rural Electric Cooperative Association will close on contracts worth \$13.7 million for smart grid components to be deployed at 23 cooperatives participating in the cooperatives' regional Smart Grid Demonstration Project (SGDP).

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Supported by a matching grant from the U.S. Department of Energy, over the course of the project, participating cooperatives will deploy more than 75 technologies and kinds of equipment in twelve states.

NRECA has made these purchases for research and evaluation of the following smart grid features:

Communications

AMI systems and digital communications software and infrastructure to enable smart grid features including demand response over AMI, load management, prepaid metering and in-home energy displays.

Efficiency and Demand Response

Software and equipment to improve efficiency both at the operational and end-user level, and enable automated demand response and load control. Components include load control switches, in-home displays, advanced Volt-Var control, demand response over AMI, meter disconnect collar sealing kits.

Reliability and power quality

Software and equipment to improve reliability by implementing SCADA, self-healing capability, power quality monitoring and regulation and improved conservation voltage regulation.

Distributed generation and renewable energy

Equipment to assist the integration of renewable energy and distributed generation resources.

NRECA has executed contracts with the following vendors: Cooper Power Systems, Inc., HD Supply Utilities, Ltd., Stuart C. Irby Company, Larson Communications, Inc., RFIP, Inc., Ruggedcom, Inc., and VFP, Inc.

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Entergy Helps Grow Electric Vehicle Infrastructure With \$160,000 Grant
Entergy selects Coulomb Technologies to bring charging stations to college campuses

Baton Rouge, LA - Entergy Corporation (NYSE: ETR) announced it is working with Coulomb Technologies to fund and donate 16 electric vehicle charging stations at college campuses in and around Entergy's four-state service area.

The first two Entergy-funded charging stations were unveiled during a special event at Louisiana State University as Entergy and LSU launched one of the state's first major forays into the electric vehicle market. The event featured Dr. Michael Martin, LSU Chancellor; Bill Mohl, president and chief executive officer, Entergy Louisiana, LLC and Entergy Gulf States Louisiana, L.L.C.; and Allan G. Pulsipher, executive director, LSU Center for Energy Studies.

"Electric vehicles are gaining widespread attention and being embraced as an important technology solution for the nation's energy future. We know that the infrastructure must be in place to support the evolution of the technology, and we hope Entergy's donation of EV chargers to LSU will help start that process for the southern region," said Mohl. "This program is part of our deeper commitment to support technologies that foster environmental sustainability and provide for clean, efficient and affordable power for today and tomorrow."

The charging stations were donated to LSU through a \$160,000 grant by Entergy's Environmental Initiatives Fund. Entergy is currently working with other universities in Arkansas, Mississippi, Louisiana and Texas to donate additional electric vehicle charging stations throughout the region.



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"As the state's flagship university, it's fitting that we are the leader in accepting and installing Entergy's gift in the company's four-state service territory," said Martin. "This partnership will go a long way to establishing a cleaner environment and a cleaner way to travel for our citizens."

The LSU charging stations, which are free to use by all LSU faculty, staff and students, are among the first in the nation to be installed on a university campus for the sole purpose of providing free charges to electric car owners and for research purposes.

"Collecting usage data will allow Entergy and LSU to conduct critical research about EV chargers," said Brent Dorsey, director of corporate environmental programs for Entergy. "The goal is to determine the impacts and opportunities of EV charging, including length to charge, consumer charging profiles, time of day for charging, impacts on electric facilities and other consumer behavior and preferences."

The charging stations were manufactured by Coulomb Technologies and are part of Coulomb's ChargePoint® Network, the largest EV

driver network in the world. Coulomb specializes in EV charging systems and operates in 14 countries. The charging station data collection is enabled by the ChargePoint® Network, which provides online access to the data including detailed usage reports, greenhouse gas and gasoline savings. Installation of the charging stations was completed by Verdek, Coulomb's south central regional distributor.

"We are proud to play a part in expanding the ChargePoint Network into the south central region," said Guy Mannino, CEO of Verdek. "As more zero-emission vehicles become available in the region, providing easy and convenient ways to charge is essential for consumer adoption of this new form of transportation."

Entergy's Environmental Initiatives Fund was established as a mechanism to reduce greenhouse gas emissions through innovative, promising projects and is part of the company's ongoing efforts to seek sustainable environmental solutions to its business.

Entergy's online address is www.entergy.com.

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Guelph Hydro's "Green" Facility Receives LEED® Certification
Office building is a testament to the company's commitment to sustainability

Guelph, ON - Guelph Hydro is pleased to announce that Phase II of its office on Southgate Drive in Guelph has officially received LEED® (Leadership in Energy and Environmental Design) certification from the Canada Green Building Council. The 3,344 square metre addition built in 2005/2006, features many energy-efficient and sustainable characteristics including a ground-source geo-thermal heating and cooling system, high-efficiency plumbing and lighting, and drought resistant and native species landscaping.

"We are immensely proud of our LEED®-certified office. Not only is it a bright, spacious, and healthy environment for our employees to work in, but it also demonstrates our commitment to sustainable business practices and our leadership in the field of clean, renewable energy," says Barry Chuddy, Chief Executive Officer, Guelph Hydro Inc.

To earn certification, the building was evaluated in areas such as energy and water efficiency, atmospheric gas emissions, indoor environmental quality, and stewardship of natural resources.

Energy and Water Efficiency

As a result of a geo-thermal heating and cooling system, lighting efficiencies, and building envelope design, the building consumes 43 per cent less energy than the minimum requirements for energy efficiency set out in the National Resources Canada Model National Energy Code for Buildings (MNECB).

Water use is 20 per cent lower than LEED® baseline measurements.

Environmentally sustainable features of the LEED®-certified building include:

- A geo-thermal heat pump system uses the ground's natural temperature to provide clean, renewable, heating and cooling for the building

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- Timers and motion sensors control building lights
- Skylights and large windows provide natural lighting
- Windows can be opened or closed to enable the flow of fresh air
- High efficiency plumbing fixtures including low-flow faucets and toilets reduce water use
- Designated carpool parking spots as well as bike racks and showers to encourage employees to bike to and from work help reduce fuel consumption and greenhouse gas emissions from personal vehicles
- Drought tolerant and native plant species that eliminate the need for landscape irrigation, excessive fertilization and pest control
- Local and recycled construction materials used throughout the building
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Note: Guelph Hydro recently installed 60 arrays of solar photovoltaic rooftop panels to feed 100 kilowatts of clean, renewable energy into the Ontario electricity grid. The solar power installation was not included in the LEED® application because the LEED® certification process began before the panels were installed.

For more information, visit www.guelphhydroinc.com

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General Physics Corp. is recognized by the North American Electric Reliability Corporation as a continuing education provider who adheres to NERC Continuing Education Program Criteria.

KCP&L and Google – A Next Generation Partnership

By Steven Gilkey, Senior Director T&D Engineering & Planning,
and William Menge, Smart Grid Director; Kansas City Power & Light.

Many of us in the utility industry are forward thinkers. Providing a service that is expected to be instantly available through a system, which must last for decades, requires some forward thinking. For those new to the industry, take a moment to consider this quote – “The economic health of an electric utility is highly susceptible to changes in economic, social and living patterns of the community. It will be necessary for utilities to take new risks and assume unfamiliar roles in the public arena.” This quote was from the 1969 Power Systems Conference presentation given by J. W. Simpson, president of Westinghouse.



As we fast forward to 2011, our leadership at KCP&L embraces the same spirit. KCP&L strives to improve life in the communities it serves. This goal permeates everything the company and its employees do. So when we were approached by Google to partner with them to help build a newer, faster Internet service, we thought it was another great opportunity to improve life in the communities in which we live and work. This Internet service, called Google Fiber is expected to be available through a system that will be built using KCP&L's existing infrastructure. Google has said Google Fiber will bring ultra high-speed fiber optic Internet service at one gigabit per second to the Kansas City, Mo. After months of positive collaboration and planning, the world now knows about the “Googlization” of Kansas City. Through this unique agreement, KCP&L will provide access to our electrical infrastructure for Google to install its fiber. In turn, Google will be able to offer Internet service at speeds up to 100 times faster than what most people have today.

Embracing the Future

This agreement is not just an agreement between two companies; it opens the door to a multi-path superhighway to the future. You may have seen some recent articles about data overload, latency and buffering frustrations. These are issues

that are becoming commonplace and will only get worse. As systems keep progressing, we need to be able to adapt. For example 3G-to-4G advancement is now mainstream in the telecommunications industry. Similarly, now is Kansas City's chance to embrace this technology and the future of the Internet in one quantum leap. This is exciting for the region and motivating for our communities as we imagine and discover what is possible with this type of Internet service.

Just as in the J. W. Simpson quote previously mentioned, service is about keeping the customer and community satisfied. With this technology, KCP&L will be able to create customer satisfaction plans for tomorrow that address customer issues that haven't yet occurred. In short, we may be able to solve customer problems, before the issue even arises. Today, customers expect instant response and the ability to access information on any topic. Customers have computers, cell phones and automobiles that can send information on thousands of data points. Utilities also seek instant updates on thousands of data points on the transmission and distribution system. How this culminates in useful information we all can benefit from is evolving, but the speed to move and process things in Kansas City is about to change.

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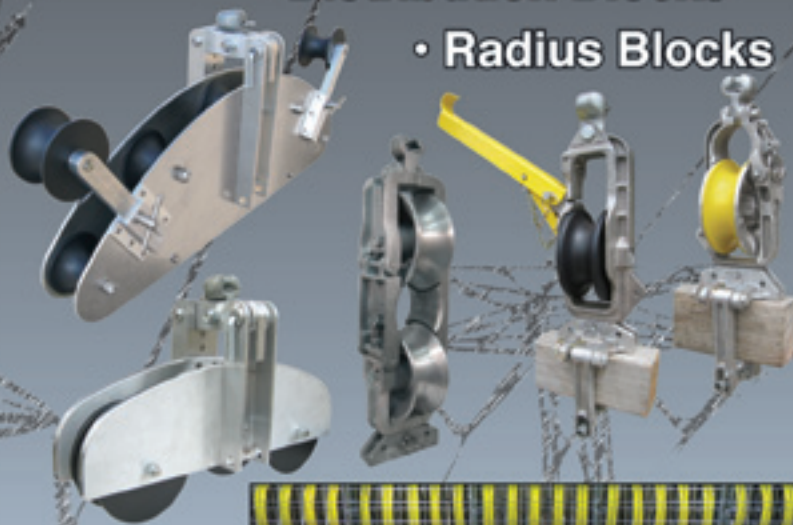


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Mike Chesser, Chairman and CEO of KCP&L and Great Plains Energy, and Kansas City, Mo. mayor Sly James exchange congratulations at the Google Fiber project announcement.

Testing Our Limits

In November 2009, KCP&L announced its SmartGrid Demonstration Project. This project is supported by a grant awarded by the Department of Energy (DOE) and matched by KCP&L and its project partners. This initiative encompasses most aspects considered to be part of a smart grid – smart generation, renewables, smart substations, smart distribution, smart buildings and smart customer end-use. The DOE is focusing a good deal of attention on interoperability and refinement of emerging smart grid standards through KCP&L's \$24 million SmartGrid Demonstration grant. As we are building a state-of-the-art system through this grant, KCP&L's partnership with Google has enabled us to expand our horizons even further. The deployment of a distribution management system known in the utility industry today is at our SmartGrid Demonstration Project's beginning, and Google Fiber will allow us to test the limits of real-time system reconfiguration. We have driven our engineers, project architects and vendors to think "outside the box;" this places our thinking "outside the universe."

Today's computers and servers are capable of manipulating and storing high volumes of data. However, these devices can only send and store the amount of data they are able to transmit. In other words, if the infrastructure is not there, the bandwidth is limiting.

This is particularly true of a distribution system; if the size and speed of the infrastructure is behind the times, the information is not up to par. Can you imagine having gigabit speed available to any piece of distribution equipment – new or existing? It is no secret that the speed of fiber communications enables extremely fast fault detection. Having the ability to reconfigure the system and isolate the fault in nanoseconds before a breaker would trip in the first place is a concept we may try testing to see if it is applicable and beneficial to our system and customers.

If you think back to the IBM PC and then consider today's Internet capabilities, mobile computing and wireless communications platforms, open standards have enabled a great deal of successful third-party development. Just a few years ago you could not buy an external computer device and connect it unless you inserted the accompanying CD first. Now your personal computer can recognize devices when they are simply plugged in. Currently, KCP&L's SmartGrid focuses attention on developing industry standards as the utility industry is not yet to the "plug-and-play" world. Google has an understanding of what it takes to do this, and we intend to work with them to help utilities move quickly down this path.

Connecting with Customers

With all of the resources Google possesses, it is able to understand and influence customer behavior like electric utilities and other industries never have. Because of their experience with customer interaction, the ability for KCP&L to brainstorm possibilities with Google is truly exciting. Google is a company that touches millions of customers each second and is continuously finding new and innovative ways to communicate with their customers.

Collaborating with Google on bringing this ultra high-speed Internet service to the Kansas City region may dramatically accelerate KCP&L's ability to educate, outreach and train customers on a variety of products and services. This could all start with our SmartGrid concepts and tools – using a combination of best practices from KCP&L and Google customer communications experience. Gigabit speed to customers will enhance these capabilities for utilities.



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As an energy provider, we have an obligation to educate our customers on energy use, power creation and distribution as well as up-and-coming technology we see in our SmartGrid Demonstration Project. Educating our customers empowers them to make wiser and more informed decisions about their energy usage. Google is an expert in marketing, and marketing is a focused level of customer education.

Benefits of Bandwidth

KCP&L takes cyber security for our company and our customers seriously. To achieve our SmartGrid Demonstration Project's full benefits, large amounts of data need to be available in multiple arenas that do not exist today. Protecting data from cyber attacks is essential to the success of a smart grid. Once again, partnering with Google could help move us forward more quickly than we could without ultra high-speed Internet service. Google understands the importance of delivering a highly reliable service, and any disruptions in service would affect public image, revenue and customer confidence for Google. Similarly, KCP&L focuses on customer satisfaction and stakeholder confidence in our system reliability and the value of the service we deliver for the price.

Another benefit of gigabit bandwidth is the ability to update software and firmware in field devices. We are all familiar with the cost of rolling a truck to update an intelligent device. Bandwidth continues to be a concern, even with today's modern advanced metering infrastructure (AMI) systems. Even if equipment is capable of updating remotely, we tend to shy away or wait for larger upgrades to avoid "clogging the system" with non-essential data flows. If bandwidth is no longer an issue because of Google Fiber, applying patches should become significantly less of a concern.

Consequently, many of us are still waiting for a real Distribution Management System (DMS). Partnering our utility expertise, including vendors, with the ingenuity and creative horsepower of Google will bring data to system operators' fingertips more quickly than ever envisioned. The possibilities abound: the graphical user interface (GUI) could become a touch screen capable of responding to voice commands; a single operator could perform at the productivity of multiple operators today, with a lower error rate; video chat between an operator and a crew truck becomes a day-to-day business practice.

Gigabit data can enable video monitoring that captures on-the-scene events. Engineers and troubleshooters can quickly place video equipment in service that can be triggered to retain rolling footage after an event. Imagine what could be learned if we are virtually present while an event occurs. This will be valuable for improving system reliability and equipment designs from an asset management perspective.



Missouri Congressman Emanuel Cleaver II thanks KCP&L for its involvement in not only the Google Fiber project, but also for KCP&L's involvement in other innovative initiatives such as its SmartGrid Demonstration Project.

Where will Google Fiber take us? No one is quite sure yet. What we do know is that KCP&L has an opportunity to be a pioneer of this technology, finding uses that will benefit the business and our customers. As the United States was developing, pioneers found a connection point in Kansas City: the Sante Fe Trail, Oregon Trail and California Trail connect here in the heartland. Google Fiber will allow KCP&L to have an Internet service that will unlock countless benefits for the community. Companies will want to move here; our schools, businesses, neighborhoods and individual residents will see the advantages of the ultra-fast broadband technology.

We have a proud history of innovation and "firsts" in our industry, from our landmark carbon offset agreement with the Sierra Club, to our SmartGrid Demonstration Project, to the introduction of all-electric vehicles to our fleet. KCP&L will pioneer into the future with Google Fiber. Just as the move from dial-up to broadband led to new and unpredictable innovations, ultra high-speed bandwidth will push the web to even greater heights – and we couldn't imagine a better place to start than the Kansas City region. ■

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ABOUT THE AUTHORS



Steven Gilkey currently holds the position of Senior Director T&D Engineering & Planning at KCP&L. He has responsibility for all engineering functions in the transmission, distribution and substation areas of KCP&L. The delivery capital budget, transmission system operations and SmartGrid strategy also fall under his direction. Mr. Gilkey has been with KCP&L since 2003.

Steven began his utility career in 1985 as an Electrical Engineer at Niagara Mohawk Power Corporation. His industry experience includes engineering, field supervision, operations management, emergency response, merger and acquisition work and has progressed through leadership roles across upstate New York and the Mid-West. Steven earned his Bachelor's Degree in Electrical Engineering from Syracuse University, and a Master's Degree in Business Administration from Rensselaer Polytechnic Institute in Troy, New York. He has recently completed Executive Programs at the Massachusetts Institute of Technology (MIT) Sloan School of Management.



William Menge is KCP&L's SmartGrid director. Key in his present responsibilities is leading a true end-to-end SmartGrid Demonstration Project spanning from smart/renewable generation through advanced automation in the distribution system, advanced metering infrastructure and into customer end-use applications, controls and programs. Prior to SmartGrid, he was Manager of Asset Management and oversaw completion of the T&D infrastructure improvement portfolios under KCP&L's award winning Comprehensive Energy Plan.

William has been with KCP&L since 2006 and possesses 25 years experience in the power industry. His industry experience includes various engineering roles, construction management, construction quality assurance, transmission project management, distribution standards, operations and maintenance program management. William serves on the N.E. Johnson County (KS) Chamber of Commerce Board, the Kansas Smart Corridor Economic Development Board, NERC's Smart Grid Task Force and received a BSEE from Bradley University.

Smart Grid Easy Rider

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Matt Wakefield



By Denis Chartrand, Chief- Distribution Network Strategies, Hydro-Québec Distribution and Matt Wakefield, Sr. Program Manager-Smart Grid, EPRI.

In North America, there are big utilities, and there are really big utilities... and then there's Hydro-Québec – the biggest of all as measured by several of the various yardsticks commonly used for such purposes. But it isn't just about size at Hydro-Québec; it's also about things like service territory diversity and the enormous amount of research and development needed to support that kind of size and diversity. Our other interview participant, the Electric Power Research Institute, also lays legitimate claim to being pretty innovative itself, creating a real powerhouse (pun intended) of capability. These two industry behemoths – along with a score of other utilities around the world – have put their considerable resources toward creating what could be called the 'Mother of All Smart Grid Demonstration Projects' with its aggressive set of goals and objectives. But read what two noted Smart Grid gurus - Hydro-Québec's Denis Chartrand and EPRI's Matt Wakefield – have to say about this broad based set of Smart Grid initiatives, and judge for yourself... – *Ed*.

EET&D : Matt, since EPRI is the principal architect of the Utility Host Site Demonstration Project Plan it seems appropriate that you kick off this interview by laying out the foundation for this program and its various goals and objectives.

Wakefield : I'll be happy to do that, Mike. Let me start by saying that we're very proud of what we've already been able to accomplish over the past three years in conjunction with what are now – with the recent addition of Hydro-Québec – 21 partners in this global program. The EPRI Smart Grid Demonstration Initiative is a seven-year collaborative research effort focused on design, implementation, and assessment of field demonstrations to address prevalent challenges with

integrating distributed energy resources in grid and market operations to create a "Virtual Power Plant."

EET&D : How often is the Smart Grid Demonstration Program being updated?

Wakefield : EPRI provides periodic updates on these projects and relevant industry news and events in the form of a newsletter, plus three face-to-face meetings per year at different project sites as well as through an annual update.

EET&D : And what is the make up and constituency of the overall Smart Grid initiative as it stands today?

Efacec Advanced Control Systems

Wakefield : Utility Host-Site Demonstrations provide the core foundation of Smart Grid initiatives everywhere. As of now, we have a total of thirteen Hosts collaborating with the 21 utility members, including utilities in France, Ireland and now Canada with Hydro-Québec. The demonstrations are supported by EPRI in design and analysis of key integration technologies and research goals in alignment with project objectives to resolve the information and technology gaps.

EET&D : I think it would be helpful to our readers if you could explain a little more about the difference between a Host Site and a Collaborator and the similarities or differences between them.

Wakefield : All utilities join the initiative as Collaborators. As a utility Collaborator, each has the opportunity to propose a project to be a Host Site that has research goals aligned with the initiative. Although the research we primarily conduct is for Host Site projects, the detailed research results are shared with all the Collaborators. Non-Host Site members benefit from the knowledge gained without the cost of deploying capital intensive projects, Host Sites benefit from research performed specifically for their projects. All of the Collaborators have committed to sharing high-level results with the public to help advance Smart Grid efforts in the industry.

EET&D : I know that EPRI originally created the IntelliGrid architecture to provide a roadmap for utilities to use in their own Smart Grid implementations. Is that being used here, and if so, how?

Wakefield : The EPRI IntelliGrid architecture is being applied to develop use cases and specify the highest priority requirements for communication and control of distributed resources. For each demonstration project implemented, a combination of performance, security, benefits, and/or interoperability assessments are conducted based on data collected through the deployments. The key to this is to use the demonstrations to increase knowledge and define the overall industry needs for integration into the overall system, and to build a consensus on the approaches that work best for integration and industry standards, based on these approaches.

EET&D : Let's move on to the Hydro-Québec Distribution program. Denis, can you give our readers a quick synopsis of how Hydro-Québec fits into the master plan for the demonstration project in Québec?

Chartrand : Sure. Hydro-Québec Distribution's Smart Grid Demonstration project completed the review process and was presented to the EPRI Board of Directors this past April as the 12th large-scale demonstration project. The project includes technologies to improve distribution system reliability and power quality, optimize power flow and distribution system energy efficiency and integrate active customer participation on the distribution system. Distribution automation equipment and Volt and VAR control are already available in the demonstration project. Automatic restoration, automatic fault location and advanced Volt and VAR control will be tested over the next few years.

An advanced metering infrastructure (AMI) and meter data management system (MDMS) will be implemented in the zone to evaluate demand response. The AMI infrastructure also provides a potential source of voltage measurement for advanced distribution applications. A charging infrastructure for electric vehicles is being installed, and vehicle-to-grid technology could potentially be tested as well. To support these distribution system technologies, a WiMax telecommunication system will be added to the existing telephone lines in order to facilitate the required exchange of information.

EET&D : That's quite a broad agenda. How did you decide on the elements of the program?

Chartrand : Hydro-Québec's CEO set out the priorities at the World Energy Congress held in Montréal on September 12-16, 2010. The main elements of that declaration were the support and promotion of renewable energy, the advancement of electric mobility, and creation of truly interactive transmission and distribution systems. These priorities are complementary to the more specific Hydro-Québec Distribution business objectives, such as improving the distribution system performance and efficiency for our customers. Smart Grid technologies are enabling these objectives.



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This is why Hydro-Québec's Distribution Smart grid roadmap integrates distribution systems advanced technologies including VVO, advanced distribution automation, fault location, etc., electric vehicle charging stations deployment and trials and, in a longer term, active customer participation in Distributed Energy Resources and Demand Response. All of these Smart Grid technologies can help us better understand the system behavior. This, in turn, allows us to optimize operational actions and decisions by reducing the traditional safety margins without compromising customer services and workplace safety standards. Optimizing the

voltage within the Canadian voltage standard on the distribution system is a good example of a reduced safety margin that directly contributes by supplying 2 TWh of our overall goal to save 11 TWh in 2015 without compromising customer service or reliability. The remaining energy savings derived from this objective will be accomplished by promoting the efficient, sustainable use of electricity by our customers.

EET&D: What do you see as the major challenges that lie ahead in Smart Grid implementation?

Chartrand: There are four main areas where most of the key chal-

lenges lie. Those are telecommunications infrastructure, information technology, field standardization and the overall management of equipment-grid interaction. The approach to validating Smart Grid technology at Hydro-Québec Distribution involves the creation of a Smart Grid Zone.

EET&D: So what exactly does this Smart Grid Zone entail in terms of facilities and equipment?

Chartrand: As we've already discussed, it includes one substation (Pierre Boucher) and a total of 12 feeders with most sections overhead averaging 10 km. Peak consumption is pegged at about 110 MW with 450 gigawatt hours, annually. There are approximately 13,500 mixed load customers across residential, commercial and industrial accounts. It's also important to remember that this is a permanent installation – not just a preliminary test lab – so we have great expectations for its long-term value as well.

EET&D: Why did you choose the Pierre Boucher substation in Boucherville as the principal site for your project?

Chartrand: There were actually several reasons. First of all, it is a fairly typical substation so it serves as a great location for staging and testing fault location, automatic restoration and advanced protection. It is also a suitable location for our electric vehicle charging stations and quick charge vehicle charging stations. We also have plans for the integration of distributed generation in the form of concentrated solar, all of which will be supported by WiMax wireless communications.

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And the fact that IREQ – Hydro-Québec's advanced research and development lab – is nearby is also beneficial on all fronts. Technical innovation on electricity systems is a trademark of Hydro-Québec, and IREQ is participating in the distribution Smart grid demonstration project. This is an example of leveraging the knowledge of all the participants to optimize the use of the available research resources.

Therefore, it afforded us a lot of diversity and flexibility in terms of what we can do in a relatively localized geographical

area. However, there are also other aspects of the project elsewhere in our service territory.

EET&D : Can you give us a few examples of what those other dimensions might be?

Chartrand : Well, another major part of the demonstration environment is the large-scale fiber-optic network that we have in downtown Montréal, which connects underground chambers in this high-density commercial zone. This provides the backdrop for remote

monitoring of the grid, remote maintenance and telecommunications with the intelligent underground chambers.

EET&D : Matt, perhaps you could jump in here and describe some of the anticipated benefits of the Smart Grid Demonstration Model and how those benefits manifest themselves.

Wakefield : There are four primary areas where we think tangible benefits can be derived. The first of these is expertise. That is, it serves as a real-world opportunity to gain experience and a feel for how Smart Grid technologies can be applied to monitoring, information and control with telecom and centralized control and integration with various existing systems. It also provides an opportunity to test the characteristics of multiple Smart Grid applications operating in parallel. Second, it delves into risk management, providing invaluable lessons learned from the testing of new applications and the ability to identify potential problems before large-scale deployment. Third, the energy conservation component gives us the ability to quantify actual reductions in energy consumption, providing the ability to analyze actual greenhouse gas reduction as an integral part of the model. And lastly, this knowledge is shared with the industry as a means of identifying gaps where future research is needed.

EET&D : What is the approximate time line for all of this to take place?

Chartrand : It's essentially a 5-year plan, although some activities have been under way to various extents over much longer periods of time.

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For example, the remote control distribution automation program was authorized in July 2005, and the underground automation program was initiated even earlier. This year we're moving on to CATVAR (Distribution System Voltage Regulation and Reactive Power Control), remote meter reading and the beginnings of our electric vehicle plug-in stations. Then, between 2012 and 2015, we'll be adding several more features including, automatic restoration, Volt-VAR optimization, advanced load control, and ultimately, concentrated solar by the end of the cycle.

Wakefield : It's also important to note that as this project goes forward there are also other implications for the various internal departments and technological disciplines as well as customer engagement. In general, as the plan progresses, customer involvement escalates fairly substantially and more strain is placed on the transmission system – which in turn has an impact on system performance. Moreover, the subsequent stress placed on the utility's telecommunications and information technology infrastructures will make those resources increasingly important to monitor closely too. Denis, perhaps you'd like to comment on that as well?

Chartrand : Yes, let me just add that because our end goal is to have a fully optimized real-time grid configuration in place by 2020, there will clearly be a need for changes and adjustments as the learning curve builds over time. Virtually every department will be affected to some degree.

EET&D : Before we close, I'd like to briefly touch on what else is happening with respect to the remaining areas you talked about earlier; namely the telecommunications piece, the CATVAR/VVO applications, your electric vehicle recharging plan, AMI and related metering initiatives, renewable energy integration and some of the more advanced future plans for the Smart Grid Zone.

Chartrand : As mentioned before, our roadmap focus on distribution system applications such as advanced distribution automation combined with fault location, which is something we expect will improve our SAIDI numbers. And, with improved VVO we can further enhance distribution system efficiency. We are also deploying the EV recharging station infrastructure. As you know, we just announced our selection of Landis+Gyr for metering, so now things will start moving along rather quickly in that area. This year we will implement those smart meters in several areas of the province, including in our Smart Grid

Zone, to test the technology. And, the WiMax telecommunication infrastructure required to support the information exchange will begin initial testing and evaluation this year at our IREQ lab.

EET&D : Any other plans for the future?

Chartrand : Over the next few years, demand response will be tried out in the Smart Grid demonstration project to evaluate the opportunity and benefits for our customers as well as for Hydro-Québec. Likewise, the new meters will create opportunities to provide information for advanced distribution applications such as VVO, which will be tested as we go forward. Our renewable energy initiative involves distributed generation and renewables integration through calls for tenders for power to be installed all over the Province of Québec.

We are also planning to enhance our monitoring with smart meters for profiling and forecasting loads (including the new EV loads) and vastly improved Smart Grid based protection and control strategies, eventually integrating DG into DMS for participation in those applications. We are also planning for utility-scale energy storage at one or more yet-to-be-determined substation locations and at EV plug-in terminals. Various other V2G initiatives to help support a viable electric vehicle rollout are also under consideration.

EET&D : Denis, I'll leave the last word to you to sum all up. It certainly sounds like your Smart Grid deployments will be both diverse and comprehensive, making for a very interesting period of learning over the next several years.

Chartrand : Yes, that's absolutely correct. It includes elements of smart distribution systems – initially as individual applications and later as integrated systems, including transmission – and charging station infrastructure for EVs, as well as AMI and telecommunications infrastructure. In particular, the Distribution Smart Grid Zone is a key element to meeting many of the Smart Grid challenges that lie ahead, not only on the power engineering side, but also regarding telecommunications, IT integration, Smart Grid standards, and the validation and integration of Smart Grid technologies and applications. With so much happening – not just with our project but for the entire global initiative – the future should be quite exciting and interesting indeed! ■



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LightsOn

Unitil Empowers Customers with the Latest Web Tools

By Cindy Carroll, Director-Business Development and Justin Eisfeller, Director-Energy Measurement & Control, Unitil.

According to recent reports by the International Energy Agency and United States Energy Information Administration, global energy demand is expected to increase approximately 36 percent¹ and U.S. demand is anticipated to grow more than 30 percent² by the year 2035. Responding to this trend, utilities and energy suppliers are placing increasing emphasis on energy efficiency, developing innovative programs to conserve usage and implementing strict new measures to reduce the environmental impacts from added power consumption. The advent of Smart Grid technology heralds yet another avenue for managing an exponentially growing power grid.

While science, technology and business systems are central to widespread efficiency efforts, customer participation is equally important to their success. After all, experts at Lux Research³ predict there will be nine times the Smart Grid data in 2020 that there is today. This will cause actively engaged participants to ensure that energy initiatives work. Residential and business customers alike will be pivotal to the research and analysis that power suppliers will need to improve, expand and sustain energy efficiency systems.

And yet, many customers remain slow to adopt energy efficiency measures, a phenomenon blamed by industry experts on both a lack of technology awareness and ease of use – or the absence thereof. Increasing energy efficiency program adoption rates will require customers that fully understand the value of such programs. Even more important is that it will challenge users to willingly redesign and sustain new energy consumption habits.

Knowledge is Power

Unitil – a Hampton, New Hampshire based provider of natural gas and electricity to both business and residential customers throughout New England – has long recognized the value of an informed and collaborative role for its customers. As a leading adopter of innovative energy efficiency technologies, Unitil knows that the long-term success of any new energy efficiency programs is in the hands and minds of its customers. At the same time, Unitil fully understands the need to communicate openly and continuously with its customers, and to provide them with ready access to tools that make a difference.

A new survey of more than 7,600 commercial gas customers and 55 utilities by J.D. Power and Associates⁴ points to an alarming trend, scoring declining satisfaction with utility communications, especially around energy savings programs via websites, as being lower than satisfaction with price for the first time in six years.

¹ International Energy Agency, World Energy Outlook 2010

² United States Energy Information Agency, Annual Energy Outlook 2010

³ Lux Research: www.luxresearchinc.com 'The Data Revolution: How Intelligent Hardware Will Drive the \$34 Billion Smart Grid'

⁴ J.D. Power and Associates; "The 2011 Gas Utility Business Customer Satisfaction Study"

Unitil's redesigned website applies advanced Web strategies to enhance site efficiency, functionality and usability. Most importantly, the company designed the new site from a customer's perspective, asking and then answering the question, "What do I need to know to make my home or commercial energy use more convenient, comfortable and affordable?" New technologies, new thinking and a collaborative and interactive business process – all focused on improving the overall user experience and boosting customer participation – are already making a difference.

The new Unitil site actively reflects the company's core commitment to energy efficiency and the increased comfort, productivity and affordability it brings customers of all types. And as a portal to expansive energy and financial tools and information, it reinforces the value of energy

efficiency to the environment, strategic energy security and economic growth. Day in and day out, the site is a versatile working partner for customers seeking the right technologies, services and maintenance solutions for their homes or businesses.

Content Counts

Unitil developed its new site with Drupal, an open-source content management platform that powers millions of websites and applications for diverse local and global businesses. The company selected Drupal for a number of factors, including its flexibility, its wealth of "out-of-the-box" content management systems (CMS), strong social media integration and the depth of its professional developer community. The new Web platform accommodates constant improvements

and supports the latest Internet technologies. Built with a streamlined organizational layout, it also facilitates backend content and structure management. A custom content management control panel generates high internal efficiencies, and an improved user interface integrates enhanced search capabilities and regional personalization that can tailor the site to each unique visitor.

The resulting improvements have provided Unitil with the opportunity to develop and integrate a variety of Web-based tools and online resources. These resources, combined with the company's highly trained customer service and business development staff, bolster education outreach efforts and build more active customer participation in the company's energy efficiency programs.

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How Unitil is Leveraging Web Technologies for Long Term Success

Energy Savings Management Pilot

Between June and August of 2011, Unitil will conduct an innovative pilot program – the *Energy Savings Management Program* – gathering valuable information on the technologies and consumer practices that will best reduce energy costs for customers. The pilot will test several Smart Grid technologies that allow customers to conserve energy usage during periods of peak electrical demand, helping gain insight on the factors that motivate customer participation in energy conservation and efficiency programs.

Eligibility

Eligible participants will be divided into three customer categories, each of which will test a different consumption control method. Smart Grid technologies installed in participating homes enable the homeowner to control energy usage and will collect and relay each household's energy consumption data to Unitil via two-way digital communications using the existing electrical grid as the communications medium. Pilot program participation includes residential Unitil customers owning a home equipped with an air conditioning system and who plan to remain at their current residence for a minimum of nine months.

Participation Incentives

To facilitate customer participation in the program, an additional functionality was integrated into the new Unitil website to help make the program easy to use and to drive energy and environmental-based education. The Energy Savings Management portal at MyUnitil.com offers participants a customized suite of online applications that details real-time energy usage data, prior day energy usage data during off-peak, on-peak and critical peak periods and daily cost of electricity, as well as Web-based tools including a cost comparison calculator that allows users to identify high impact changes in usage specific to their household.

Future Program Plan

The Energy Savings Management program is well positioned for future growth pending a favorable outcome from the pilot suggesting continuation of the program is warranted. By leveraging the advanced Web technologies and technical innovations used to improve the efficiency, functionality and usability of the Unitil website, the program can expand to facilitate more in-depth studies, producing valuable additional data about customer participation and usage and that could help shape future energy efficiency programs.

Lights On



As an example, integrated social media channels including Flickr and YouTube allow for instantaneous content sharing, and the company's Twitter feed, @Unitil, which has grown to nearly 500 followers in only two months, offers real-time system and service restoration updates via Unitil.com's *Outage Center*. A *MyUnitil* account management section features easy online bill pay options as well as resources and advice to help customers lower their energy costs. *Our Community* is a section that details Unitil's involvement in the local neighborhoods it serves and *The Media Center* maintains a current collection of company news, upcoming events and safety tips.

A 'Suite' Set of Tools & Tips

The Energy Efficiency section of Unitil's advanced new website also hosts a variety of energy saving tips and other informational tools for customers to use in managing energy costs. This information, prompted by growing customer demand for online account management, allows Unitil to better serve an expanding customer base. These toolkits access extensive reference libraries that inform and engage customers on energy and environmental topics of all kinds.

Home & Commercial: The *Home* and *Commercial Energy Suites*, for example, provide customers with rich tools to identify and understand their energy usage, costs and any sudden or high impact changes in their energy consumption. The *Home Energy Suite* features energy efficiency calculators and an energy reference library covering everything from electricity fundamentals to compact fluorescent lighting. The *Energy Calculator* helps estimate energy use costs based on user-supplied data and allows customers to perform energy

conservation scenarios to pinpoint opportunities for cost savings. The *Appliance Calculator* helps identify energy usage specific to any number of home appliances. An interactive *Lighting Calculator* displays a cost/use comparison of CFL and incandescent lamps.

Kid's Corner: There is also an educational *Kid's Corner* that explores energy topics, addressing efficiency, safety, conservation and other issues with easy-to-understand content and vivid graphics. Teachers can even download lesson guides from a dedicated *Teacher Feature*. The *InteractiveEnergyHome* link guides visitors on an energy-smart tour of a three-dimensional home. A *HomeEnergySuite* for gas customers includes a calculator dedicated to comparing home heating costs, from oil, propane, heat pumps and gas.

The *CommercialEnergySuite* features an in-depth library on commercial energy systems, building design and technologies, as well as an animated explanation of how energy demand affects cost. A commercial calculator estimates energy usage and cost based on customer inputs and even offers three efficiency levels for each calculation.

Electric + Gas: Both electric and gas efficiency programs that partner with local, state and federal agencies are explained on the website, introducing sizable rebates and incentives for ways to improve efficiency, comfort, convenience and cost. Energy-saving solutions and rebates for qualified weatherization measures and energy efficient equipment are also illustrated, as are important energy saving tips for homes, apartments or small businesses.

LightsOn

The new site further includes interactive calculators for electricity and natural gas as well as appliance management tools that help customers understand where energy really goes and how to reduce expenses. And as a practical matter, Unitil provides home weatherization strategies and professional guidance on purchasing major appliances.

For Electric Customers: For electric customers, the new website is a go-to resource for The Energy Star Appliance Program – a collaboration with local retailers to promote the benefits of Energy Star appliances and The Energy Star Lighting Program, in which local retailers offer rebates on the purchase of energy-saving, Energy Star lighting products. The Energy Star Homes Program promotes energy efficient building design and construction practices. And to further encourage customer participation, Unitil rebates and incentives are offered for many of these initiatives.

For Gas Customers: Gas customers can find information on high efficiency space and water heating equipment, available to customers planning to install high efficiency gas-fired equipment. The section also provides information on Unitil's Income Eligible Program and how some customers can receive no-cost energy efficiency benefits.

Free Energy Efficiency Evaluations: Businesses of all sizes can easily access energy-saving information. Small commercial electric customers can learn how to receive free energy efficiency evaluations and incentives on installed equipment and technologies. Large electric customers, as well as those undergoing major renovations or building new facilities, also can access Unitil's financial and technical services through this section of the site. Commercial natural gas customers can tap a wealth of information on programs with Unitil that share costs for efficiency improvements – from multi-family building customers to small and large commercial and industrial programs to new equipment and construction projects.

The Unitil website is a transparent, high technology window. It brings together a company culture of extensive information, clear guidance and prompt solutions – and more than 170,000 New England homes and businesses seeking safe, reliable and affordable energy services. As a portal, and as a resource for all of the company's stakeholders, the site represents Unitil's fundamental commitment to energy conservation and efficiency as well as technology and innovation, encouraging two-way communication and higher levels of customer participation. ■



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Cindy Carroll is Director, Business Development for Unitil Service Corp. and has 20 years of experience in the utility industry. Cindy oversees the creation, implementation and advancement of the company's business expansion and economic development initiatives, energy efficiency programs and critical customer management. Prior to joining Unitil, Cindy held positions with EnergyUSA and Northern Utilities, Inc. She is a member of the New Hampshire Business and Industry Association's Energy & Regulated Utilities Committee as well as the Advisory Panel to the New Hampshire Local Energy Committee Working Group. She previously served on the NH Energy Efficiency & Sustainability Board of Directors and holds a Bachelor of Arts degree in Communication from the University of New Hampshire as well as an MBA from New Hampshire College.



Justin Eissfeller is Director, Energy Measurement and Control for Unitil Service Corp. Justin is an expert engineering professional with extensive experience in the energy industry and oversees the company's advanced metering infrastructure, substation systems and SCADA controls, as well as the coordination of its grid modernization efforts and previously served as Unitil's director of engineering. He is a registered Professional Engineer in the State of New Hampshire, a member of the IEEE Power Engineering Society and serves on the Board of Directors for the Energy Council of the Northeast (ECNE). Prior to joining Unitil, Justin held positions with Heidelberg Web Systems and Public Service of New Hampshire. He holds a Bachelor of Science degree in Electrical Engineering with a Power Engineering Option from Northeastern University, as well as an MBA from the University of New Hampshire's Whittemore School of Business.



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BY BERNADETTE CORPUZ,
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District Energy: No longer the Bridesmaid?

Today, most nations of the world have an energy policy of some sort. Reliability and security of supply are typically overarching objectives, even in the most developed and richest of economies. Increasingly, renewable energy has become a household word in energy policies. Renewable energy policy often has an identifying bell tower, like a white paper or a strategic directive issued by the relevant government department, even a gleaming piece of green legislation. In Ontario, district energy does not have a tall bell tower so it can be difficult to extract a definitive policy and regulatory framework. This article describes pieces of the policy and regulatory architecture that touch the district energy landscape in Ontario.

Introduction

In 2009, Ontario attracted worldwide attention when the province's Government introduced the Green Energy and Green Economy Act, 2009 (Green Energy Act). Barely two years later, the number of applications submitted to the resulting Feed-in Tariff (FIT) program is nothing short of astounding. Tens of thousands of applications, coupled with mandatory connections, conservation targets, and transmission and distribution infrastructure planning requirements contained in the Act, has resulted in policy makers and regulators banging their heads to find continued solutions to effect implementation.

Decisions relating to transmission and distribution infrastructure development and the attendant cost allocation occupy significant amounts of attention from the Ontario Energy Board (the province's energy regulator) and the Ontario Power Authority (OPA). But as provincial authorities, distributors and transmitters grapple with

prioritizing connection issues and associated infrastructure development, there is an equally important piece of the clean energy plan sitting perhaps closer to the proverbial home, er, um, load – namely, district energy.

First Things First

For the purposes of this article, district energy is defined as the central provision of heating or cooling. Heating distributes heat generated in a centralized location for residential and commercial heating requirements such as space and water heating. The heat may be obtained from a combined heat and power (CHP) plant. Cooling distributes thermal energy in the form of chilled water from a central plant to multiple buildings through a network of underground pipes for use in space and process cooling.

The Policy Context

Today, any discussion of energy policy in Ontario necessarily begins with the province's Long Term Energy Plan. In November 2010, the Ontario Government issued its updated energy policy – the Long Term Energy Plan (LTEP). Key elements of the LTEP include:

- Demand will grow about 15 percent between 2010 and 2030;
- Ontario will be coal-free by 2014;
- Nuclear power will continue to account for approximately 50 percent of the province's electricity supply ;
- Ontario's target for clean, renewable energy (wind, solar and bioenergy) is 10,700 MW by 2018;
- CHP is an energy-efficient source of power and the OPA will develop a standard offer program for projects under 20 MW; and
- Conservation remains a priority with targets of 7,100 MW.



In February of 2011, the Ministry of Energy issued the Supply Mix Directive, which reflects the key elements of the LTEP. The directive also requires the Ontario Power Authority to prepare a 20-year integrated power system plan (IPSP) to meet the government's goals.

In May 2011, the OPA issued its IPSP Planning and Consultation document to provide stakeholders with information on the status and outlook for the electricity system. The document is intended to guide consultations that will assist the OPA in developing an updated IPSP.

District Energy: The Needle in the Haystack?

District energy does not occupy an express place in the LTEP or the Green Energy Act. However, district energy that generates power from a CHP plant that utilizes an eligible green energy fuel source would be eligible for the FIT Program. In addition, the LTEP does contain an important and explicit reference to the development of a CHP standard offer program. This focus on CHP is an important element in the district energy space.

Ministerial Directives

CHP has been on the Ontario Government's radar as an important element to develop prior to the LTEP.

The Minister of Energy issued a directive to the OPA in June 2005 to procure up to 1,000 MW of CHP projects. In April 2008, the Minister further directed that approximately 100 MW of this be renewable CHP. To date approximately 400 MW have been procured. (Another direction, issued on June 14, 2007, directed the OPA to launch a clean energy supply standard offer program for the procurement of small CHP facilities.)

In November 2010, the Minister of Energy directed the OPA to complete the procurement of the 1000 MW of CHP projects under certain conditions (CHP Directive). The CHP Directive essentially replaced and superseded the previous three CHP and clean energy related directives. Under the CHP Directive, CHP projects under 20 MW are to be purchased under a standard offer program and the larger, under individually negotiated contracts. In both exercises, the OPA is required to consider the following:

1. Projects must be located in parts of the province that the OPA identifies as appropriate;
2. cost effectiveness of the project;
3. whether the project can be accommodated by local distribution systems and whether there are local benefits associated with the project;
4. whether the projects meets technical requirements and is designed as a viable source of supply to a heat load;
5. the extent to which the project is sized to match the heat load requirements (useful heat output);
6. a project's ability to accommodate electricity system load following and other operability requirements; and
7. contract terms shall reflect a reasonable costs for Ontario electricity consumers and a reasonable balance of risk and reward between project proponents and consumers.



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CHP at the Altar: An SOP of My Own

On May 6, 2011, the OPA launched the clean energy standard offer program (CESOP), a day which opened the door for project applications to be accepted until June 30, 2011 (the launch period). The program rules reflect the requirements contained in the CHP Directive.

The CESOP has upfront locational eligibility requirements. The original draft program rules specified a list of areas where projects could be located. The final program rules will accept applications for projects in other areas as well, following the launch period.

The program has two streams: Combined Heat & Power (with which this article is concerned), and Energy Recovery. The CHPSOP is intended to support efficient use of natural gas-fired electricity generating facilities. To be eligible to participate in CHPSOP, a proposed generating facility must constitute a CHP facility that utilizes natural gas for the production of 95% or more of the electricity generated by the facility as averaged over a contract year, and may only

supplement natural gas with "Eligible Alternative Fuels", being renewable biomass, biogas, and any "Eligible Primary Energy Source".

The CHP facility must generate electricity and useful heat output (specified), deliver the electricity through a meter to a distribution system or an electrical host facility, and deliver the useful heat output through a meter to one or more host facilities. Behind-the-meter configurations will only be accepted where there is a sufficient technical rationale.

The OPA will work together with the Independent Electricity System Operator and any applicable transmitter and Local Distribution Company (LDC) to determine if there is sufficient transmission and distribution system connection resources to accommodate the project, taking into account: (i) all prior CESOP Applications, (ii) prior applications under the FIT Program, and (iii) any other generation that is existing, committed or subject to ministerial directive.



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The relative prioritization of prior applications under the FIT Program could be problematic for CESOP applicants. The FIT Program has received more than twenty thousand applications since October 2009. Moreover, the CHPSOP Contract is primarily a financial agreement that is intended to provide Suppliers with the benefit of a financial contract based on net revenue support level in \$/MW-month for the 20-year term of CHPSOP Contract.

CHP Individual Procurement Initiatives

The CHP Directive also authorized the procurement of individually negotiated CHP projects greater than 20 MW in capacity. The OPA issued a request for proposals in respect of this on June 21, 2011 (CHP IV). The OPA is targeting October 2011 for the selection of proponents. As with FIT and CESOP projects, the potential for CHP IV projects will be significantly affected by available transmission and distribution. The OPA has stated that

it will target projects that are located in areas that can be accommodated by the transmission and distribution grids.

Any Old-fashioned Regulation?

District energy, including CHP, remains largely unregulated in Ontario. District energy projects are not part of a rate-based regime from which the recovery of costs can be relied upon. However, the regulatory function of transmission and distribution investment planning and cost allocation can substantially affect the viability of CHP projects.

Summary

Although district energy in Ontario remains largely unregulated, the articulation of Ontario's district energy policy has been emerging for the past several years. As discussed above, Ontario's district energy policy has been largely focussed on CHP. The current CESOP and CHP IV procurement exercise are promising attempts to increase CHP's role in energy supply. An optimist will choose to ignore the looming cloud of crowded transmission and distribution capacity. District heating and cooling, absent CHP, will continue to rely largely on market mechanics and, in many instances, municipal interest, to fully develop. So for now, there is no bell tower for district energy in Ontario. But with the inherent localized nature of district energy solutions, perhaps the lack of a policy bell tower is an appropriate analogy. ■

ABOUT THE AUTHOR

Bernadette Corpuz is a Senior Associate in the Electricity Markets Group of the law firm Borden Ladner Gervais LLP (BLG). As a member of the Electricity Markets Group, Ms. Corpuz advises a wide range of energy market participants, including distributors, transmitters, generators, and commercial users with respect to a variety of commercial and corporate transactions related matters, including mergers and acquisitions, financing and energy markets. Ms. Corpuz can be reached at bcorpuz@blg.com or 416-367-6747.

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Con Edison and EPRI Collaborate on Manhole Arc Sensing and Recognition Technology

By Neil Weisenfeld, Department Manager-Distribution Cable Systems, ConEd (NY)
and Doug Dorr, Senior Project Manager, Electric Power Research Institute (EPRI)

When underground electrical cables age and deteriorate, the corresponding arcing associated with the pre-failure of the cable can be both a hazard and an impending alarm. If located and repaired before an event occurs, there is a significant opportunity to improve electric power system reliability as well as public and worker safety. To address this concern, the Electric Power Research Institute (EPRI) and Consolidated Edison of New York are collaborating to develop technology that will alert workers to the presence of low-voltage system cable faults in underground structures.

The prototype Manhole Arc Recognition System – or MARS unit – is presently undergoing field trials and preliminary results show that it can detect arcing events with very high accuracy. The work has resulted in a prototype safety device that takes advantage of today's advanced computing and high speed microprocessing technology to warn workers of the possible danger from electrical arcing before they enter a structure and to monitor for the initiation of arcing as crews work in energized manholes, as illustrated below.



MARS device sensor pod readied for lowering into a manhole during field testing

What is Cable Arcing?

We can observe many examples of arcing in the real world, such as lightning strikes, the spark you would get from touching the plus and minus terminals of your car's jumper cables together or even the small spark in the dark observed when you rub your feet on a carpet and touch another person. For electric power systems, cable arcing is the physical phenomenon that occurs when the voltage of any electrical cable or conductor creates an intermittent arc, a spark, or completes an unintended current path over to another object at a different voltage potential. In most cases the other object is the earth, a grounded pipe or conduit, or even other power cables.

Many times this arcing starts after the insulated jacket around the cable, or one of its splice points, becomes nicked, damaged or otherwise degraded and moisture or grit creates an easy path for arcing to begin. While most cable arcing starts out as just a nuisance sparking event after a hard rain or under high moisture conditions, over time, the cable insulation can slowly degrade until the arcing becomes continuous and a smoking or burning condition initiates. Using well-known knowledge of arcing such as the known frequencies and patterns that occur with different kinds of arcs, we can recognize the unique signatures or patterns associated with the various sources of the arc, in a similar manner to fingerprint recognition.

In this case however, we are using the spectral or electrical fingerprint. By knowing exactly what to look for and by having a solid understanding of both real world cable arcing and the many other types of signals that are not associated with degraded electrical cables (such as subway trains, welders, AM radio stations and so on) we can use advanced microprocessing technology to quickly and efficiently discern between the “real thing” and the many other arc sources that could be considered to be “false positives.”



Figure 1: Example Arc Sources from Preliminary Lab Tests

Development of the MARS Unit

Development of the arc detector has been built upon a foundation of earlier proof-of-concept testing by EPRI, which suggested that even small, low-current arcs emit discernable signatures that can be picked up by properly configured off-the-shelf hardware. This led EPRI and Con Edison to collaborate in testing various hardware devices and filtering algorithms under both laboratory and field conditions. Much of this work was performed at the Con Edison Cable and Splice Center for Excellence, an advanced lab environment well suited for such an effort. The overall objective was to develop a relatively low-cost system that detects arc faults with very high sensitivity and a minimum of false alarms. (Figure 2 shows the MARS sensing, detection and alarming scheme.)

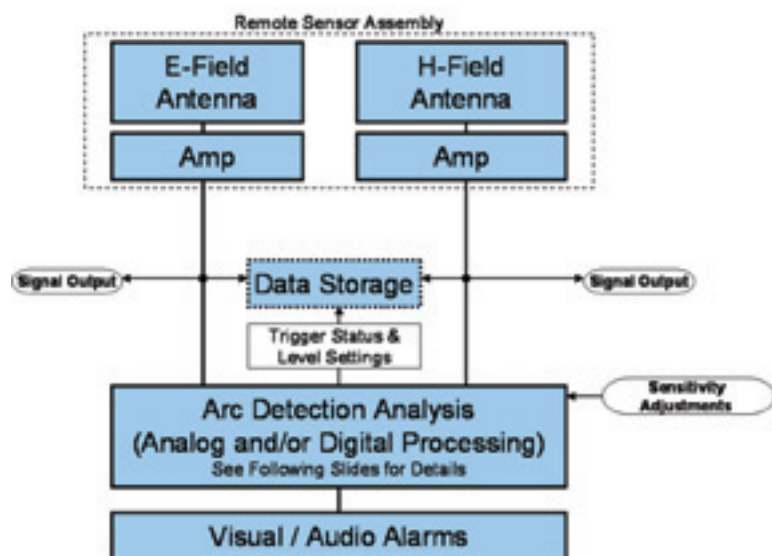


Figure 2: MARS Sensing, Detection and Alarming Scheme

The prototype arc detection system, shown in Figure 3, is now being field tested to confirm its capabilities, reliability and sensitivity objectives. Worker and public safety is a top priority for Con Edison, and if this system can be optimized and then commercialized, there is a significant potential to improve safety for both workers and the public and to advance the state-of-the-art in detection of low-voltage arcing.



Figure 3: The first prototype MARS systems focused on size and cost reduction.

Using the MARS technology is straightforward. The measurement system has two parts. One part houses the micro processor, the data acquisition system, and the alarm system. The other part houses the sensors which detect the electric and magnetic fields produced by the arcing current.

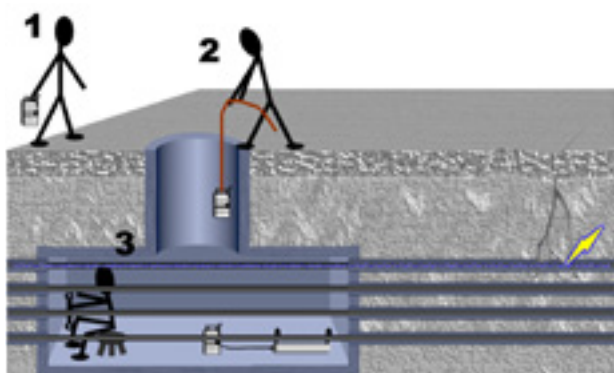


Figure 4: MARS Application Concept

Once the frequencies present within the manhole are sampled, the analysis program runs through a series of “recognition algorithms” and if the right combination of cable arcing signatures is detected, the unit sounds an alarm and initiates a flashing light that alerts workers to the possibility of an arcing concern. After determining that the manhole is safe to enter, workers keep the sensor with them as a warning indicator in case a nearby arcing event begins while they are inside the manhole. (Figure 4)

The major advantage of the MARS technology over other techniques that look for arc signatures is the non-contact sensor pod. Most existing arc sensing technologies require the user to clamp a sensor around the cables to be measured, which is not feasible if the objective is to scan the structure prior to entry. The only non-contact device suitable would be an AM radio receiver, but such a receiver is not capable of distinguishing between real arcing and the many other spectrum emissions that might cause false alarms. The MARS prototype is the first device to accurately accomplish arc detection and alarm objectives with the operator safely outside the underground structure.

The ability to recognize specific electromagnetic signatures that appear during arcing events is central to the detector’s function. Two decades of EPRI research has led to important developments in arc fault recognition and detection within power systems, and the industry now has a better understanding of the nature of the arc itself.

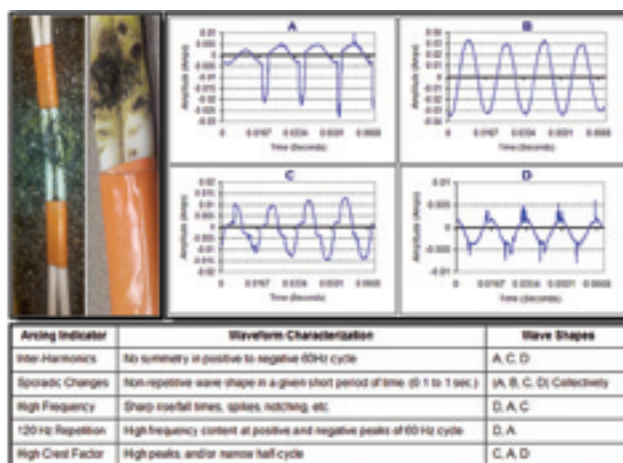


Figure 5: Examples of MARS signal processing techniques

Knowing what to look for – as well as what not to look for – is integral to developing a cost effective, widely deployable technology. For example, a cable arcing event is always going to have a sporadic and random amount of current flow associated with it because the arc path tends to change in moisture content relatively quickly as the arcing occurs. Knowing that the real arcing event will have a random and sporadic peak amplitude or crest factor is just one of eight unique electrical fingerprints that can be used to discern between real cable arcing and other false positives.

Furthermore, our knowledge of the U.S. electrical power systems operation at a 60 Hertz power frequency means that real cable arcing will always have 60Hz and its multiples (120 Hz, 180Hz and so on) embedded within the radio frequency arcing signatures. The broad spectrum of electrical emissions during cable arcing has allowed a number of key signatures to be tested and evaluated, and through digital signal processing, an arc may now be detected in its early stages with a high level of confidence. Overall, the concept is to look for all of the spectral fingerprints simultaneously and quickly discern whether or not real arcing is present before a worker enters a manhole. (Figure 5)

Future Work

Many years of research results have gone into the development of the arc detection algorithms used in the MARS device and the key element that has finally enabled successful field application is today’s microprocessing and computing capabilities – where the signals of interest can be acquired, analyzed and acted upon all in a matter of a few seconds rather than in hours or days.

What this means from a practical application standpoint is that the system and the algorithms have the potential to be integrated with power system protective devices, power quality monitors and even mounted on utility vehicles to perform mobile scanning during regular maintenance trips.

In fact, Con Edison is presently evaluating ways that algorithms similar to those used for the MARS system can be incorporated within a network of sensors that they have deployed across portions of the Manhattan underground system. It is believed that down the road, the MARS technology may become a part of the

electric utility of the future's Smart Grid where we find these advanced diagnostics and recognition systems used with existing monitoring and communications systems and new advanced robotics and sensor applications. ■



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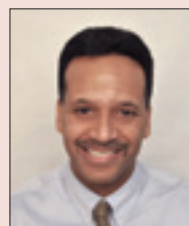


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Doug Dorr is a Senior Project Manager at the Electric Power Research Institute and leads the team that developed the prototype MARS technology. He has been involved with Smart Grid technology research for over ten years and currently leads the EPRI advanced Electromagnetic Compatibility (EMC) field measurement team as well as the efforts to develop hardware useful for advanced power systems measurements, analysis and diagnostics. Dorr is a senior member of the IEEE and is a co-author of two IEEE text books on power quality and transformer design. He also serves as a chairman for committees and working groups associated with lightning protection, power quality, facility/equipment grounding and harmonics. He holds a Bachelor of Science degree in Engineering from Indiana Institute of Technology in Ft. Wayne, Indiana.



Volume 5 No. 2

With William T. (Tim) Shaw
PhD, CISSP

SECURITY SESSIONS

I've been working on the [supply] chain gang...

Welcome to the latest installment of *Security Sessions*, a regular feature focused on security-related issues, policies and procedures. Most people involved in security, and in particular cyber security, understand the need to protect the pathways used to attack our vital cyber infrastructure. For most people that means communication circuits, both wired and wireless. Some people also remember that the world's oldest data exchange mechanism (SneakerNet) also needs to be watched and managed. But one of the least obvious pathways that can be (and has been) used for cyber attacks is something we security folks call the "supply chain". Just like a rear-end, everybody has one, and keeping with that metaphor, it is important to protect it because if you don't protect your supply chain your rear-end might end up in jeopardy too – **Tim**.

We all buy stuff and expect the stuff we buy to be safe, reliable and meet our expectations of quality and performance. No one is ever happy to buy a product and then discover that it is faulty – or worse – unsafe. In business we have the same basic requirements; we just deal with a totally different set of 'stuff'. The set of suppliers and vendors we deal with and their sub-suppliers and sub-vendors (i.e., the people from whom we procure our automation systems and support services and other business-related stuff), are broadly called our "supply chain".

One way an attacker can get to our automation systems is to attack them in the supply chain rather than waiting until we have acquired them and our cyber defenses are all in place, and then, trying to attack them from afar. There have already been several instances of computer-based products – laser printers and 'smart' electric meters come to mind – that

turned out to have secret malware and spyware embedded in their outsourced software or firmware. It is highly probable that more of this is happening as software development is subcontracted to low-cost, but questionably trustworthy, foreign sources.

Supply chain protection means establishing processes and procedures that reduce/eliminate the possibility of something like that happening to you. No one (probably including your automation vendor) wants to discover that the SCADA, DCS or ESD system they provided came with the malware 'factory installed'. Your procurement process ought to be addressing vendor cyber security requirements, including how your vendors test their products and how they manage their software development and subcontracting.

As a former supplier, I must admit to being guilty of incorporating clandestine user accounts and 'back doors' into our systems for our own convenience. That way, when a customer called in a panic because they had screwed things up to where they couldn't even log in any more, it was really handy to have a secret entrance that allowed us to remotely fix the damage they had inflicted. But of course, that means that there are now lots of former employees who know about those back doors and secret passwords. I'm glad that they're all trustworthy individuals, and I'm even happier that most of those older systems have been replaced through the years.

You might think that the practice of including secret 'back doors' in control systems is bizarre and something that no reputable vendor would ever do, but I suggest having a frank discussion with YOUR automation vendors – this practice is far more common than most people think. Part of supply chain protection is ensuring that no such secret "open-sesame" access is built into your automation equipment.

SECURITY SESSIONS

Most of us understand that in the last two decades – and particularly in the last decade – our computer-based automation systems, whether SCADA, DCS, MES or ESD, have all migrated onto the same commercially-available hardware, operating systems, networking and communications platforms as use by conventional IT systems. In fact, we now hear discussions about “Cloud” SCADA systems and the use of virtualization in these kinds of systems. Yes, when automation systems were highly proprietary they were much less likely to be subject to cyber attack. But they also cost ten times as much and became technologically obsolete in short order, making support and maintenance a major issue.

So, this technology migration has had both good and bad outcomes. The basic

fact is that our legacy computer-based automation systems are vulnerable to cyber attacks, not only because they have become far more standardized, but also because they are based on a mountain of software written in languages like ‘C’ that have integral weaknesses and security flaws. Hey, who knew?

As a person who has written a lot of software through the years – much of it in ‘C’ – I’m also guilty of making the assumption that no one would intentionally try to screw up my programs and cause them to malfunction. Of course, when I wrote programs that interacted with humans I knew that human error had to be considered, so I included some basic validity checking. But I never typed random gibberish as user input just to see how the program would respond (okay, maybe just a bit,

but certainly not to any great extent!) The fact is, if my program’s input was coming from another computer or a local program, I just assumed that the input would be provided as specified.

I also presumed that the standard functions and libraries that were part of the programming language were properly designed and thoroughly tested and could be used with confidence. Boy, was I stupid – or, maybe just naive? One of the reasons that you get inundated with security patches and updates on nearly a daily basis is that vendors, researchers and the ‘bad guys’ are constantly looking through that software mountain and finding a treasure trove of design and/or coding flaws to exploit. There is actually an international black market for selling newly discovered (called ‘zero day’) flaws to the highest bidder.

The field of Software Assurance is the study of how to manage the design, development, testing, management, delivery and deployment lifecycle of software such that the software performs exactly as expected. This means no surprises – intentional or accidental – under a full range of environmental conditions, including intentional malicious attacks. In other words, the software is as free from exploitable flaws as is possible and designed to withstand and survive attacks without compromising system security.

Please understand that I am simplifying a very complex field into a few sentences, but this is the gist of the concept. The Department of Homeland Security (DHS) has done an excellent job of collecting a set of ‘best practices’ and creating a common body of knowledge on this subject, in cooperation with various educational and research institutions. And, they have created a set of quite useful pocket references that are freely available on their website: <https://buildsecurityin.us-cert.gov/swa/>.


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SECURITY SESSIONS

One significant outcome out of this study of software assurance is a set of coding/programming practices that greatly reduces the possibility of exploitable flaws. There are also 'secure' versions of language function libraries as well as utility programs that can check software for violations of these proper coding practices. One would hope that all vendors whose products are, or contain, software have adopted secure coding practices. One would also hope that they have programs in place to go back and remediate the flaws in their legacy code. Part of supply chain protection deals with the insistence that your vendors address cyber security in their product development processes and overall lifecycle – and require their software subcontractors to do the same.

Another aspect of software assurance is having procedures and processes that guarantee the executable code you receive from a vendor was generated from the approved source code and, that no unauthorized or undocumented additions or modifications were made to the source code along the way. Your vendor ought to have processes in place – a chain of custody if you will – that allows them to be totally confident that the 'run-able' code they provide to you can be directly associated with the approved source code and support libraries.

Something else that often happens with complex automation systems is that vendor field support and maintenance personnel often end up practically living at your site during system installation and commissioning. You get to know these folks and start to treat them like trusted employees and even give them an unescorted, all-access key card. Then at some later point in time you need some support and someone else shows up from that same vendor organization and you just assume that they will be as trustworthy as the personnel who used to support your system. But how do you really know? If you don't know how your vendor vets their personnel and ensures their trustworthiness, you really can't be sure that these new support personnel ought to be given free and unsupervised access to your plant and critical systems. Unfortunately, the notion that people with malicious intentions could work their way into third-party support organizations is not as far fetched as you might think.

Another aspect of supply chain protection is taking steps to verify that vendor/contractor personnel are acceptably trustworthy, either by requiring that your suppliers perform some basic level of background, criminal and financial checks, or performing these

checks yourself prior to allowing supplier personnel into your facility. That is, although you would not be very likely to let a complete stranger enter your computer/control room facilities, when a person shows up wearing a shirt that has your automation vendor's logo on it, you probably don't ask any – or at least not totally adequate – questions about who they are. Instead, many of you probably just lead them into your computer room or control center. That would be fine as long as you can be sure that your vendor is taking their personnel security seriously (an important part of supply chain protection) and ensuring the trustworthiness of their personnel. And even if they do, it would still be a good idea to call for a credential check before allowing them into your critical facilities.

A final but equally important aspect of supply chain protection is performing adequate factory and site acceptance testing on your automation systems and ensuring that such testing goes beyond merely doing a functional and performance test to also include security testing. It is always much more cost effective, and less disruptive, to fix problems at the factory rather than on site. Your acceptance process ought to include sufficient cyber security testing and validation aspects so that you can feel reasonably secure. There are good recommendations out there about the kinds of cyber security testing that you should require from your automation vendor. But that will be subject matter for a future column. – *Tim*

ABOUT THE AUTHOR

Dr. Shaw is a Certified Information Systems Security Professional (CISSP) and has been active in industrial automation for more than 30 years. He is the author of [Computer Control of BATCH Processes](#) and [CYBERSECURITY for SCADA Systems](#). Shaw is a prolific writer of papers and articles on a wide range of technical topics and has also contributed to several other books. He is currently Principal & Senior Consultant for Cyber SECurity Consulting, a consultancy practice focused on industrial automation security and technologies. Inquiries, comments or questions regarding the contents of this column and/or other security-related topics can be emailed to Tim@electricenergyonline.com.

Vegetation Management Innovation

By Clay Tutaj, Senior Consultant
KEMA Inc.



For many utilities, distribution system vegetation management (VM) programs represent both a substantial portion of annual maintenance spending as well as a major point of contention with customers over the aesthetic impacts resulting from VM. But when VM programs are implemented and managed properly, the result is almost always improved reliability -- even for customers who argue about the aesthetics. Yet even utilities with large-scale VM programs in place still experience vegetation-related outages that can account for as much as 20-50% of service outages, measured in customer minutes interrupted. To further mitigate these outages, proper VM program design is imperative.

What does this large annual expense buy in terms of improved reliability and how should a program be designed? The answer often is "it's hard to say." And in reality it is, and here is why:

- Reliability metrics (which would help us measure the effect part of cause and effect) and their composition are often an afterthought to the restoration process.
- During the restoration it may not be clear that the cause was vegetation related as the evidence may be gone.
- Vegetation growth is subject to all manors of variable environmental factors and certainly not necessarily consistent throughout a distribution system.
- Distribution circuits vary greatly in layout, equipment and customers so it follows that the benefits of a program will vary by circuit.

Despite these difficulties, in the modern data-centric utility world surely something can be done to do better. So, what's in our data tool-kit that we can put to work?

- **Outage Management Systems** – Can provide estimates for interruptions caused by vegetation often on a circuit basis; we'll need to make some assumptions about how accurate this information is.

- **Rainfall Measurements** – We've found through work with several utilities that a lagging estimate shows a very high correlation to growth (this may seem obvious, but to quantify it is another thing).
- **Historical Trim** – We'll need to know what's been done in the past and how much it cost us.
- **Circuit Exposure** – Not surprisingly, the amount of exposure to vegetation (of equipment that is susceptible to failure) has a direct relationship to the amount of vegetation-related outages. Some utilities are even starting to collect vegetation data-mappings that can be used to overlay with Geographic Information Systems (GIS) mapping delivery equipment to create an instant exposure map.
- **Circuit Models** – Using information that is already put to use by load-flow programs, can be used to estimate reliability.
- **Weather Data** – Can be used to get detailed statistics about how vegetation-related outages vary under different conditions.

Several utilities are already putting this available information to use in innovative ways, not only estimate the future impact of their current program on reliability, but also to consider, drive and justify program changes.

Cycle Trimming: An Example

As an example of this, let's take a look at a common 'go-to' installment of many VM programs: Cycle Trimming. Cycle trimming can come in several varieties, but the most basic is a flat cycle, where every 'X' years a circuit is trimmed. Some variations of this are reliability-based trimming (i.e., poor reliability feeders are trimmed more frequently) or some further granularity, such as only trimming laterals every 8 years, while primaries are trimmed every 4 years.

Using historical reliability metrics attributed to vegetation on a feeder basis, circuit exposure, and historical trim dates for those same feeders, we can correlate the years-since-trim and outage events – the time elapsed since a circuit was last trimmed.

FIGURE 1 shows an example of how the relationship between years-since-trim and outage events may look. (A single outage event may lead to many customer interruptions depending on where the outage event occurs on the system.) It's important to note that this figure implies that no matter how frequent the trim cycle is – even in 'Year 0' – vegetation-related outage events still occur; so what gives?

Well, the cycle trimming adheres to a standard – this standard, which defines the minimum acceptable distance between lines and vegetation – will vary by utility. The types of interruptions we are experiencing are outside of this range and still making contact or, perhaps are the result of some violation of the standard. Given the current standard, in this example it appears that the lowest we can expect outage interruptions to go (even if we trimmed all the time) would be about 0.16 outage events per year mile. In other words, if we had a 10-mile long distribution line and a year elapses on average between trims, we would expect to see 1.6 outage events.

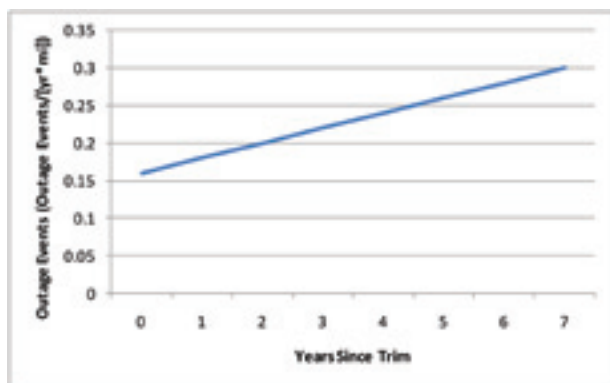


Figure 1: Vegetation-Related Outages by Years-Since-Trim

Further, this relationship between outage events can be employed to estimate the direct reliability impact on a given circuit using a model or even system-wide by

aggregating or extrapolating. Using this outage event model and a reliability modeling approach, alternatives to the current trim cycle can be investigated with a reasonable level of confidence in the impact of those changes. This can be taken even further by comparing the marginal costs and benefits or even by comparing those results with alternative reliability solutions to find the best overall value.

Solutions

How else can we put this information to work for us?

- Determine the benefit of switching from a 'one-size-fits-all' solution to a cycle schedule that targets the best bang-for-the-buck circuits. It's likely that better reliability can be achieved for the same cost or, the same reliability for a lower cost.
- Determine how rainfall impacts growth rates and reliability and what can be expected in the upcoming years.
- Determine the impact of historical changes in a vegetation management program. Often, a utility will want to know what a major program change has meant in terms of benefits; that is, did it really live up to expectations?

Plus, with the increasing amount of information at the disposal of utilities across their entire organizations, pulling the pieces together in creative ways can answer some otherwise tough questions... and having those answers can be a real advantage.

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Clay Tutaj is a Senior Consultant with KEMA Inc. in Raleigh, NC. Mr. Tutaj provides analytical solutions for reliability, asset management, emergency response and storm forensics for transmission and distribution systems internationally. He can be reached at clay.tutaj@kema.com.

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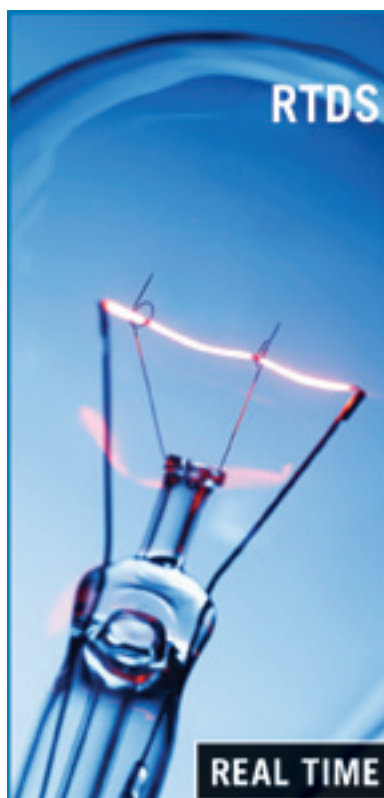
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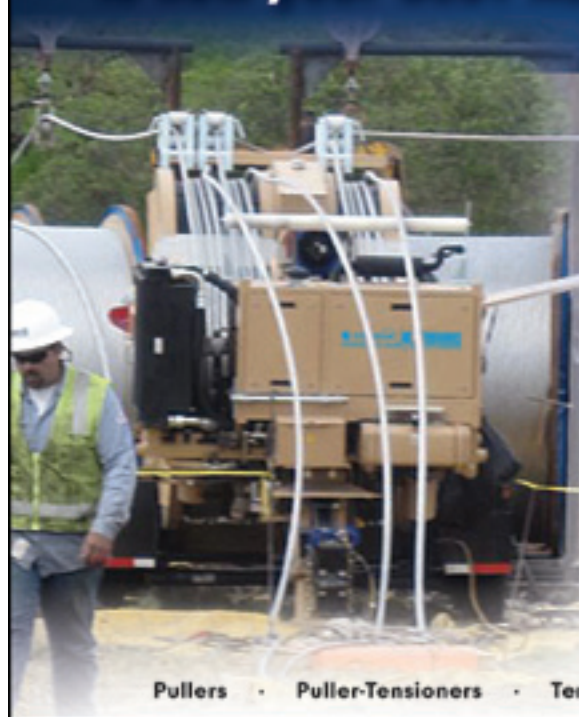
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BUS CONDUCTOR - ALUMINUM

WILLIAMS METALS WELDING ALLOYS INC

Tel: (610) 225-0105
www.wmwa.net

BUS DUCTS

MP HUSKY LLC

Tel: (864) 234-4800
www.mphusky.com

BUSHING REPAIR

PCORE ELECTRIC COMPANY, INC.

Tel: (585) 768-1200
www.pcoreelectric.com

SURPLEC HV SOLUTIONS

Tel: (819) 821-3636 • 1-877-996-3636
www.surplechv.com

BUSHINGS

MVA POWER INC

Tel: (450) 589-0445
www.mvapower.qc.ca

PCORE ELECTRIC COMPANY, INC.

Tel: (585) 768-1200
www.pcoreelectric.com

TRENCH LIMITED

Tel: (416) 298-8108
www.trenchgroup.com

BUSHINGS - COMPOSITE

POLYCAST INTERNATIONAL

Tel: (204) 632-5428
www.polycastinternational.com

BUSHINGS - CONDENSER-TYPE-CAST EPOXY

PCORE ELECTRIC COMPANY, INC.

Tel: (585) 768-1200
www.pcoreelectric.com

BUSHINGS - DISTRIBUTION APPARATUS (THROUGH 34.5KV)

PCORE ELECTRIC COMPANY, INC.

Tel: (585) 768-1200
www.pcoreelectric.com

POLYCAST INTERNATIONAL

Tel: (204) 632-5428
www.polycastinternational.com

BUSHINGS - HIGH VOLTAGE APPARATUS (OVER 34.5KV)

PCORE ELECTRIC COMPANY, INC.

Tel: (585) 768-1200
www.pcoreelectric.com

BUSWAYS

MVA POWER INC

Tel: (450) 589-0445
www.mvapower.qc.ca

C

CABLE - ACCESSORIES

HUBBELL POWER SYSTEMS INC.

Tel: (573) 682-5521
www.hubbellpowersystems.com

CABLE - AERIAL SPACER

DOW WIRE & CABLE

Tel: 1-800-441-4DOW
www.dowwireandcable.com

CABLE - AERIAL, SELF-SUPPORTED

DOW WIRE & CABLE

Tel: 1-800-441-4DOW
www.dowwireandcable.com

CABLE - COAXIAL

DOW WIRE & CABLE

Tel: 1-800-441-4DOW
www.dowwireandcable.com

CABLE - CONTROL

DOW WIRE & CABLE

Tel: 1-800-441-4DOW
www.dowwireandcable.com

OLDCASTLE ENCLOSURE SOLUTIONS - PLASTIBETON

Tel: 888-868-5214
www.oldcastleprecast/enclosures

CABLE FAULT CURRENT LIMITING, UNDERGROUND

SUPERPOWER, INC.

Tel: (518) 346-1414
www.superpower-inc.com

CABLE - FIBER OPTIC

DOW WIRE & CABLE

Tel: 1-800-441-4DOW
www.dowwireandcable.com

OLDCASTLE ENCLOSURE SOLUTIONS - PLASTIBETON

Tel: 888-868-5214
www.oldcastleprecast/enclosures

CABLE - GROUNDING

HASTINGS FIBERGLASS PRODUCTS INC.

Tel: (269) 945-9541
www.hfgp.com

TALLMAN EQUIPMENT CO

Tel: (630) 860-5666
www.tallmanequipment.com

PRODUCTS AND SERVICES

CABLE - JUMPER

HASTINGS FIBERGLASS PRODUCTS INC.

Tel: (269) 945-9541
www.hfgp.com

CABLE - OPTICAL GROUND WIRE

DOW WIRE & CABLE

Tel: 1-800-441-4DOW
www.dowwireandcable.com

CABLE - PREASSEMBLED CABLE DUCT

OLDCASTLE ENCLOSURE SOLUTIONS - PLASTIBETON

Tel: 888-868-5214
www.oldcastleprecast/enclosures

CABLE - PULLING

CONDUX TESMEC INC.

Tel: (507) 387-8069 • 1-877-854-1750
www.conduxtesmec.com

TALLMAN EQUIPMENT CO

Tel: (630) 860-5666
www.tallmanequipment.com

CABLE - RESTORATION

NOVINIUM

Tel: (206) 529-4828
www.novinium.com

UTILX CORPORATION

Tel: (800) 252-0556
www.utilx.com/

CABLE - SUBMARINE

NOVINIUM

Tel: (206) 529-4828
www.novinium.com

CABLE - TEMPORARY GROUND

HASTINGS FIBERGLASS PRODUCTS INC.

Tel: (269) 945-9541
www.hfgp.com

CABLE - UNDERGROUND DISTRIBUTION

NOVINIUM

Tel: (206) 529-4828
www.novinium.com

CABLE - UNDERGROUND, POLYMER-INSULATED

DOW WIRE & CABLE

Tel: 1-800-441-4DOW
www.dowwireandcable.com

OLDCASTLE ENCLOSURE SOLUTIONS - PLASTIBETON

Tel: 888-868-5214
www.oldcastleprecast/enclosures

CABLE - UNDERGROUND, RESIDENTIAL

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www.dowwireandcable.com

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Tel: 888-868-5214
www.oldcastleprecast/enclosures

CABLE ACCESSORIES - URD

DOW WIRE & CABLE

Tel: 1-800-441-4DOW
www.dowwireandcable.com

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282
www.utilitytnb.com

THOMAS & BETTS CANADA - UTILITY DIVISION

Tel: (450) 466-1102, x234
1-800-466-1102, x234
www.tnb.ca

CABLE CUTTERS - HYDRAULIC

TALLMAN EQUIPMENT CO

Tel: (630) 860-5666
www.tallmanequipment.com

CABLE FAULT LOCATING - EQUIPMENT

PHENIX TECHNOLOGIES INC.

Tel: (301) 746-8118
www.phenixtech.com

RCC ELECTRONICS

Tel: (905) 238-6848
www.rcce.com

THIES ELECTRICAL DISTRIBUTING CO.

Tel: (519) 621-2524
www.djinfo.com/tedc

CABLE LASHERS (SPINNERS)

TALLMAN EQUIPMENT CO

Tel: (630) 860-5666
www.tallmanequipment.com

CABLE PULLING ACCESSORIES

CONDUX TESMEC INC.

Tel: (507) 387-8069 • 1-877-854-1750
www.conduxtesmec.com

CABLE TRAY

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www.oldcastleprecast/enclosures

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282
www.utilitytnb.com

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AMERICAN WIRE GROUP

Tel: 954-455-3050
www.buyawg.com

CABLEK INDUSTRIES

Tel: (514) 421-7171
www.cablek.com

CYBERXLINK

Tel: (951) 691-5708
www.cyberxlink.com

PRODUCTS AND SERVICES

DOW WIRE & CABLE

Tel: 1-800-441-4DOW
www.dowwireandcable.com

PRIMUS CABLE

Tel: (951) 691-5025
www.primuscable.com

CABLES - HIGH TEMPERATURE SUPERCONDUCTING

SUPERPOWER, INC.

Tel: (518) 346-1414
www.superpower-inc.com

CABLES - HIGH VOLTAGE - XLPE

DOW WIRE & CABLE

Tel: 1-800-441-4DOW
www.dowwireandcable.com

CABLES - MEDIUM VOLTAGE

DOW WIRE & CABLE

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www.dowwireandcable.com

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RADIAN RESEARCH, INC.

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www.radianresearch.com

CAPACITORS

ABB

Tel: (514) 856-6266
www.abb.ca

MVA POWER INC

Tel: (450) 589-0445
www.mvapower.qc.ca

CAPACITORS - CONTROLS

BREWS SUPPLY LTD.

Tel: (905) 564-1116
www.brewssupply.com

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

CAPACITORS - POWER FACTOR CORRECTION

PHASECO, INC.

Tel: (281) 893-7522
www.phaseco.com

STACO ENERGY

Tel: (937) 253-1191
www.stacoenergy.com

CAPACITORS - SWITCHES

SOUTHERN STATES, LLC.

Tel: (770) 946-4562
www.southernstatesllc.com

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282
www.utilitytnb.com

THOMAS & BETTS CANADA - UTILITY DIVISION

Tel: (450) 466-1102, x234
1-800-466-1102, x234
www.tnb.ca

CIRCUIT BREAKER COMPONENTS

WAUKESHA COMPONENTS

Tel: (800) 338-5526
www.waukeshaelectric.com

CIRCUIT BREAKERS

ABB

Tel: (514) 856-6266
www.abb.ca

CIRCUIT BREAKER SALES CO. INC.

Tel: (940) 665-4444
www.cbsales.com

MITSUBISHI ELECTRIC POWER PRODUCTS, INC.

Tel: (724) 778-3115
www.meppi.com

TRAYER ENGINEERING CORPORATION

Tel: (415) 285-7770 • (800) 377-1774
www.trayer.com

CIRCUIT BREAKERS - MEDIUM AND HIGH VOLTAGE

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Tel: (610) 515-8775
www.belyeapower.com

MVA POWER INC

Tel: (450) 589-0445
www.mvapower.qc.ca

T & R ELECTRIC SUPPLY COMPANY INC.

Tel: (605) 534-3555
www.t-r.com

TRAYER ENGINEERING CORPORATION

Tel: (415) 285-7770 • (800) 377-1774
www.trayer.com

CIRCUIT BREAKERS - MODIFICATION AND REPAIRS

BELYEA COMPANY, INC.

Tel: (610) 515-8775
www.belyeapower.com

MAGNETECH INDUSTRIAL SERVICE

Tel: (330) 830-3500 • 800-837-1614
www.magnetech.com

CIRCUIT BREAKERS - OIL

BELYEA COMPANY, INC.

Tel: (610) 515-8775
www.belyeapower.com

SURPLEC HV SOLUTIONS

Tel: (819) 821-3636 • 1-877-996-3636
www.surplechv.com

CIRCUIT RECLOSERS, AUTOMATIC - THREE-PHASE

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

CIRCUIT SWITCHERS

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

PRODUCTS AND SERVICES

SOUTHERN STATES, LLC.

Tel: (770) 946-4562
www.southernstatesllc.com

CIRCUIT SWITCHERS - MOBILE

SOUTHERN STATES, LLC.

Tel: (770) 946-4562
www.southernstatesllc.com

CLAMPS - GROUND

HASTINGS FIBERGLASS PRODUCTS INC.

Tel: (269) 945-9541
www.hfgp.com

CLAMPS - HOT LINE

HASTINGS FIBERGLASS PRODUCTS INC.

Tel: (269) 945-9541
www.hfgp.com

HUBBELL POWER SYSTEMS INC.

Tel: (573) 682-5521
www.hubbellpowersystems.com

MACLEAN POWER SYSTEMS

Tel: (847) 455-0014
www.maclepower.com

TALLMAN EQUIPMENT CO

Tel: (630) 860-5666
www.tallmanequipment.com

CLAMPS - TEMPORARY GROUND

HASTINGS FIBERGLASS PRODUCTS INC.

Tel: (269) 945-9541
www.hfgp.com

MACLEAN POWER SYSTEMS

Tel: (847) 455-0014
www.maclepower.com

TALLMAN EQUIPMENT CO

Tel: (630) 860-5666
www.tallmanequipment.com

CLOCKS AND TIME DISPLAYS

SYMMETRICOM

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www.symmetricom.com

CLOTHING - FLAME RESISTANT

TRUE NORTH GEAR

Tel: (800) 873-5725
www.truenorthgear.com

COATINGS - BUS BAR

MVA POWER INC

Tel: (450) 589-0445
www.mvapower.qc.ca

COMMUNICATION SYSTEMS

CALAMP

Tel: (805) 987-9000
www.calamp.com

CELERGY NETWORKS, INC.

Tel: (760) 268-1913
www.celergy.com

DIGITALGRID, INC.

Tel: 919-844-4866 extn 224
www.digitalgridinc.com

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

TC COMMUNICATIONS

Tel: (949) 852-1972 • 1-800-569-4736
www.tccomm.com

COMMUNICATION SYSTEMS - PROTECTIVE RELAYS

AMETEK POWER INSTRUMENTS

Tel: (585) 263-7700
www.ametekpower.com

DIGITALGRID, INC.

Tel: 919-844-4866 extn 224
www.digitalgridinc.com

H & L INSTRUMENTS

Tel: (603) 964-1818
www.hlinstruments.com

NOVATECH, LLC

Tel: (410) 753-8300 • (800) 253-3842
www.novatechweb.com

TC COMMUNICATIONS

Tel: (949) 852-1972 • 1-800-569-4736
www.tccomm.com

COMPRESSION DIES

TALLMAN EQUIPMENT CO

Tel: (630) 860-5666
www.tallmanequipment.com

COMPUTER CONTROLS AND AUTOMATION

OPEN SYSTEMS INTERNATIONAL, INC.

Tel: (763) 551-0559
www.osii.com

THE FOSTER GROUP, INC.

Tel: (312) 609-1009
www.thefostergroup.com

COMPUTERS - EQUIPMENT

MATROX GRAPHICS INC.

Tel: (514) 822-6000
www.matrox.com/graphics

COMPUTERS - RUGGED MOBILE

SYBASE, INC.

Tel: 1-800-SYBASE5
www.sybase.com

COMPUTERS - SOFTWARE

TERRA SPECTRUM TECHNOLOGIES

Tel: (866) 619-5444
www.terra-spectrum.com

VANGUARD SYSTEMS

Tel: (610) 891-7703 (8am - 5pm EST)
www.vansystems.com

WRIGHT TREE

Tel: (800) 882-1216
wrighttree.com

CONCRETE - POLES

MVA POWER INC

Tel: (450) 589-0445
www.mvapower.qc.ca

PRODUCTS AND SERVICES

CONDITION ASSESMENT SYSTEMS

DOBLE ENGINEERING CO.

Tel: (617) 393-2908
www.doble.com

WEIDMANN DIAGNOSTIC SOLUTIONS INC

Tel: (800) 811-2284
www.weidmann-electrical.com

CONDITION MONITORING

WEIDMANN DIAGNOSTIC SOLUTIONS INC

Tel: (800) 811-2284
www.weidmann-electrical.com

CONDITION MONITORING EQUIPMENT

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Tel: (617) 393-2908
www.doble.com

CONDUIT - ACCESSORIES

CALBRITE

Tel: (800) 225-7473
www.calbrite.com

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282
www.utilitytnb.com

THOMAS & BETTS CANADA - UTILITY DIVISION

Tel: (450) 466-1102, x234
1-800-466-1102, x234
www.tnb.ca

UNDERGROUND DEVICES INC.

Tel: (847) 205-9000
www.udevices.com

CONDUIT - PLASTIC

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282
www.utilitytnb.com

CONDUIT - POLYETHYLENE, CONTINUOUS

DOW WIRE & CABLE

Tel: 1-800-441-4DOW
www.dowwireandcable.com

CONNECTORS - BOLTED - DISTRIBUTION

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Tel: (800) 326-5282
www.utilitytnb.com

CONNECTORS - COMPRESSION, DISTRIBUTION

ASK PRODUCTS INC.

Tel: (630) 896-4056
www.asklug.com

HUBBELL POWER SYSTEMS INC.

Tel: (573) 682-5521
www.hubbellpowersystems.com

MACLEAN POWER SYSTEMS

Tel: (847) 455-0014
www.macleanpower.com

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282
www.utilitytnb.com

CONNECTORS - COMPRESSION, TRANSMISSION

MACLEAN POWER SYSTEMS

Tel: (847) 455-0014
www.macleanpower.com

CONNECTORS - ELECTRICAL

MVA POWER INC

Tel: (450) 589-0445
www.mvpower.qc.ca

CONNECTORS - GROUNDING

ERICO, INC.

Tel: (440) 248-0100
www.erico.com

MVA POWER INC

Tel: (450) 589-0445
www.mvpower.qc.ca

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282
www.utilitytnb.com

THOMAS & BETTS CANADA - UTILITY DIVISION

Tel: (450) 466-1102, x234
1-800-466-1102, x234
www.tnb.ca

CONNECTORS - PLUG-IN

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282
www.utilitytnb.com

CONNECTORS - SUBSTATION

DMC POWER (FORMERLY DEUTSCH METAL COMPONENTS)

Tel: 888-SWAGE-NOW
www.dmcusa.com/

HUBBELL POWER SYSTEMS INC.

Tel: (573) 682-5521
www.hubbellpowersystems.com

MVA POWER INC

Tel: (450) 589-0445
www.mvpower.qc.ca

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282
www.utilitytnb.com

THOMAS & BETTS CANADA - UTILITY DIVISION

Tel: (450) 466-1102, x234
1-800-466-1102, x234
www.tnb.ca

CONNECTORS - TECK CABLE

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282
www.utilitytnb.com

PRODUCTS AND SERVICES

CONNECTORS, UNDERGROUND - TERMINATING

THOMAS & BETTS - UTILITY GROUP

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www.utilitytnb.com

THOMAS & BETTS CANADA - UTILITY DIVISION

Tel: (450) 466-1102, x234
1-800-466-1102, x234
www.tnb.ca

CONSOLES - SCADA CONTROL CENTERS

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www.primate-tech.com

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CORELOGIC

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S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

WALTER DOW ASSOCIATES LTD.

Tel: (416) 236-8880
www.walterdow.com

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S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

UTILICON SOLUTIONS, LTD

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www.utiliconltd.com

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www.quantaservices.com

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

CONSULTANTS - CABLE TESTING AND FAULT LOCATING

KINECTRICS INC.

Tel: (416) 207-6000
www.kinectrics.com

CONSULTANTS - POWER QUALITY

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

CONSULTANTS - SUBSTATION DESIGN & ENGINEERING

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Tel: (970) 207-9648
www.exponentialengineering.com

PRIMARY POWER GROUP

Tel: (905) 426-2952
www.primarypowergroup.com

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

SARGENT & LUNDY LLC

Tel: (312) 269-2000
www.sargentlundy.com

STANLEY CONSULTANTS, INC.

Tel: (800) 553-9694
www.stanleyconsultants.com

CONSULTANTS - T&D ENGINEERING

COMMONWEALTH ASSOCIATES, INC.

Tel: (517) 788-3000
www.cai-engr.com

PATTERSON & DEWAR ENGINEERS

Tel: (770) 453-1410
www.pd-engineers.com

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

SARGENT & LUNDY LLC

Tel: (312) 269-2000
www.sargentlundy.com

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www.wireservices.ca

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www.sargentlundy.com

CONSULTING

CN UTILITY CONSULTING

Tel: (707) 829-1018
www.cnutility.com

HART ENERGY CONSULTING - ELECTRIFICATION OF TRANSPORT STUDIES

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www.hartenergyconsulting.com

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

CONSULTING ENGINEERING

DOBLE ENGINEERING CO.

Tel: (617) 393-2908
www.doble.com

GDS ASSOCIATES, INC.

Tel: (770) 425-8100
www.gdsassociates.com

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

SARGENT & LUNDY LLC

Tel: (312) 269-2000
www.sargentlundy.com

W.I.R.E. SERVICES

Tel: (204) 480-5800
www.wireservices.ca

PRODUCTS AND SERVICES

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MERSEN CANADA

Tel: (416) 252-9371
www.mersen.com

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CN UTILITY CONSULTING

Tel: (707) 829-1018
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CONTRACTORS

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

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www.utiliconltd.com

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MAUELL CORPORATION

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www.mauell-us.com

CONTROL SYSTEMS - ELECTRIC/ ELECTRONIC

AXIOMATIC TECHNOLOGIES CORPORATION

Tel: 1-905-602-9270 x225
www.axiomatic.com

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

CONTROLLERS/CONTROLS - PROGRAMMABLE

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

CONTROLS

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

CONTROLS - CAPACITORS

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

CONTROLS - PEAK DEMAND

NEOPTIX FIBER OPTIC SENSORS

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www.neoptix.com

CONTROLS - SUPERVISORY

H & L INSTRUMENTS

Tel: (603) 964-1818
www.hlinstruments.com

NOVATECH, LLC

Tel: (410) 753-8300 • (800) 253-3842
www.novatechweb.com

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

CONTROLS - TEMPERATURE

KRENZ & COMPANY INCORPORATED

Tel: (262) 255-2310
www.krenzvent.com

CONTROLS - VAR

S&C ELECTRIC COMPANY

Tel: (773) 338-1000
www.sandc.com

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282
www.utilitytnb.com

THOMAS & BETTS CANADA - UTILITY DIVISION

Tel: (450) 466-1102, x234
1-800-466-1102, x234
www.tnb.ca

COOLERS - TRANSFORMER OIL

TRANTECH RADIATOR PRODUCTS INC.

Tel: (803) 637-3166
www.trantechradiators.com

CORONA EQUIPMENT - SALES

OX CREEK ENERGY

Tel: (608) 589-5513 • (800) 531-6232
www.ox-creek-energy.com

OX CREEK ENERGY ASSOC INC - SPECIALIZED CAMERA SALES

Tel: (800) 531-6232
www.specialcamera.com

CRANES

AIR TECHNICAL INDUSTRIES

Tel: (440) 951-5191 • 800-321-9680
www.airtechnical.com

CRANES - HYDRAULIC

AIR TECHNICAL INDUSTRIES

Tel: (440) 951-5191 • 800-321-9680
www.airtechnical.com

CRANES - MANUFACTURERS/ DISTRIBUTORS

AIR TECHNICAL INDUSTRIES

Tel: (440) 951-5191 • 800-321-9680
www.airtechnical.com

DUECO INC.

Tel: (262) 547-8500
www.dueco.com

CRIMPING TOOLS - ELECTRICAL

TALLMAN EQUIPMENT CO

Tel: (630) 860-5666
www.tallmanequipment.com

CROSSARMS

DIS-TRAN STEEL, LLC

Tel: (318) 448-0274
www.distran.com

DIS-TRAN WOOD PRODUCTS, LLC

Tel: (318) 448-0274
www.distran.com

HUGHES BROTHERS INC.

Tel: (402) 643-2991
www.hughesbros.com

PRODUCTS AND SERVICES

LOCWELD INC.

Tel: Tel.: (450) 659-9661
www.locweld.com

THOMAS & BETTS - STEEL STRUCTURES DIVISION

Tel: 1-877-2TB-MEYER
www.meyersteelstructures.com

THOMAS & BETTS CANADA - STEEL STRUCTURES DIVISION

Tel: 905-858-1010, x3782
www.meyersteelstructures.com

CROSSARMS - FIBERGLASS - REINFORCED

ALUMA-FORM INC

Tel: (901) 362-0100
www.alumaform.com

HUGHES BROTHERS INC.

Tel: (402) 643-2991
www.hughesbros.com

MACLEAN POWER SYSTEMS

Tel: (847) 455-0014
www.macleaupower.com

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www.mvapower.qc.ca

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MVA POWER INC

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www.mvapower.qc.ca

RELAYS - PROTECTION

CD NOVA & ASSOCIATED COMPANIES

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www.cdnova.com

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www.digitalgridinc.com

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Tel: (918) 622-4530
www.enoserv.com

RONDAR INC.

Tel: (905) 561-2808
www.rondar.com

RELAYS - SUBSTATION AUTOMATION

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www.icmiinc.com

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Tel: (989) 644-2581
www.lormfg.com

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MACKAY COMMUNICATIONS

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www.mackaysatellite.com

SCADA - COMMUNICATIONS

DIGITALGRID, INC.

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www.encorenetworks.com

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Tel: 919-844-4866 extn 224
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SENSORS - TEMPERATURE

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www.deltastar.com

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www.sandc.com

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SWITCHES - CAPACITORS

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Tel: (415) 285-7770 • (800) 377-1774
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Tel: (416) 252-9371
www.mersen.com

SWITCHES - THROWOVER, AUTOMATIC

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SWITCHGEAR - DC TRACTION

MERSEN CANADA

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SWITCHGEAR - HIGH VOLTAGE

MERSEN CANADA

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