



# ***Electric Energy T&D***

## **MAGAZINE**

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Hit from a Series of  
EF4 and EF5 Tornadoes

*Inside* ↘  
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In the past few months I have had the opportunity to meet with several different plant managers from different industry segments, ranging from refining and petrochemical to nuclear power generation, and in almost every case they were still struggling with how to go about establishing acceptable cyber security for their facilities.

### 45 GUEST EDITORIAL The Clean Energy Kingdom

The Kingdom of Saudi Arabia ("KSA") is pursuing an ambitious strategy to diversify the country's energy portfolio over the next 20 years by procuring up to 54 gigawatts ("GW") of electrical energy from renewable sources.

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# POWERPOINTS

## Breaking Wind

A little over a month ago, American Secretary of the Interior Sally Jewell and Bureau of Ocean Energy Management (BOEM) Director Tommy P. Beaudreau announced that BOEM, on July 31, will hold the first-ever competitive lease sale for the development of commercial wind energy. The location of the auction sites is the U.S. Outer Continental Shelf and comprises 66,674 hectares (164,750 acres) offshore Rhode Island and Massachusetts. This step is another milestone in President Obama's 'all-of-the-above' energy strategy. "Today we are moving closer to tapping into the enormous potential offered by offshore wind to create jobs, increase our sustainability, and strengthen our Nation's competitiveness in this new energy frontier," remarked Secretary Jewell.<sup>1</sup> According to the DOE's National Renewable Energy Laboratory the forthcoming power could support over one million homes.

Far inland, for those of us living along the shores of the Great Lakes, the same benefits of offshore wind power should be a no-brainer. To this end, two years ago, Ontario quickly came out of the gate and became the front-runner in the race to develop freshwater offshore wind energy. Government scientists had been researching the issue from at least 2007 and a previous moratorium on the matter was lifted in 2008. The then-premier Dalton McGuinty was certain that developments in offshore wind could be completed in a way that would not harm ecosystems and ordered two studies dealing directly with impacts on aquatic animals and fish habitat and one study looking closely at the engineering impacts. The three papers were submitted in the summer of 2011. Ontario's commitment attracted major turbine manufacturers and supply chain companies and stood to see thousands of excellent jobs develop in the province.

That was then. Ontario is now blowing its 'first mover' advantage. While others are on the accelerator, the province sits in neutral seemingly content to watch the huge dividends from freshwater offshore energy float away. In February, 2011, a provincial election year where votes were the most important consideration, the government kicked offshore wind out of the feed-in-tariff (FIT) program and all applications were suspended. To justify this action, it slapped a moratorium on all offshore projects saying more scientific research was needed to prove any offshore wind developments are protective of the environment and posed no health risks. As a result of turning its back, the government is currently embroiled in law suits that run into the billions of dollars – taxpayers' dollars.

When Ontario's stance sent original investors running a mile it left the door wide open and Ohio eagerly stepped in to take the lead. The regional non-profit and economic development Lake Erie Energy Development Corporation (LEEDco) has received approximately US\$4 million from the U.S. Department of Energy. The money will go towards engineering, design, siting, and permitting for its five-turbine (possibly nine) 'Icebreaker' wind farm located 11 kilometres (7 miles) off the shoreline of Cleveland. This installation will be a first of its kind in North America and is slated to produce 20 megawatts (MW) of electricity.



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The Ohio project has attracted industry-leading manufacturers, a university, and several municipal governments to the table prompting LEEDco to set its sights on delivering 1,000 MW of offshore energy by 2020, all from within Ohio's jurisdiction. The fact that much of this could have been along Ontario's shore of Lake Erie has not gone unnoticed. Industry analysts and experts are still scratching their heads wondering why some entities have been pushed aside while others were given the green light. This includes a large Korean firm being given the right to develop 2,500 MW of renewable power on condition they invest CA\$7 billion, source many of the supplies in Ontario, and meet job creation targets.<sup>2</sup>

## Where is the program now?

A little over two months ago, Ontario's Energy Minister Bob Chiarelli confirmed that any party waiting for offshore wind development in the province's jurisdiction to get underway is in for a long wait. "All I can say at this point is that offshore is still in a moratorium and it's likely to stay that way for some time," he told reporters.

When asked to explain why it was going nowhere, he started ducking and diving by answering that it has everything to do with how un-established offshore wind development is in Ontario. "The basic reason is that all of the other elements of green energy have been implemented in various jurisdictions. Wind was well established in Ontario, solar was well established, biomass was well established in different jurisdictions. But offshore wind was not in the same category of experiential advancement."

In a recent interview, McGuinty's tune had changed. He said, "The fact of the matter is that there is a dearth, there is a shortage of science when it comes to locating wind turbines in fresh water. If they decide to put up a thousand in a square mile, I'm not sure that would be in keeping with standards that properly protect the aquatic life in the Great Lakes. We'll take the time to do this thoughtfully and responsibly."

In actual fact, it's unclear if researchers in the Ministry of Energy are even working on the studies that the former premier indicated were necessary before reopening the debate on the subject. What is abundantly clear, however, is that Ontario's new premier, Kathleen Wynne is completely non-committal on the topic.

I was very interested to read the following thoughts of Gideon Forman, Executive Director of the Canadian Association of Physicians for the Environment (CAPE):<sup>3</sup>

CAPE believes properly positioned offshore wind turbines will, over time, effectively stabilize electricity rates, create jobs, reduce pollution, and provide us with a local source of clean, renewable energy. We can't help but wonder why Ontario is back in Court to stymie the growth of this sector.

Huge steps on developing offshore wind are being made globally and by our neighbours to the south. Why are the Americans aggressively committing to new offshore projects on the east coast of the U.S. and their side of the Great Lakes? It is because offshore wind provides big renewable energy dividends.

Ontario's far offshore wind generation resource has all the benefits of onshore wind and more.

The location of turbines over water produces an entirely different dynamic that arguably enhances daytime wind volumes and electricity production. It provides another non-polluting tool to deal with peak energy demand in the daytime.

We need to think beyond Ontario's current short-term electricity surplus and be prepared for the future. Imagine the consequences of a power shortage in the next few years as our economy ramps up again. Imagine Ontario getting back its industrial mojo and demonstrating our ingenuity and skills while employing people in an industry for the future.

I couldn't agree more that Ontario has the perfect opportunity to advance this energy of the future and realize the incredible accompanying benefits into the bargain. Carefully and responsibly developed offshore wind, set far enough from the shore, should be considered a vital element in Ontario's clean energy portfolio.

Short of studies on creating electricity that produces highly radioactive waste, one would be hard-pressed to find another energy source exposed to so much study for so long before a single kilowatt was flowing. If the topic really needs that much more scrutiny, perhaps the time has come to actually get both feet wet and erect a model that can be properly studied.

<sup>1</sup> News Release, U.S. DOI. "Interior Announces First Offshore Renewable Energy Lease Sale." (June 4, 2013).

<sup>2</sup> Spears, J. "Wind farm files \$475 million NAFTA claim over Ontario offshore moratorium" *The Star Business* (November 23, 2012).

<sup>3</sup> Forman, G. "Is Ontario blowing its chance to be an offshore wind winner?" *Environmental Communications Options' Media Releases* (April 17, 2013).



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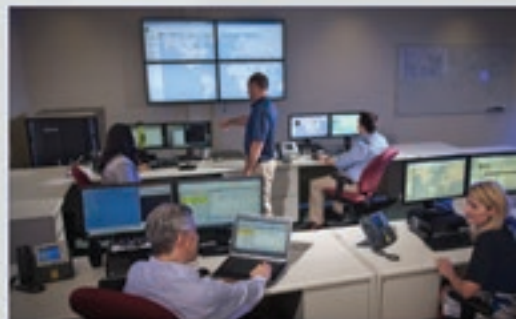
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## Xcel Energy plans to bolster veteran hiring practices

### CEO outlines benefits to hiring veterans to Joint Economic Committee

Washington, DC, July 2013

- Ben Fowke, chairman, president and CEO of Xcel Energy, outlined to the U.S. Congress Joint Economic Committee ways the utility plans to bolster its military hiring practices.

"I'm pleased to be able to speak to the committee about our long standing commitment to veterans and our plans to increase those efforts,"

Fowke said. "We value the skills, commitment and diversity that veterans bring to the workplace."

"Our industry faces a significant need for new, qualified employees as over half of our workforce is eligible to retire over the next 10 years. It only makes sense for us to enhance our ability to identify, attract and hire from this pool of qualified, skilled candidates."

Attractive qualities exhibited by military-experienced employees include the ability to learn quickly, support a team environment, respect procedures, prioritize safety, multi-task and provide leadership to those around them.

Currently, about 12 percent of Xcel Energy's 11,000 employees are veterans, with many represented in management. The company forecasts a need for linemen, engineers, and operations and maintenance personnel.

In his comments, Fowke thanked U.S. Rep. Erik Paulsen and U.S. Sen. Amy Klobuchar, vice chair of the joint committee, for their work in helping former military transition into the workforce. Fowke complimented Klobuchar for introducing the Veterans to Paramedics Transition Act, which would provide private sector certification for military emergency medical services personnel. Fowke called the approach valuable, suggesting it could act as a model for other industries.

Fowke outlined several things that can be done to help veterans transition into the private sector, including translating military skills into job requirements, strengthening résumés and improving interviewing skills. Fowke said helping veterans achieve certifications and credentials relevant to the industry would also improve their chances of obtaining private sector jobs.

Xcel Energy has recently received recognition for its veteran hiring practices. Xcel Energy was named one of GI Jobs' Top 100 Military Friendly Employers for the last five years and won the Most Valuable Employer for Military by CivilianJobs.com.

Within the utility industry, Xcel Energy has worked to open channels to identify and recruit qualified veterans and plans to expand those efforts. The company partners with Troops to Energy Jobs, Military.com, Corporate Gray and Hire Veteran to reach potential candidates. Xcel Energy also offers orientation, training and leadership development programs to transition veterans into the workforce and retain them.

"We would welcome the opportunity to work with members of the Joint Economic Committee to develop other tools that would enhance our ability to hire and train veterans," said Fowke. "It's good for us, good for them, and good for our communities."

Xcel Energy complies with all requirements of the Uniformed Services Employment and Reemployment Rights Act, as well as all state laws. In addition, the company supports its employees who are called to active duty with enhanced benefits.

## AEP Expects To Retire 585-Megawatt Coal-Fueled Unit In Ohio

Columbus, OH, July 2013 - American Electric Power (NYSE: AEP) announced that it expects to retire its 585-megawatt (MW) coal-fueled Muskingum River Plant Unit 5 in Beverly, Ohio, in 2015.

AEP reached an agreement with other parties in February to modify the company's 2007 New Source Review Consent Decree and give AEP the option to retire Muskingum River Unit 5 or refuel it with natural gas. Due to the cost of compliance with environmental regulations and current market conditions, AEP has determined that it is unlikely to make the capital investment to refuel the unit.

AEP will record a non-operating, pre-tax impairment charge for Muskingum River Unit 5 of approximately \$150 million to \$170 million in the second quarter of 2013. This does not impact AEP's 2013 operating earnings guidance range of \$3.05 to \$3.25 per share, and the company continues to expect to deliver an earnings growth rate of 4 to 6 percent based upon 2013 operating earnings guidance.

The company previously announced its intent to retire Muskingum River Units 1-4 (840 MW) in 2015. Approximately 95 employees working at Muskingum River Plant Units 1-5 will be impacted. AEP will work to provide displaced employees with opportunities to apply for jobs at other AEP facilities. Employees whose positions are eliminated and who do not find another position with the company will be considered for severance benefits.

AEP previously announced the planned retirement of 2,538 MW of coal-fueled generation owned by AEP Ohio in Ohio and West Virginia by the end of 2015. The addition of Muskingum River Unit 5 brings AEP Ohio's total retirements to 3,123 MW. The remaining 10,725 MW of AEP Ohio-owned generation -- including 2,427 MW slated to be transferred to Appalachian Power and Kentucky Power following state regulatory approvals -- will consist mostly of low-emitting, fully controlled coal-fueled plants, natural gas-fueled combined cycle and combustion turbines, and a small hydro plant.

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## TECO Energy Seeks Acquisition Approval from New Mexico Regulators

**Decision on Acquiring  
New Mexico Gas Co. is Expected  
by Early 2014**

**Tampa, FL, July 2013** - TECO Energy Inc. (NYSE: TE) filed its application with the New Mexico Public Regulation Commission (PRC) for approval of its acquisition of New Mexico Gas Co.

The application – filed jointly with New Mexico Gas Co. and its parent company, Continental Energy Systems LLC – was submitted in Santa Fe and included more than 100 pages of testimony and exhibits. A decision by the PRC is expected by early 2014.

In May, TECO Energy entered into a definitive stock purchase agreement with Continental Energy Systems to acquire New Mexico Gas Co. for a purchase price of \$950 million, subject to customary closing adjustments. The transaction is expected to close in the first quarter of 2014, pending approval from state and federal regulators.

New Mexico Gas Co. serves approximately 509,000 customers throughout New Mexico. Upon closing of the transaction, TECO Energy subsidiaries would serve more than 1.5 million regulated electric and gas utility customers in Florida and New Mexico.

## FirstEnergy to Deactivate Two Coal-Fired Power Plants in Pennsylvania

**Akron, OH, July 2013** - FirstEnergy Corp. (NYSE: FE) announced that it expects to deactivate two coal-fired power plants located in Pennsylvania by October 9, 2013. The decision is based on the cost of compliance with current and future environmental regulations in conjunction with the continued low market price for electricity.

The plants scheduled to be deactivated are Hatfield's Ferry Power Station in Masontown, Pa., and Mitchell Power Station in Courtney, Pa. The total capacity of these plants is 2,080 megawatts, representing approximately 10 percent of the company's total generating capacity, but about 30 percent of the estimated \$925 million cost to comply with the Environmental Protection Agency's Mercury and Air Toxics Standards (MATS).

In total, about 380 plant employees and generation related positions are expected to be affected. Eligible employees will receive severance benefits through the FirstEnergy plan or as provided by their collective bargaining agreement.

Following the deactivation of the Hatfield's Ferry and Mitchell power stations, FirstEnergy will continue to operate one of the nation's largest, cleanest and most diversified electric generating fleets. The company's fleet after the deactivations will be comprised of 56 percent coal, 22 percent nuclear, 13 percent renewables and 9 percent gas/oil, and will have a generating capacity of more than 18,000 megawatts.

With the deactivation of these two plants, in addition to the nine plants the company announced for deactivation last year, nearly 100 percent of the power generated by FirstEnergy will come from resources that are either non- or low-emitting, including nuclear,

hydro, pumped-storage hydro, natural gas and scrubbed coal units. The company expects to invest approximately \$650 million in MATS-related control technology to enhance or modify existing air quality equipment or install new equipment on its remaining facilities. Following these upgrades, FirstEnergy expects to reduce emissions of nitrogen oxides by 84 percent, sulfur dioxide by 95 percent and mercury by 91 percent below 1990 levels. In addition, the company expects to reduce carbon dioxide emissions 20 to 30 percent below 1990 levels by 2020.

The plant deactivations are subject to review for reliability impacts, if any, by PJM Interconnection, the regional transmission operator that controls the area where they are located.

## Mayor Emanuel, GE, Silver Spring Networks and ComEd Announce Multiyear Smart Meter Contracts, Bringing Millions of Dollars in Investment and Jobs to Chicago

**GE to manufacture smart meters in Chicago,  
Silver Spring Networks to open new office here**

**Chicago, IL, July 2013 - City** - City of Chicago Mayor Rahm Emanuel joined GE, Silver Spring Networks and ComEd at a GE manufacturing facility on the south side of Chicago to announce new Smart Grid contracts that will bring millions of dollars of investment and new jobs to Chicago. GE announced that it will manufacture smart meters on the city of Chicago's south side, and that it will seek to hire local residents to build these meters.

Additionally, ComEd laid out the general schedule for installation of smart meters throughout the city of Chicago. The city's south side will start to receive the new meters in 2014 and will have the network fully in place by 2016; at that point the north side will begin to receive the meters and will have them by 2018. By 2018, each of the city's 1.3 million homes or businesses is expected to have a smart meter.

"Chicago's new Smart Grid is substantially increasing economic opportunity for the City, by adding both manufacturing and professional jobs, opening new offices and facilities, and helping Chicago residents conserve electricity and save money," said Mayor Emanuel. "A modern, high-tech electric infrastructure is essential for Chicago's global economic competitiveness."

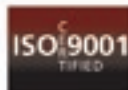
ComEd and GE are partnering on a \$200 million contract for GE to manufacture and deliver approximately 4 million smart meters, which ComEd will install for all customers beginning this September through 2021. GE will assemble the smart meters in Chicago at a south side factory, creating approximately 50 jobs. Smart meters provide timely data to electricity users about how much power they're using, giving customers more control over their energy use.

Silver Spring Networks, which provides the technology platform for ComEd's smart grid network, will also open a new facility in Chicago that will house dozens of new technology jobs and a next-generation network operations center to serve Smart Grid projects in Illinois and across the Midwest. That facility, which was announced by Mayor Emanuel in January 2012, is being implemented now and is currently being staffed.



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"Our \$2.6 billion Smart Grid investment will benefit Chicago—and all our customers—by strengthening the local economy, creating jobs, attracting new businesses to Chicago and giving more choice and control to our customers," said Anne Pramaggiore, president and CEO, ComEd. "In 2012, we initiated programs to improve our grid by adding new smart technology -- smart switches that reroute power in the event of outages and smart sensors that monitor critical equipment. We are excited to now launch our final and largest smart grid program -- smart meters -- and to begin to deliver the benefits they can bring to consumers."

"The Illinois Smart Grid program will provide ComEd's customers with the benefits of a modern grid and help GE grow its local workforce in Chicago," said Mark Hura, general manager of sales in North America, GE Digital Energy. "This program allows us to be local with our customer by adding positions focused on the assembly of smart meters, a technology that offers a range of benefits to consumers such as shortened restoration time in the event of an outage. ComEd is a valued customer to GE, as demonstrated by our long standing relationship and our recent successful smart meter pilot program. We look forward to working with ComEd to make grid modernization a reality in Chicago, and all of ComEd's service territory."

"As the leading company delivering the technology and network solutions that implement the smart grid, Silver Spring Networks is proud to be among the companies that are investing in Chicago, creating jobs and boosting the local economy," said Scott Lang, chairman, president and CEO, Silver Spring Networks. "As we work with ComEd to begin full-scale deployment, we plan to open a new office in Chicago and establish a network operations center that will create dozens of new high-tech jobs."

A smart meter is a digital electric meter that collects electricity usage information every 30 minutes and sends that information to ComEd through a wireless connection. Customers can get access to their individual usage data and electricity costs at any time, and make more informed decisions about how and when they use electricity. Additionally, when fully functional, smart meters will alert ComEd to power outages automatically—without requiring customers to contact ComEd—and help pinpoint the source of the problem so ComEd can restore power faster. Smart meters also eliminate estimated bills and cut down on electricity theft, saving ComEd and customers money.

As part of its smart grid work, ComEd is participating in the creation of the Energy Foundry, an early-stage impact venture fund created to support game-changing grid and energy ideas, and to empower consumers to harness the benefits of the energy-tech revolution. The initial source of funding totaled \$22.5 million and was provided by ComEd and Ameren. During the lifetime of the Energy Foundry, outside public and private sources also may contribute resources. In partnership with the Energy Foundry, ComEd will establish a smart grid test bed to serve as a venue for Energy Foundry participants, and others, to develop new smart grid technologies.

To bring more jobs to its workforce, ComEd is also piloting a new Construction Jobs Educational Pilot Program to provide candidates interested in construction fields with the training, information and guidance needed to compete for good-paying, entry-level jobs in construction-related fields. The program will run in parallel at three sites across the Chicagoland area by Bethel New Life, Chicago Urban

League, and the National Latino Education Institute. The pilot aims to provide 40 participants with career guidance, life skills training, and practical education about the construction industry, as well as the requirements for entering this industry.

ComEd is investing \$2.6 billion over 10 years in a modern grid that will reduce power outages and give customers more choice and control over their energy use. More than \$1.3 billion of that investment is earmarked to build a Smart Grid network and install 4 million smart meters in all Northern Illinois homes and businesses. ComEd's modernization efforts are designed to reduce outages by 700,000 per year, saving customers an estimated \$100 million in outage-related costs.

## FERC Approves Implementation for ISO-PacifiCorp Energy Imbalance Market ISO also issues revised Market Design Proposal

**Folsom, CA, July 2013** - The Federal Energy Regulatory Commission (FERC) has approved the implementation agreement between the California Independent System Operator Corporation (ISO) and PacifiCorp that establishes the scope and schedule for a variety of tasks the parties will undertake to launch an energy imbalance market by October 2014.

"We find that the Implementation Agreement is just, reasonable, and not unduly discriminatory or preferential. Accordingly, we will accept the Implementation Agreement, effective July 1, 2013, as requested," FERC said in the ruling.

Among its provisions, the implementation agreement sets out procedures for PacifiCorp to pay the ISO a \$2.1 million fixed start-up fee to enable PacifiCorp to participate in the ISO's existing energy imbalance market. The implementation agreement was filed with FERC on April, 30, 2013.

### Revised market design released

The ISO also issued yesterday July 2, 2013 a revised "straw proposal" that sets forth the proposed structure and rules for operation of the energy imbalance market. The market design reflects changes made in response to stakeholder feedback regarding earlier versions. Among the changes are extensions to the time external parties will have to review and offer comments to the market design rules before they are finalized and submitted to the ISO Board of Governors to consider in November.

The revised market design proposal and adjustment to the stakeholder process does not affect the planned October 2014 "go-live" date for the EIM. See the revised market design proposal [here](#).

The ISO and PacifiCorp announced a partnership in February 2013 to add PacifiCorp's two balancing authorities covering portions of six western states to the existing EIM operated by the ISO in California. The EIM is intended to reduce operational expenses for both parties through more efficient dispatch of resources within and between balancing authorities, the ability to share and therefore reduce the need to hold flexibility reserves, and reduced curtailment of renewable generation sources.

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IEEE 400.2-2004, IEEE 400-2001, NS 161-2004

VDE DIN 0276-620/621, CENELEC HD 620/621, IEC 60060-3



VLF-34E

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## Energy-efficiency programs by Consumers

Energy are producing long-term savings and sustainable benefits for customers

**\$365 million in savings, 900 new jobs created, trade allies up to 2,100**

**Jackson, MI, July 2013** - Customers who participate in Consumers Energy's energy efficiency programs are receiving significant long-term savings and benefits.

"The savings are real. The benefits are broad, measurable and sustainable. And hundreds of Michiganders are working because of energy efficiency programs driven by Michigan's enlightened energy reform law," said Patti Poppe, Consumers Energy's vice president of customer experience and operations.

"Consumers Energy has made a promise to the people of Michigan to provide low cost energy when they want it. As we plan for the long term, Consumers Energy knows that the lowest cost energy is the energy that we collectively don't use. By leveraging technology advances and good communication, energy efficiency is an important part of the energy mix for customers of Consumers Energy," said Poppe.

Participating customers have saved \$365 million since the programs were launched in 2009, with savings extending almost 10 years beyond the initial installation date of

equipment. Electric program savings could power 142,000 Michigan homes for one year, and natural gas program savings could annually heat about 60,000 homes.

"During a critical time, we're proud to say that these programs are putting people to work in Michigan," said Poppe. Consumers Energy estimates that 900 new jobs have been created, primarily through its energy efficiency trade ally network.

Poppe noted that the appliance recycling program is having a positive impact on environmental sustainability and job creation. In four years, more than 67,000 refrigerators and freezers have been recycled, thereby avoiding carbon dioxide emissions equal to the operation of 134,000 cars per year.

"Placed end-to-end, the number of recycled refrigerators and freezers would stretch for 70 miles, from Jackson to St. Johns," said Poppe. This program employs 54 people, including drivers and warehouse personnel in Grand Rapids and Livonia.

Consumers Energy works with 2,100 energy efficiency trade allies, up from 1,700 two years ago. These trade allies provide customers with information about energy efficiency rebates and equipment. The trade allies have primary businesses in heating, ventilation and air-conditioning, windows, insulation, appliances, lighting, builders and as architects.

In 2013, more than 106,000 residential customers and more than 29,000 business customers participated in at least one energy efficiency program. More than 8,000 highly efficient gas furnaces were installed, replacing less efficient furnaces. Over 1.1 million compact fluorescent light bulbs (CFLs) were purchased. More than 400 major Michigan retailers supported the energy efficiency effort by offering CFLs discounted up to half the normal purchase price, made possible by funding from Consumers Energy.



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# THE GRID TRANSFORMATION FORUM

Envisioning the 21<sup>st</sup> Century Grid

## Vital Tips to Get the Lights Back On

We are speaking with John D. McDonald, director, technical strategy and policy development for GE's Digital Energy business.

In the Grid Transformation Forum feature of January/February 2013 Electric Energy T&D we interviewed John D. McDonald, director, technical strategy and policy development for GE's Digital Energy business.

Triggered in large part by the destruction and hardship caused by Superstorm Sandy, John described how energy providers can improve their performance to ensure the power gets back to the customer in the safest and most expeditious manner.

We are now fortunate to be in conversation with John as he explains in detail key tips utilities can implement to narrow the gap between energy demand and energy supply.

**EET&D:** Everyone knows there is no 'silver bullet solution' to fall back on when a major weather event like Sandy hits. With this year's hurricane season and summer heat waves already upon us, please explain the strategies that utilities should have in place to prepare for and lessen the effects of power outages.

**McDonald:** Before I get into that, I should reiterate that utilities must consider communications infrastructure as the foundation of the grid and that it must be robust enough to support the technologies that are overlaid on top of it. There are three different aspects of the communications infrastructure that utilities should focus on:

1. **Response requirements:** These ensure that the communications infrastructure can support the smart grid applications' response needs in a matter of seconds, minutes or hours.
2. **Bandwidth:** Applications send data back and forth. The infrastructure must be strong enough to support the data flow requirements of the smart grid.
3. **Latency:** The delay in communications that the grid infrastructure can tolerate must be satisfactory to the application.

Major weather events like Superstorm Sandy will continue to happen, and loss of power will undoubtedly occur. To this end we have developed seven 'tips' to get the lights back on. I'll preface these

by reminding utilities that they need to invest in the right modern technologies and integrate them together into the electric grid.

**EET&D:** Is there a descending order of importance to the utilities among the 'tips?'

**McDonald:** They are all vital, but the first one I recommend is for utilities to reach out and communicate with customers ahead of severe weather about steps they can take to prepare for and what they should do if an outage occurs. Proactive, clear lines of communication will set expectations and help customers to understand the process for power restoration. This can be done through traditional channels such as phone calls and digital channels such as e-mail, text messaging and social media. Customers also should be encouraged to contact utilities through these same channels if their power goes out, creating a two-way dialogue between utilities and their customers.

The next tip is to integrate the five core components of the modern grid, including smart meters and an advanced metering infrastructure (AMI), geographic information system (GIS), outage management system (OMS), distributed management system (DMS) and distribution automation (DA) capabilities. Doing this will allow these core components to cohesively work together to improve restoration times.

**EET&D:** How would the utility translate the core components into a workable and winnable solution?

**McDonald:** That's a good question. Fortunately, we live in the "Information Age," so it's much easier for a service provider to gain the upper hand when facing an incident. To this point, our third tip is to leverage the capabilities of all grid technologies by enhancing the flow of information across the electrical network – the communications infrastructure that is the foundation for all grid applications. Utilities can use the power of big data and analytics to improve restoration time by enabling their workforce – both in the office and out in the field – with improved grid visibility and management platforms, mobile applications, social media and Google Maps™ technologies.

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# THE GRID TRANSFORMATION FORUM

Envisioning the 21<sup>st</sup> Century Grid



**EET&D:** The first three tips center on the communications infrastructure, big data and enterprise data management, and consumer engagement. However, the distribution grid is where wires connect customers' property to the system. Is the same amount activity by the energy suppliers taking place on the distribution grid?

**McDonald:** Bringing power directly to customers is an area that needs more investment. The part of the grid that handles this has traditionally received the least amount of grid investment. Of the 48,000 distribution substations in the U.S., less than half have automation installed, which means that, apart from customers calling in to report an incident, the utility has no way of monitoring for and detecting outages in the distribution system. Effectively managing power outages, particularly in extreme events like Sandy, is a critical area that requires immediate attention.

Our fifth suggestion relies on a feature of smart meter communications that we call 'last gasp' – a capability GE has built into its smart meter technology. The utility can leverage smart meter communications in tandem with AMI's two-way communications system to more quickly identify outages and restore electricity. When power is lost, these meters have stored enough energy in an on-board capacitor to send a final communication to the utility alerting them of the outage and its location. Pinpointing the exact location of an outage will help crews to restore power quickly and reduce downtime.

**EET&D:** There's no question that the latest technologies are awesome but as we all know, weather events of any size can damage property and crucial assets. How do you see mitigation in this area?

**McDonald:** Prepare for extreme weather by anticipating additional needs and repairs of current electrical infrastructure and the possible reconfiguration of it. During and after the storm, damage assessment and restoration teams should then work closely to document major damage and prioritize the deployment of work crews to restore power where it is critical.

Our seventh, but no less important tip, is to urge the energy provider to invest in software capabilities to receive and analyze data in real time during the restoration process. This will give utilities important status reports on the restoration process that they can communicate to stakeholders. After a major weather event, it is critical to ensure the accuracy of the data captured – especially outages that impact many people and industries.

**EET&D:** We are very grateful, John, that you've been able to take some more time with us. Power outages resulting from events like Sandy and the brutal snow storms of February and March of this year will no doubt happen again. It's so good to know you and your team have developed such a comprehensive and invaluable set of tips to help restore not only power, but also hope, to all of those affected.

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**THE PROVEN POWER.**

# Mabey Mats: Maximum Access, Minimal Environmental Impact

When major utility provider Dominion Resources, parent company of Dominion Virginia and North Carolina Power, needed to upgrade electric power at Lake Gaston, the popular vacation spot on the border of North Carolina and Virginia, it faced an unusual challenge. The company needed to replace 14 aging wooden towers installed 50 years ago in the middle of the lake to support a long network of power lines.

How could it get heavy construction vehicles into position without harming the sensitive wetlands surrounding the lake? The answer was Mabey Mats, a safe and innovative alternative to wooden mats that can support heavy equipment on water or land while minimizing environmental damage.

## Tower Replacement Challenge

The project, undertaken in 2012, sought to replace the wooden towers with modern three-pole steel structures to improve the reliability of electricity for Dominion's customers. When the towers were first installed, there was no water in the 34-mile long, man-made lake and hydroelectric dam reservoir. Today, however, those towers stand in 16 feet of water, making it a challenge to access them for replacement. Adding to the challenge is the fact that the lake is a highly popular boating location; work originally planned for the summer had to be postponed to the fall of 2012.

While a barge could be used to replace the poles themselves, concrete needed to be pumped out to the new pole sites to build caissons to contain the new steel structures. That's when Dominion and its contractor, Waff Construction, turned to Mabey Inc. for help. With an extensive depot network, Mabey is one of the country's largest providers and installers of temporary roadways. The project called for the installation of DURA-BASE® mats, an innovative system of interlocking mats made of high-density polyethylene (HDPE), that have been used in a variety of challenging and environmentally sensitive situations throughout the U.S. Each mat can support over 2000 pounds.

"The Mabey mats were a great advantage on the water," said Michael J. Hebert, Dominion's Construction Coordinator. "They allowed us to build a bridge to the barges and leave the concrete trucks on the shore, instead of putting the trucks on the barges. In the lowland areas, the mats caused virtually no damage. Unlike logging mats that sink into the ground, the Mabey mats lie flat. They were just great and we found it remarkably easy to use them."



## Environmentally Beneficial

In all, the project required more than 3,600 of Mabey's heavy-duty mats. Most of them were used to construct a temporary roadway that protected sensitive marshes and wetlands in the backwaters of Big Stonehouse Creek, which is in the western part of the lake, from heavy construction equipment. The remaining mats created an 800-foot long floating road over an eastern section of the lake to accommodate utility worker foot traffic and support the pipes that served as conduits for the concrete. After finishing in one area, the floating road was easily detached and moved to the next tower, using boats to pull the assembled floating platform across the lake to the new location.

"Our mats not only float, they also protect the environment and the linemen putting up the poles," says Howard Taylor, V.P., National Accounts, Mabey Inc. "Our experienced team installed the Mabey Mats and had to be sensitive to both the wetlands and the heavily populated area. The mats provide a safe, easy, cost-effective approach to environmentally-conscious construction."

Mabey's DURA-BASE® mats are used in a variety of situations across the U.S. for utility work, landscaping or events where there is water, mud, marsh or other sensitive areas. Unlike wooden mats, Mabey's mats are completely safe and approved for use in these areas because they do not absorb water and will not cross-contaminate material from one site to another.

These mats are so strong that not only could they hold the pipe pumping concrete out to the 'island' as needed, they allowed workers to look like they were 'walking on water.' They have been used in other places to keep heavy equipment, such as cranes, tractor-trailers and bucket trucks, afloat.

Hank DeWald, a reporter for the local newspaper Lake Gaston Today who covered the project extensively, remarked that the wetlands and neighborhoods around the lake looked as pristine as if nothing had been there. Shortly after project completion, he said, "[B]oth the use of [Mabey Mats] and Dominion's unwavering stance on protecting the environment, were the main reasons that sensitive wetlands already look as if no work was ever done there."

## Efficiency Gains

In addition, the Mabey Mats mats saved the utility company about a month of project time, which also minimized disruption to area residents and the natural habitat.

# Tough site conditions have met their match with Mabey Mats.



rain



snow



mud



protected areas

## When site access is a challenge, Mabey Mats rise to the occasion!

If you need oversized trucks or even cranes to get the job done, only Mabey Mats can meet your crew's needs in the field. Superior in numerous categories, the choice is definitely Mabey!

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- ✓ Improves productivity
- ✓ Does not retain moisture/chemicals
- ✓ Recyclable
- ✓ Twist-lock fasteners prevent mats from shifting
- ✓ Engineered with consistent properties
- ✓ Flexible for a variety of terrains



# GREEN OVATIONS

Innovations in Green Technologies

## Intelligent Surveillance & Security for Electrical Utilities

Protect substations and facilities at every corner of your Enterprise

By Mahesh Saptharishi



Jim Rogers, the CEO of Duke Energy calls the grid 'The Great Enabler' of our time because of everything it brings to life – in our daily personal lives as well as our businesses. It connects our great society. The National Academy of Engineering refers to 'The Grid' as the single most important invention of the 20th century. And yet, our North American critical infrastructure is under attack every day. A general lack of basic physical security at many facilities means that anyone with intent could do serious damage – whether it's copper theft, vandalism or planned sabotage. And this is what keeps most energy executives up at night.

Although the federal government regulates many utilities and energy companies, a fairly large percentage of them are not. In the United States for example, the Federal Energy Regulatory Commission (FERC) is a federal government agency that does not oversee the nearly 90 percent of utilities that are privately held or regulated by state governments. It's up to each of these utilities to determine the best strategy to secure their substations, electrical grids and power plants.

The challenge is of course, that physical perimeter security is often both complex and expensive. And it's not just operational risks and costs that need to be considered, but the magnitude of a potential event that affects the entire community – from hospitals to emergency responders to the regular citizen. For this reason, an effective perimeter security strategy requires that a system can detect, identify and prevent threats and be aware 24/7/365.

### Sense of Urgency

The electrical utility industry has not historically put much effort toward securing its substations. Facilities are often dispersed geographically and located in remote areas away from the beaten path. They often don't have on-site personnel and have few routine maintenance visits. With resources and budgets at a premium, physical perimeter security just hasn't been a top priority despite the potential impact of a compromised facility.

### Renewable Energy Vandalism What's the Cost?

- \$500K+ in damages in a year
- \$100K+ in single incident
- Water & oil spills
- \$100K+ in clean-up & damages
- Energy outages
- Project stoppages
- Rewards of up to \$25K

But with the five hundred percent increase in the price of copper over the past ten years, combined with increased attention to the environment and public policy, unwanted intrusions are on the rise. The growing number of accounts of unlawful intrusion, copper theft, and vandalism at utilities is a bit un-nerving. Recent accounts of vandalism at renewable energy projects in California and copper theft at substations in the mid-west resulted in hundreds of thousands of dollars in damages – in water and oil spills, copper wire & equipment replacement, and outages. In 2011, multiple vandalism attempts against a wind project in the California desert cost more than a half million dollars in damages alone.

Clearly, the traditional approach of restricting access and entry to facilities using gates, fences and signs isn't enough. More and more electrical utilities and energy companies are integrating advanced analytics, professional monitoring and HD video surveillance to detect suspicious activity and keep the bad guys out.

### Perimeter Solution Strategies

- Detect intruders and suspicious activity using HD surveillance cameras, analytics, and access controls
- Identify likely targets of vandalism and theft – often in remote areas, unattended facilities and infrastructure that has easy access to metal – copper in particular
- Secure perimeters with fences, guards, monitoring, motion detectors, and cameras
- Understand existing IT networks and impact new systems will have on the network
- Deploy a scalable, actionable system that easily integrates with existing systems
- Require real-time event detection, tracking and notifications so personnel can focus attention and respond in time
- Combine known technologies into a single system – integrating IP cameras with analytics, professional monitoring services, access control, and mobile monitoring

### What is Physical Perimeter Security?

A great perimeter security strategy does three things really well:

1. Detect
2. Identify
3. Prevent

In a nutshell, it keeps intruders out and secures the critical infrastructure that people rely on. It will also help minimize or eliminate safety concerns for both the perpetrator and employees – high-voltage copper can kill – as well as help control operational impact and manage overall risk. That sounds like a lot – and it is. Luckily there are tools readily available to help optimize physical perimeter security.

# On the Grow

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## Five Essential Elements of Perimeter Security

1. **Physical Presence:** Establish a perimeter around the facility with fences, warning signs, gates and on-site security guards. Most facilities have this level of physical protection today.
2. **Virtual Presence (video surveillance):** Adding video surveillance around the perimeter is essential. Video surveillance provides security managers not only with a method to record and review video for evidence but also a means to detect, track and analyze events. Analytics are what drive efficient video streaming and live event notifications.
3. **Perimeter Detection:** As a complement to fences and signs, motion sensors, HD surveillance cameras and analytics alert personnel to things that shouldn't be there. Advanced analytics provide an extra level of detection – detecting events as they occur and notifying responders when those events are important.
4. **Notifications:** Security personnel are more effective when they receive live event notifications of suspicious activity. Additionally, the use of lights, alarms and audio provide an extra level of security, letting intruders know they have been detected.
5. **Monitoring:** Remote video monitoring provides anytime/anywhere verification and response. 24/7 off-site professional monitoring companies provide timely response and notification to responders.

Electrical substations, energy utilities, oil & gas pipelines, water treatment plants, and renewable energy projects are subject to tremendous risk – not only for copper theft and minor acts of vandalism, but planned terrorist attacks. Unfortunately, securing these assets can be very difficult. They are often located in remote areas with harsh conditions such as desert and tundra and are often dispersed throughout a large geographical area.

One of the most reliable and accurate solutions to monitoring and preventing vandalism and attacks is the deployment of flexible, easy to use intelligent video surveillance systems. Advanced pattern-based analytics deliver instant event notifications to desktop or mobile devices to alert designated personnel of events in progress. Fewer false alarms and real-time event detection keep security personnel focused on situations that matter.

## Physical Perimeter Security Checklist

- Superior detection accuracy. Advanced analytics self-learn and become more precise and accurate over time. Advanced analytics significantly reduce false alarms and accurately differentiate legitimate threats from benign scene activity. The system sees and learns like humans so security personnel can

focus their attention on what really matters. Security is more effective and intruders are deterred.

- Eyes on multiple sites. Multiple sites are seamlessly monitored 24/7/365. Remote guards and central monitoring stations are supported with instant event notifications and live video verification.
- No bandwidth bottlenecks. Zero bandwidth recording means there's no impact on the existing network. Months of HD video can be stored on the device. Solutions scale easily from 1 to 1000 cameras.
- Infrastructure friendly. Real-time analytics on the edge enable easy deployment over cellular networks
- Early identification and notification. Advanced algorithms, pattern analysis and a robust set of definable rules help isolate areas of concern

## An Electric Co-Op Success Story

Gardner Energy, an electric co-op in Gardner, Kansas chose VideoIQ advanced analytics and edge storage to help mitigate loss and manage liability. It was on-going theft and vandalism at their three substations that drove the utility to change its approach to perimeter security. Their perimeter security goal was to detect, identify and prevent intruders from entering their substations.

The biggest drivers for Gardner in choosing this approach to perimeter security were the integrated advanced analytics, on-board edge storage in every HD camera and appliance and monitoring options. Storage at the edge of the network eliminated bandwidth concerns for the utility. With a tight budget and no trained security personnel, Gardner needed a system that was accurate, reliable and easy to use. The VideoIQ system also does more than just record incidents after the fact; it alerts operators as soon as an intruder comes on site, so personnel can focus their attention on what matters. The advanced analytics accurately track people walking around the field of coverage and send instant alerts to monitoring personnel. Since the installation, there have been no incidents of vandalism or theft.

The perimeter security solution investment was about one third the cost of a full-time guard service, and it provides 24/7/365 protection without hiring extra personnel, investing in additional IT infrastructure or needing additional video storage devices.

## GARDNER PERIMETER SECURITY BENEFITS

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# GREEN OVATIONS

Innovations in Green Technologies



## Mobile Access & Instant Event Notifications

Monitor the security system anytime and anywhere with instant notifications, event verification, audio talk-down and immediate response to threats. Mobile monitoring and instant event notifications enable real-time prevention 24/7/365 awareness.

## Edge Storage

Intelligent edge storage has the capacity to stream in high definition only events important to the end-user as they occur and record activity continuously without impacting network infrastructure. Bandwidth consumption is reduced by 90 percent, centralized storage is unnecessary, and it's easy to add systems to remote locations.

## Scalable

As an all-in-one device, VideoIQ solutions can simply scale from one to one thousand plus devices. Our advanced analytics manage storage and bandwidth requirements, so it's easy to add new devices without impacting infrastructure, video quality (recorded or streamed) or analytics capabilities.

## Physical Perimeter Security is Important

The energy and electric utility sectors are dynamic and the security challenges that come with it are always changing. Cyberattacks are one of the most talked about national security threats of our time – and for good reason. But it's not the only threat that should concern the utility sector.

Remote facilities and substations are a significant part of our energy infrastructure. Out of site shouldn't mean out of mind. If you can see it, you can better manage it. With today's advanced technologies in video surveillance, monitoring and analytics, remote substations and dispersed facilities can have an optimal physical security solution – one that delivers accurate and live event notifications straight to responders via any device, months of recorded and searchable video and superior event detection with fewer false alarms. Real-time physical security of remote substations and pipelines is possible.

All energy companies are important – whether it's the small energy co-op in Kansas or the global Fortune 50 oil & gas company. As the National Research Council\* (NRC) report and many energy experts say, 'energy facilities are vulnerable to disgruntled people – not to mention coordinated terrorist attacks.' The potential impact breached facilities can have on communities makes investigating a real-time prevention solution worth it.

\* Terrorism and the Electric Power Delivery System, NRC, November 2012.

## About the Author



**Mahesh Saptharishi** was part of the Werner H. Kirsten internship program at the National Cancer Institute where his work focused on immunology. The amazingly adaptive nature of the immune system inspired him to start thinking about mathematical models of learning. He went on to get his doctorate at Carnegie Mellon University in machine learning while working with robots (two robots named Lewis and Clark). Lewis and Clark, outfitted with 5 cameras, were built for autonomous navigation, surveillance and reconnaissance. The realization of what is possible while continuously learning from rich visual sensory data inspired Mahesh to co-found Broad Reach Security. Two years later, Broad Reach Security joined forces with GE to develop VideoIQ - an award winning, state-of-the-art automated video surveillance system. In 2007, VideoIQ became an independent technology company focused on taking video analytics to the next level. Mahesh continues to be inspired by the adaptive nature of the immune system as he works on designing threat detection and prevention systems.

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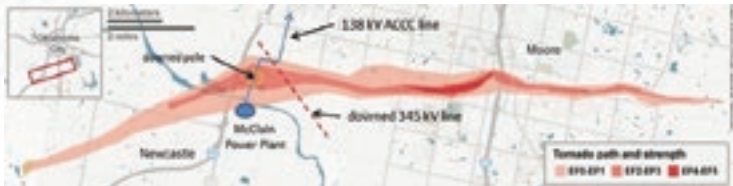
# OG&E Takes a Hard Hit from a Series of EF4 and EF5 Tornadoes

## New High-Strength Conductor Helps Expedite Repairs

By Dove Bryant,  
Director Technology,  
CTC Global

On Monday afternoon, May 20, 2013, an EF5 tornado, with peak winds estimated at 210 miles per hour (340 km/h), struck Moore, Oklahoma and adjacent areas, killing 24 people and injuring 377 others. The tornado was part of a larger storm that produced several other tornadoes during the previous two days. Another EF5 tornado occurred just 11 days later near El Reno, less than 30 miles (48 km) away.

The tornado of May 20 touched down west of Newcastle at 2:56 p.m. CDT, staying on the ground for 39 minutes over a 17 mile (27 km) path, crossing through a heavily populated section of Moore. The National Weather Service reported that the tornado was up to 1.3 miles (2.1 km) wide.



At the peak of the May 20 storm, more than 41,000 OG&E\* customers were without power. However, within a few days, OG&E quickly reduced that number to approximately 5,000 customers, which included several thousand customers who suffered damages to the extent that they would not be able to accept power in the short term.

To restore power as quickly as possible, OG&E deployed nearly 1,000 company employees, contractors and crew members from neighboring utilities that worked around the clock to repair or replace nearly 1,000 damaged or destroyed structures. While power was restored quickly, additional outages were required to allow complete restoration of OG&E's system.

In 2006, OG&E installed approximately 35 miles (56 km) of the 'new' ACCC Drake size composite core conductor on new steel monopoles to carry 138 kV current from the McClain power plant north towards Oklahoma City. The 140 foot (43 m) steel monopoles were approximately 122 feet (37 m) above ground level with an embedment into the ground of approximately 18 feet (5.5 m).

The path of the May 20 tornado crossed directly over the southernmost section of the 138 kV ACCC line just across the North Canadian River 0.9 miles (1.5 km) north of the power


plant. Flying debris damaged the aluminum strands on the ACCC and ACSR conductors in several areas. Surprisingly, the ACCC conductor's composite core was not damaged. This is especially remarkable considering one of the steel monopoles was hit by a large object (suspected to be a 40 foot shipping container that was on the opposite side of the road prior to the tornado).



This photograph taken from the north looking south towards the power plant shows the location of the downed monopole after its removal and prior to its replacement. The shipping container on the left (east) side of the road was previously on the right (west) side of the road behind the steel monopole.



The impact to the steel monopole caused it to bend to an angle of approximately 45 degrees at ground level. The structure could have possibly been knocked completely to the ground if it had not been for the ACCC conductor's strength. The load transferred to and through the conductor was actually enough to cause the two adjacent structures to also lean over in spite of their substantial embedment. While the force caused the aluminum strands to snap at one location on the ACCC conductor, surprisingly the high-strength composite core did not fail. The fact that the damaged conductor stayed in the air helped simplify and expedite repairs.



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## OG&E Takes a Hard Hit from a Series of EF4 and EF5 Tornadoes



Newly installed replacement pole next to base of the damaged monopole.

Due to the damage to the aluminum strands on the ACCC conductor adjacent to the impacted monopole, a 30 foot (9 m) long section of new ACCC conductor was spliced in using 2 full-tension splices after the monopole was replaced. The manufacturer of the ACCC conductor, CTC Global, sent a field supervisor to the site to assist.

To accomplish the splicing in of a new section of ACCC conductor, the contractor gripped the conductor on either side of the damaged section with pocket book grips connected by a section of steel wire and a chain hoist. Tension was applied to the assembly to release tension on the damaged area of conductor. The damaged section was cut out and a new section of ACCC conductor was installed with two full tension splices. The tension on the chain hoist was released which completed the repair process.



Crew measuring the damaged area of conductor in preparation for replacement.

Two other sections of ACCC conductor near this location were also replaced due to strand damage from flying debris. One section required splicing in a new 80 foot (24 m) piece of ACCC conductor using two full-tension splices and the same process as described above. The other section, of approximately 800 feet (244 m), used one splice and terminated at a dead-end. Repair sleeves or armor rods could have also been used over areas where the damage was relatively minimal, but there were so many areas in these sections, it was decided it would be better to simply replace them.

To replace the longer 800 foot (244 m) section, which was damaged but also not broken, the crew installed sheave wheels at the dead-end and tangent structures adjacent to the damaged conductor. A rope was used to pull the new ACCC conductor into position. This time, Chicago grips and a chain hoist was used to transfer tension from the undamaged section of ACCC to the new section. A full tension splice was then installed. At this point the damaged conductor was removed. The new ACCC conductor was pulled to tension and a 'hard-side' dead-end was installed. The new conductor was placed into the existing suspension clamps which completed the repair in this area.

Approximately one mile (1.6 km) to the northeast, a double circuit 138/345 kV lattice steel tower line experienced structural failure due to the impact of flying debris. This caused the double-bundled ACSR conductors to fall on the 138 kV ACCC line where it crossed under the tower line as well as adjacent ACSR distribution lines and two 138kV ACSR taps off of the tower line that went to the same power plant across the river. The ACCC conductor did not appear to be damaged, but after the 345 kV line was repaired, the areas of the ACCC conductor that were hit by the 345 kV line were covered with armor rod to reinforce potentially damaged strands.



138/345kV lattice structure downed by flying debris.

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## OG&E Takes a Hard Hit from a Series of EF4 and EF5 Tornadoes



138/345kV conductors dropped on ACCC and adjacent distribution line. Note the force of the impact was great enough to snap the upper phase insulator. The impact did not appear to damage the ACCC conductor although armor rods were installed on the ACCC conductor as a precaution.

OG&E's post-storm analysis indicated the design loading on the failed 138 kV ACCC monopole line was only about 60 percent or less, carrying only the one ACCC single conductor circuit. However, tornadoes are strange creatures. They will blow away a new brick home and leave a vacant crumbling wood frame house across the road unscathed.

The lattice towers, though designed in the 1960's for 115 mph (185 km/h) winds, were probably loaded closer to the ultimate as they were double circuit 345/138 kV with bundled conductors on both circuits. In 2000, OG&E added the second bundle conductor to the lower 138 kV circuit which required some structural reinforcement. The design criteria for the 138 kV steel monopoles were 95 mph (153 km/h) with a 1.1 Safety Factor, which equates to a wind speed of about 105 mph (169 km/h).

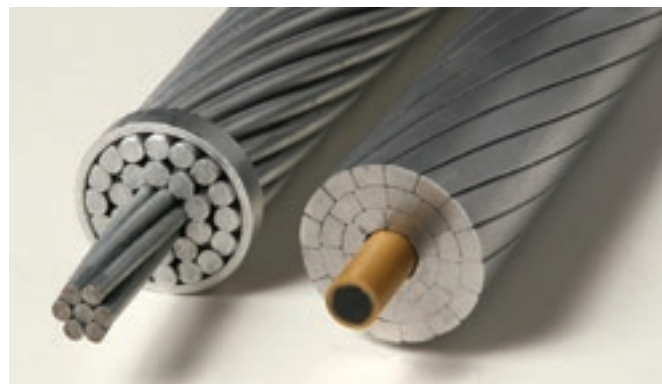
Dan Morehead, Lead Transmission Engineer for OG&E, stated that overall, for the magnitude of damage from the May 20 and May 31 tornadoes, the damage to the transmission system was not as bad as he had anticipated. OG&E lost seven 345kV double circuit towers, five 345kV double circuit two-pole steel structures, ninety-seven single pole 138kV and 69kV Structures and ten H-Frames on May 20. Then, only 11 days later, on May 31, OG&E lost another ninety single pole structures and twenty-one H-Frames.

More detailed National Weather Service data received recently indicated that a wind speed of 111 to 135 mph (179 to 217 km/h) most likely occurred at the area where the ACCC conductor damage occurred and the steel monopole was hit. Considering that a shipping container flew from one side of the road to the other over a row of trees, most likely after impacting the steel monopole, the actual wind force may be underestimated to some degree.

At the 138/345 kV tower crossing, wind speeds were estimated at 136 to 165 mph (219 to 265 km/h). Just east of the tower line crossing, wind speeds of 166 to 200 mph (267 to 322 km/h) were estimated. However, most damage appeared to result from flying debris more than from the speed of the wind itself.

It appeared that some portion of a trailer house (including the wheel base or chassis) was thrown into the double circuit lattice structure. Dan Morehead also stated that one could possibly design for any level of extreme wind, but not necessarily design for such widely varying impacts such as flying buildings, trailers and farm vehicles.

While the adjacent steel reinforced ACSR conductors were damaged or destroyed by flying debris, the robustness of the ACCC conductor's composite core was impressive. The fact that it didn't break even when structures were knocked over allowed OG&E to make repairs as quickly as possible. As we work to build a more robust and efficient grid, new technologies will surely make our jobs easier.



Conventional ACSR steel reinforced conductor (left) next to an ACCC composite core conductor (right)

\*OG&E serves more than 800,000 retail customers in Oklahoma and western Arkansas, and a number of wholesale customers throughout the region. OG&E, with about 6,800 megawatts of capacity, generates electricity from natural gas, western coal, and wind. OG&E's electric transmission and distribution systems span 30,000 square miles.



### About the author

**Dave Bryant,**  
Director  
Technology, CTC  
Global was one  
of the original  
developers of the

ACCC conductor and ancillary hardware components. His background in composite materials, testing and industrial design helped expedite the commercialization of the ACCC conductor.

# Effects of Electric and Magnetic Fields on Transmission Line Design

By James Hannigan  
PE, PMP, SAIC

Electric and magnetic fields are important factors to be considered when designing transmission lines. They occur in nature and have become much more prevalent in our everyday lives through man-made sources such as electric power. When planning transmission lines it is important that designers have a reasonable understanding of the nature of both so it can be considered during design; understand the effects of electric and magnetic fields from transmission line operation including corona; and mitigate these effects by modifying the design, where possible.

## Properties of Electric and Magnetic Fields

Electric fields are produced by voltage, and magnetic fields are produced by current. Electric fields and magnetic fields manifest themselves in different ways and have different characteristics. For example, an electric field is easily shielded by an object, such as a tree or a house, while a magnetic field is not. The presence of an electric field may cause a shock when touching a metal object, such as a fence or car, near a transmission line. The shock is caused by the body of the observer spanning a voltage gradient. A magnetic field has the ability to induce a current in a conductive object – for transmission lines this would require a long conductive object to be in close proximity to the line in order to have a noticeable effect. An example would be a parallel railroad or fence.

Electric and magnetic fields are coupled – therefore related to each other – when the distance to the source is much larger than the wavelength. However, when the wavelength is much larger, they are un-coupled and the effects of each should be considered separately. For low frequency fields, as is the case with power systems, the wavelength is about 3,100 miles and much larger than the typical distance of concern from the source, and therefore, the two are un-coupled. X-rays are an example of a coupled source. When electric and magnetic fields are coupled, they are referred to as electromagnetic fields; when they are not coupled, they are referred to as electric and magnetic fields. Both terms are abbreviated as EMF.

The actual EMF at any point in space is the cumulative EMF from all sources, and the magnitude and direction of all sources are summed to give the total EMF. Depending on the direction of each individual EMF source, they may partially add or partially cancel. The nature of the EMF, whether it be alternating (AC) or steady-state (DC), will also determine its properties.

## Environmental Effects of EMF

Historically, research on the effects of EMF on an individual's health has been inconclusive. The most recent research suggests that there is no link between EMF and adverse health effects. But despite these research findings, negative public opinion remains. The health concerns originate from early scientific studies that show that exposure to magnetic fields generated from low-frequency power systems may be linked to an increased rate of cancer in humans. With very high frequency magnetic fields (such as those from X-rays), because of the exceptionally high rate at which the forces alternate, the wave generated can cause energy to be emitted to an object, which is known as radiation. If the object is human tissue or other organic matter, this can damage chemical bonds and may eventually cause cancer or other health disorders. However, this is not the case with the low frequency fields of power systems EMF; because of their much slower alternating frequency, they do not have the ability to cause radiation.

Source	Magnetic Field (mG)	Electric Field (kV/m)
<b>Typical Steady State EMF Values</b>		
Magnetic Resonance Imaging (MRI)	20,000,000	
Permanent "Refrigerator" Magnets	250,000	
Earth's Magnetic Field (Northern US)	570	0.2 - 12
<b>Typical 60 Hz AC EMF Values Encountered</b>		
Transmission Lines (typ. @ ROW edge)	0.5 - 50	0.1 - 2.0
Common Home Appliance @ 3'	0.1 - 10	
Common Home Appliance @ 1'	40 - 300	
Personal Care Appliance @ 0.5'	600 - 700	

Table 1 Typical Commonly Occurring EMF Levels

Nonetheless, the health concerns remain with the general public. As previously noted, there are various sources of EMF, some natural. Table 1<sup>1</sup> summarizes the EMF levels of multiple sources present in our everyday lives. It is important to note that some are DC while others are AC. One of the main contributors to daily EMF exposure is common household appliances. Table 2<sup>2</sup> is a summary of typical appliances and their EMF levels. To alleviate public concern, multiple states limit the level of EMF strengths at the edge of the transmission line right-of-way (ROW). There are also several regulatory agencies that publish recommendations for EMF exposure to the general public, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) being the most prominent.

# Effects of Electric and Magnetic Fields on Transmission Line Design

Appliance	Magnetic Field Strength (mG)			
	at 1 Foot		at 3 Feet	
	Upper Limit	Lower Limit	Upper Limit	Lower Limit
can opener	163.02	7.19	6.44	1.30
clock	13.18	0.34	0.68	0.03
coffee machine	7.30	0.09	0.61	0.00
computer monitor	134.70	0.20	9.37	0.01
copier	18.38	0.05	2.39	2.39
desktop light	32.81	32.81	1.21	1.21
dishwasher	8.91	4.98	1.63	0.84
microwave oven	54.33	0.59	4.66	0.11
portable heater	19.60	0.11	1.38	0.00
printer	43.11	0.74	2.45	0.18
portable fan	85.64	0.04	3.12	0.03
radio	4.07	0.43	0.98	0.03
range	35.93	0.60	2.83	0.05
refrigerator	2.99	0.12	0.60	0.01
television	12.99	1.80	1.11	0.07
toaster	4.63	0.29	0.47	0.01
vacuum cleaner	22.62	7.06	1.28	0.51

Table 2: Typical Magnetic Fields of Home Appliances

A sample of these values is shown in Table 3.<sup>3</sup> Further evidence of the negligible impact of power systems' EMF is the fact that the levels of permissible EMF exposure from power lines published by ICNIRP were more than doubled when revised in 2010 as compared to the levels established in 1998.

Source	Magnetic Field (mG)	Electric Field (kV/m)
<b>Typical Organizational 60 Hz EMF Recommendations</b>		
ACGIH (for occupational)	10,000	25
NIR AIHA (for occupational)	4,170	8.3
ICNIRP (for general public, continuous)	2,000	4.2
IEEE (for general public, continuous)	9,040	5
<b>Sample 60 Hz EMF Regulatory Requirements</b>		
Florida (@ ROW Edge)	150	2
Massachusetts (@ ROW Edge)	85	1.8
Montana (@ ROW Edge)		1
New Jersey (@ ROW Edge)		3
New York (@ ROW Edge)	200	1.6

Table 3: Typical Published EMF Limitations

Even though it is believed that there is a minimal, if any, link to adverse health effects from low frequency AC EMF, there are other potential adverse implications of EMF in the operation of a transmission line.

Potential effects of electric fields from the operation of transmission lines include:

- Spark discharge as a person touches metal object near a transmission line
- Fuel ignition, pole fires, or dead tree burning by spark discharge
- Induced voltages and sparks during construction activities if other live lines are present

- Interference with heart pace-makers or other electrical devices
- Damage to fiber optic cable by dry-band arcing
- Corona discharge and its effects – audible noise, line losses, etc.

Potential effects of magnetic fields from the operation of transmission lines include:

- Induction of current in parallel wires or other long metal objects
- Interference with computer monitors or other magnetic devices, such as compasses

## EMF Reduction

There are many factors that contribute to the intensity of EMF. The two most critical factors in calculating EMF are the distance to the source and its electrical properties of voltage and current. Typically, the voltage and current are driven by load demand and cannot be reduced whereas the distance to the source is driven by cost (because a higher line requires taller and more expensive structures) and is not easily increased. If the EMF of the individual conductors can't be reduced, it must be accounted for and mitigated properly by the transmission line designer through the employment of other methods.

The EMF experienced by an observer is cumulative to the EMF produced by each source in the area. The conductors can be phased within a circuit so that the EMF emitted by each can partially cancel the others; or if more lines are present on the ROW, their conductors can be phased as well to allow for additional EMF cancelling. Often times, if a new line is constructed on an existing ROW, it can be phased to allow for a lower EMF post construction. Phasing will sometimes create a higher peak EMF near the center of the ROW with a lower EMF at the ROW edge; however, the edge is typically the location subject to regulatory requirements.

Another option is to alter the configuration of the line. The location of the conductors and shieldwires within the circuit can have a significant effect on EMF. For example, a vertical line has conductors higher than a horizontal line reducing their effective EMF at ground level; and a delta configuration will have a similar effect. A reduction in phase spacing generally correlates directly to a reduction in magnetic field, so the location and quantity of shieldwires can also affect EMF and should be examined. Hardware modifications, like the addition of V-strings that may move the conductors up and closer to the center of the ROW, can have similar effects.

Non-traditional designs for line configurations can also be employed to further reduce EMF. As shown in Figure 1, a transmission line can be designed as a dipole by using bundled conductors and energizing traditional A and B phases, but altering the C phase to have one sub-conductor opposed to the A phase and one opposed to the B phase instead of 120 degrees out of phase from each. Additionally, all three bundles can be split and oriented alternately (such as a circular or hexagonal arrangement) to allow for EMF cancelling.

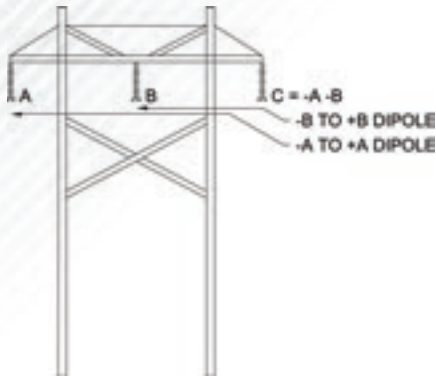


Figure 1: Transmission Line as a Dipole

In certain circumstances, it may be appropriate to install a passive shield line to reduce EMF on an existing circuit. The passive shield line is a 'dummy' line that emits EMF, which directly opposes the EMF of the transmission lines. The 'dummy' line would be a short line that forms a closed loop under each side of the transmission line of concern. Using the current induced by the magnetic field of the transmission line, it emits its own magnetic field and can be designed and phased to effectively cancel out the existing EMF. However, modifications can be costly, visually unappealing, and would increase line losses.

## Properties of Corona

Corona is a phenomenon that occurs as a result of high electric fields and has adverse electrical and environmental effects. Corona is a discharge of electricity from an energized surface. The discharge occurs when a highly concentrated electric field causes the air surrounding the surface to become ionized. Electrons are regularly discharged from an energized surface, but when the electric field is concentrated enough and exceeds a certain critical value, the single discharged electron collides with the air molecules and causes the release of their electrons. If a chain reaction of discharging of electrons from the surrounding air molecules – known as an electron avalanche – results, corona has occurred.

The surface condition of the energized material plays an important role in determining the critical value of the electric field at which corona discharge can occur. Any defect on the surface of a conductor that disrupts smoothness greatly increases the intensity of the electric field, increasing the likelihood of corona. Surface irregularity examples include: broken strands on a conductor, sharp edges on hardware, water droplets on a conductor, or abrupt changes in charge of hardware (which could occur at an insulator).

Conductor diameter is a variable that can affect the critical value for the formation of corona and is typically governed by the load required to be carried by the line. However, the use of bundled conductors allows the line to carry the same load with smaller diameter conductors, effectively raising the corona threshold and reducing the likelihood of corona. Air density is another variable

that is proportional to the critical value – a decrease will cause a reduction in the critical value. This could occur in a higher elevation or, possibly, with the use of high temperature conductors that heat the air in the vicinity of the conductor. Weather conditions will also contribute to corona. As noted above, the presence of rain droplets and lines near the ocean that may have salt deposits or those near contaminated generating facilities will all increase the surface irregularity.

## Environmental Effects of Corona

The electron avalanches of corona create streamers or discharges of electricity. This causes rapid heating of the air before it has time to expand and results in something similar to a tiny explosion. Many of those in sequence will create a noise that can be heard as a slight crackle or hum. The audible noise created by corona can not only be a nuisance, but a governing design constraint. According to the Electric Power Research Institute, the threshold noise level for abutter complaints to occur is approximately 53 decibels (dB) at ROW edge.

These discharges emit light seen in the dark and can also create electromagnetic interference with radio and analog TV broadcast signals; which are most significant in the AM radio bands. The process of ionizing the air also results in the creation of ozone – a gas that is commonly understood to be harmful to Earth's atmosphere. These effects, along with the process of ionizing the air, use energy and that energy comes from the transmission lines and results in power loss. Typically, though, audible noise limitations will govern the design before these other factors.

Corona also causes hardware degradation over extended periods of time. The corona streamers cause the hardware to heat up and may result in cracking or other defects. Because of their configuration – with an abrupt change from the energized fitting to the fiberglass insulating rod – polymer insulators create a higher electric field than is present on other transmission line hardware. This results in a lower threshold for corona and the streamers can easily damage the weather seal between the sheath and the fitting or the sheath itself. This is also exaggerated by the presence of water droplets following a rain storm. Because the fiberglass core needs to be completely isolated from weather, polymer insulators are especially susceptible to catastrophic failure due to corona.

## Corona Reduction

The main area of concern for reduction of corona is hardware assemblies for extra-high voltage lines. This includes 345-kilovolt (kV) lines and above, but the designer may wish to employ corona mitigating techniques described below to lower voltage lines on a case-by-case basis, if warranted. Any sharp edge can cause the onset of corona – an exposed cotter key, the 90degree angle of a bolt head, the sudden terminus of the tip of a compression deadend or even armor rods can be enough of a disruption of the smooth surface to cause the onset of corona.

## Effects of Electric and Magnetic Fields on Transmission Line Design

It's important to procure hardware that is 'corona-free' or rated for '[extra]-high voltage.' When this is specified, manufacturers will supply parts with tapered edges or rounded caps to cover protruding objects. Figure 2 shows examples of corona-free versus traditional hardware.

Figure 2



Corona-Free (Left) vs. Traditional (Right) Clevis Hardware

Corona-Free (Top) vs. Traditional (Bottom) Suspension Clamp

Corona-Free (Top Two) vs. Traditional (Bottom) Armor Rods

The energized end of an insulator is generally subject to higher electric fields. Corona is mitigated at this location by the introduction of a corona ring to the hardware assembly. A corona ring is a conducting ring that mitigates corona by expanding the electric field beyond the first insulator and dispersing the electric field over a larger area. (One may also be applied to the cold end as well, depending on the line's characteristics.). The size and shape of corona rings may be adjusted to account for a range of hardware and insulator configurations; the designer should always consult the corona ring manufacturer to determine the appropriate application. Because of the high potential for damage and the severity of the failure mechanism from corona in polymer insulators, the designer may wish to employ the use of corona rings at voltage levels as low as 115 kV.

Finally, corona can be mitigated through post construction inspections performed on locations where corona is of particular concern. This might include highly contaminated areas; extra-high voltage lines, such as 500 kV and above; lines with polymer insulators; or lines where audible noise has been reported. Retrofitted hardware can be installed if high levels are detected. Routine maintenance should be conducted in a timely manner and include the washing of insulators in areas with high potential for contamination as well as visual inspection of the lines to mitigate any defects in the smooth surfaces, such as a damaged conductor, backing out of cotter pins, or loose hardware.

By initially limiting EMF and corona and then employing mitigating techniques where necessary, a design can be produced that is satisfactory for all stakeholders.

### About the author



**James Hannigan** is a senior transmission line engineer for SAIC. He has a master's degree in civil engineering, with a structural emphasis from Worcester Polytechnic Institute and has more than eight years of experience in transmission line design focused in licensing and permitting, rehabilitation of existing lines, and design of wood pole structures.

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<sup>1</sup> Electric and Magnetic Field (EMF) Analysis of Expansion of Lines Originating at Millbury Substation, 2009; Gradient LLC; [Massachusetts] D.P.U., [Docket] 09-136/137, Exhibit PAV-3; <http://www.env.state.ma.us/dpu/docs/siting/09-136/12409nepptp6.pdf>

<sup>2</sup> Electric and Magnetic Fields Measurement and Possible Effect on Human Health – What We Know and What We Don't Know in 2000 [Fact Sheet]; California Electric and Magnetic Fields Program, State of California; Gray Davis, Governor; <http://www.ehib.org/emf/longfactsheet.PDF>

<sup>3</sup> Electric and Magnetic Field (EMF) Analysis of Expansion of Lines Originating at Millbury Substation, 2009; Gradient LLC; [Massachusetts] D.P.U., [Docket] 09-136/137, Exhibit PAV-3; <http://www.env.state.ma.us/dpu/docs/siting/09-136/12409nepptp6.pdf>

# Aerial LiDAR enters Indian Electricity Sector

## A new approach to OHL design in India

By Paul Richardson

An innovative aerial survey utilising LiDAR technology and PLS-CADD™ software has been successfully deployed in the Indian electricity transmission sector for the optimisation of 1,900 circuit kilometres of 765 kV overhead lines (OHLs) that run across mountains, plains and urbanised areas. Network Mapping, a UK and US based aerial LiDAR service provider, performed the survey work as a consultant to Jabalpur Transmission (JTCL) and Bhopal – Dhule Transmission (BDTCL), owned by Sterlite Grid Limited, an innovative Indian engineering firm at the forefront of the power transmission infrastructure sector. The purpose of the project was to assist with two 35-year Design-Build-Operate concessions by employing LiDAR technology to optimise route corridors for planned transmission lines to maximise load transfer capacity and reliability and minimise construction costs and delays. The project attracted commentary from the Chancellor in the UK and the Finance Minister of India as a demonstration of improving Anglo-Indian initiatives. This article describes the project, the unique challenges faced in India, and the results of the LiDAR and PLS-CADD™ optimisation process.

### New infrastructure for India

India is currently engaging in large scale investment in its transmission infrastructure with 109,000 circuit kilometres to be designed and constructed as part of the 12th 5-year plan (2012 to 2017). This level of investment is required to meet the huge increases in demand created by growth of the industrial and population bases together with rising living standards. Gross Domestic Product has increased by 7.7 percent between 2007 and 2011, and the population by 1.76 percent per year from 2001 to 2011. Black-outs and brown-outs are common; six hundred million people were left without power in July 2012 following the cascading failures of the northern, eastern, and north-eastern grids.

The concessions for the new-build projects that form the topic of this article were comprised of five single circuit lines and one double circuit line at the 765 kV level. The six concessions crossed mountainous terrain, flat plains, and large rivers in five states of Central India. These States, from west to east, incorporated Gujarat, Maharashtra, Madhya Pradesh, Chattisgarh, and Jarkandh.

Against this context it was crucial for JTCL and BDTCL to design new Over Head Lines (OHL) for their concessions that would provide extremely high levels of both utilisation and reliability in a cost

effective solution. This necessitated deployment of the very latest technology. Aerial LiDAR survey techniques and PLS-CADD™ software were chosen by Sterlite to fulfil these objectives.

“It is a matter of great pride that Sterlite Grid becomes the first organization in India to undertake and accomplish an aerial LiDAR survey as a part of the construction of its Transmission Line assets,” remarked Pratik Agarwal, Director, Sterlite Grid. “All the tower spotting concerns are known prior to construction itself and resolved thereby helping in faster project implementation and lesser provision for contingencies.”

### The process

#### *Capturing data using aerial LiDAR technology – the benefits*

Aerial LiDAR technology is a rapid survey technique that has been employed extensively to assess electricity transmission infrastructure throughout the world. Digital 3D models are created by emitting laser points, generally from a helicopter acquisition platform. Only one technician is required to operate a base station within each 20 kilometre radius of the survey platform. The technique allows comprehensive data of a high resolution to be captured quickly, with typical point densities being in excess of 20 points per square metre. Provided there is adequate ground control, the absolute accuracy of a single point will be of a high level and the relative accuracy between points will be even greater still. The high resolution of survey points captured by the system allows the ground surface, man-made and natural features to be adequately mapped to ensure regulatory clearance is met for the new line design.

The speed of data capture as compared to conventional surveying is one of the major benefits of a LiDAR survey. Typically, data capture progresses at a rate of 60 kilometres per day. For Sterlite's survey, data for the entire 1,600 kilometres of transmission lines was captured in 20 days (a higher than average capture rate of 75 kilometres per day) and processing was completed within 3 months. The difficult terrain encountered would have posed significant obstacles to a traditional survey; due to the aerial nature of Network Mapping's survey, however, this was much less of a problem. Conducting a survey from an aerial platform also avoided issues of inflated land compensation claims that can sometimes arise when ground surveyors have a prominent presence in an area.

# Aerial LiDAR enters Indian Electricity Sector

Aerial LiDAR surveys allow a greater survey width to be captured in a short space of time as compared to conventional surveying. This is of particular benefit to route optimisation, as a wider survey swath allows such options to be assessed using the survey-derived data. This attribute of Network Mapping's aerial LiDAR survey provided benefits to JTCL and BDTCL, as one challenge that had to be tackled were powerlines that crossed tribal villages and schools along the Dharamjaygarh to Jabalpur route. Tribal ethnicities and their relationship with the wider Indian population and government is a sensitive issue in India, requiring Network Mapping to re-align these routes using the LiDAR data so that such areas and issues were avoided.

## The process

### *Challenges to data capture*

India presented its own unique challenges to data capture. Initially, importing the equipment into the country proved problematic, with customs procedures taking a long time. The varied and difficult nature of the terrain proved a challenge for ground crews as road conditions sometimes inhibited travel and logistics. As well as this, the time taken and difficulty of obtaining landing and take-off permissions hindered proceedings slightly. This was mainly due to difficulties in locating regional airfields to gain such permissions. Despite these obstacles, the data capture progressed smoothly and quickly, displaying the versatility of the methodology and the ability of Network Mapping and Sterlite to work together to address the various procedural compliances that were required prior to flying.



The aerial LiDAR system lands in rural India, attracting a crowd.

### *Data processing*

The LiDAR data is imported into PLS-CADD™ as a classified point cloud. Using this data, models can be created in PLS-CADD™ to assess various criteria in relation to the new-build lines, which can inform on the best options for alignments, tower designs and tower positions, in order to produce a least cost solution. Such models can compute and balance cost against the reliability and performance of lines, thus producing a route which is both cost effective and in accordance with regulation.

"We're very grateful to Sterlite Grid for giving us this opportunity," said David Langworth, Chairman, Network Mapping. "This seminal project demonstrated that LiDAR data is now available in India and when combined with PLS-CADD™ provides an invaluable technology for the development of overhead lines. This has opened the opportunity

for aerial LiDAR to be used in support of India's rapid infrastructure growth and to deliver utilisation and reliability improvements to existing grid infrastructure."

## Outcomes of the approach

Optimisation of route alignments can provide many benefits to engineers. Modelling calculates the most appropriate, lowest cost solution that can overcome obstacles in the landscape. The swath width of the survey enables alternative horizontal alignments to be explored. The main obstacle for Sterlite, however, was the terrain, which meant the focus of this optimisation was the vertical alignment. With PLS-CADD™ modelling, it could be determined prior to construction which tower designs and positions would cross valleys, hilly terrain, and rivers in the most cost effective manner, whilst still meeting all structural and clearance regulation.

Specific examples of optimisation providing benefits to cost, reliability, and schedule abound within this project, including:

## The process

### *Reliability*

The terrain of the powerline routes presented the main obstacle to JTCL and BDTCL's construction. Hills, mountains, and large rivers meant that a standard suite of tower designs would not provide as reliable a service, due to these landscape features compromising the effective operation of such structures. Thus many different and more specialised tower designs needed to be employed for proposed towers to ensure that ground clearance distances were maintained. The Jabalpur to Bhopal route provides an example of this, as the hilly terrain required larger and stronger towers than was originally anticipated. PLS-CADD™ modelling also enabled the design of special uplift towers in order to cross a mountain and large rivers along the Dhule-Aurangabad route in a manner which did not compromise the ground clearances of the lines. The ability of aerial LiDAR survey to overcome such topographical difficulties ensured an increased level of reliability for the power lines, as the optimised tower designs and positions reduced the number of structural and clearance violations within the network.

### *Cost and Schedule improvements*

The highly accurate and detailed nature of the data allowed the project to be planned effectively, saving time and money. The survey optimised the route design which resulted in 22 fewer towers being used, thus reducing the Bill Of Quantities (BOQ) for the project. Because site conditions could be studied in the desktop, no check surveys were required and construction delays were minimized. Health and safety benefits can also be realized in the same manner. These attributes improve cost effectiveness and reduce risks to field crews by nullifying the need for sending personnel to the site for such checks in potentially hazardous areas. Schedule times can also be improved due to the fact that the information required is already at hand, meaning no extra time needs to be spent on gathering information. End-to-end costs were also reduced as any design modifications could be completed before construction commenced.

## Aerial LiDAR enters Indian Electricity Sector



Stock imagery examples of PLS-CADD™ modelling which enabled the crossing of features, such as wide river valleys and human settlements

"The availability of this highly detailed and accurate aerial LiDAR corridor mapping prior to the detailed design phase of this project is like providing the perfect race track for a finely tuned supercar to push all of its capabilities to the limits," stated Otto J. Lynch, P.E., Vice President of Power Line Systems, Inc. "The cost savings and engineering confidence over traditional surveying and archaic line design methods is immeasurable. We at PLS are proud to continue

to be a part of providing a complete and modern engineering solution that delivers both an economical and reliable solution to the grid development in India."

### LiDAR has improved reliability, cost effectiveness and scheduling for OHL design work in India

This project commissioned by Sterlite and executed by Network Mapping has demonstrated that LiDAR survey and PLS-CADD™ are feasible tools that are now available for use by design engineers in India. The technology enables new overhead lines to be designed in such a way that reliability, cost effectiveness, and scheduling are maximised. A natural extension to the value that this technology can offer to the Indian transmission grid is to demonstrate application for the as-built survey of existing transmission lines to check clearances and mitigate violations to prevent future black-outs.

#### About the author



**Paul Richardson** is Network Mapping's Engineering Director. He has over 30 years' experience of working for, and with, Power Utilities in Europe, the United States, the Middle East, India, and Australia. Paul has worked extensively on new build and existing T&D assets and has spearheaded the use of LiDAR in reducing capital spend, improving reliability and increasing utilisation. [www.network-mapping.com](http://www.network-mapping.com)

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# THE BIGGER PICTURE

BY BERNADETTE CORPUZ, BORDEN LADNER GERVAIS LLP



## The Chameleon in the Sun, or Wind – Ontario's Feed-in Tariff Program (FIT) A Status Check

### FIT 2.0 – The First Procurement Window

As expected, the first procurement window launched under Ontario's Feed-in Tariff Program ("FIT") 2.0 opened on December 14, 2012 and closed on January 18, 2013. Approximately 4,000 applications were submitted. The Ontario Power Authority ("OPA"), with an independent evaluation monitor, completed the review of the applications in May to determine which applications were complete and eligible. The OPA employed an independent evaluation monitor for the purpose of ensuring that the reviews were conducted in an objective and consistent manner. Those applications that made it through this first round of review will proceed to the transmission and distribution availability testing ("T&D Test") in the order in which they have been ranked, according to the priority points received during the initial review process. Time stamps will be used to break any ties in points awarded. During the summer of 2013, the OPA expects to award up to 200 MW of contracts to applications that pass T&D Testing.

Unsuccessful applicants will be able to reapply during the next Small FIT window, which is expected to open in the fall of 2013.

### The Process of Elimination

Future applicants can learn some lessons from this first procurement window. The OPA has provided the following summary of some of the most common and most frequently occurring issues that caused an application to fail the first round of review:

- Missing supporting materials submission. Applications required both an online electronic submission and a follow-up hard copy package that included supporting materials. Some applicants only provided online applications;
- Wrong fees and securities provided (incorrect amounts, improper format, for example, cheques not certified);
- Wrong or inconsistent legal names. An applicant may have identified a certain legal name but identified a different name or entirely different entity on supporting materials;
- Missing required originals of supporting documents;
- FIT reference numbers were not included on documents;
- Missing required forms altogether;

- Incomplete forms;
- Inconsistent and inaccurate forms;
- Unacceptable locations. Some projects were attempting to locate on prime agricultural lands, or to build on or next to residential properties;
- Lease, Option and Site Access Rights were not in the name of the applicant; and
- Lease, Option and Site Access Rights conditions were in favour of the landlord.

The errors described above were fatal to an application. The FIT Rules provide that the decision of the OPA is final. There is no appeals process for those applicants that were unsuccessful following the first round of review. The moral of the story – pay attention to the detail, get it right, and get it right the first time.

### Future Procurement

While renewable procurement policies continue to evolve, Ontario remains steadfast in its commitment to renewable energy projects, and in particular, small projects. The province plans to make 900 megawatts (MW) of new capacity available between now and 2018 for the Small FIT and microFIT programs. During the fall of 2013, the OPA will open a new procurement window for both programs. Beginning in 2014, annual procurement targets will be set at 150 MW for Small FIT and 50 MW for microFIT.

### New Procurement Stream

Ontario's FIT Program continues to change colour as the province's new government takes hold of its constituents' demands. Just past the one year anniversary of the FIT Program's first major revision (FIT 2.0), the renewables sector will see yet a few more changes. But the FIT chameleon will still be a chameleon with renewable energy remaining a key component of the new government's energy policy.

On May 30, the province announced that it will work with the Ontario Power Authority ("OPA") and municipalities to develop a competitive procurement process for renewable projects over 500 kilowatts (kW). This new procurement stream will replace the existing large project stream of the FIT Program (i.e. Large FIT).



## The Government's Response

An objective of the new stream is to better meet the needs of communities. Energy planners and developers will be required to work directly with municipalities to identify appropriate locations and site requirements for future large renewable energy projects.

To achieve this, Ontario says that it will:

- Revise the Small FIT (projects between 10 and 500 kW) program rules to give priority to projects partnered or led by municipalities;
- Work with municipalities to determine a property tax rate increase for wind turbine towers; and
- Provide funding to help small and medium-sized municipalities develop Municipal Energy Plans - which will focus on increasing conservation and helping to identify the best energy infrastructure options for a community.

The FIT Program's current priority points system already awards 2 points for projects that come with municipal council support. The planned revisions would place even further priority on those projects that demonstrate a municipality's actual involvement rather than simply support.

The province's plans appear aimed at assuaging longstanding critics of the thwarted ability of municipalities to have some say over project siting within their boundaries.

Ontario's new government says it will change how the province plans and builds large energy infrastructure projects in the future, and place increased focus on the needs of communities. In this light, the government has asked the OPA and the Independent Electricity System Operator ("IESO") to develop a new regional energy planning process based on formal input from municipalities, communities and the energy sector.

The IESO and OPA are expected to report back to the Minister of Energy with a joint implementation plan by August 1st, 2013. The recommendations are to include proposals that:

- set out a method for regional energy plans, including procedures for the development of such plans;
- include transparent mechanism for consultation with municipalities, Aboriginal communities and other stakeholders in the development of regional energy plans;
- include processes to ensure that municipalities are engaged in the siting of large energy infrastructure projects; and
- reflect recommendations with respect to siting large energy infrastructure projects made by the Standing Committee on Justice Policy.

The actual power that will be given to municipalities in siting decisions remains to be seen. The notions above suggest that while municipalities must be consulted, the province is expected to retain decision making authority over the siting decisions on large energy infrastructure projects.

The government also recently announced a review of Ontario's Long-Term Energy Plan, to determine the best energy supply mix for the province over the next 20 years. The review will be based on a public consultation process and be completed within six months.

## 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, Bernadette 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. Bernadette can be reached at [bcorpuz@blg.com](mailto:bcorpuz@blg.com) or 416-367-6747.

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# SECURITY SESSIONS

You can't get there from here. Ya gotta be born there!

In the past few months I have had the opportunity to meet with several different plant managers from different industry segments, ranging from refining and petrochemical to nuclear power generation, and in almost every case they were still struggling with how to go about establishing acceptable cyber security for their facilities. Depending on their industry they have regulatory pressures from NERC, DHS, NRC, DOT or some other agency or industry group. This late in the game I was surprised to see that anyone would still be trying to figure out how to start. Personally, I always like to start at the beginning and proceed to the end.

There has been a LOT of guidance published, by many experts and organizations, about all sorts of ways to approach cyber security. Yes, the majority of them are aimed at conventional business 'IT' cyber security, but a sufficient number have been oriented towards industrial automation and process automation systems. In many cases the real problem with getting started is the on-going warfare between corporate IT and the plant instrumentation and control (I&C) organization. In this column I have often spoken of the critical differences between 'IT' best practices and 'I&C' best practices and about how they often clash; mainly over the issue of safety. But forgetting those differences for the moment there are a set of generic activities that need to be performed in order to establish adequate cyber security for a plant facility. The ISA (International Society for Automation) has pretty good guidance about how to get a cyber security program up and rolling. The NRC has published 'Regulatory Guide' [RG 5.71] with a lot of similar guidance, although it is focused on protecting nuclear facilities and may be a bit much for other industry segments. But, it does contain a lot of good ideas and suggestions about how to move forward with setting up a program.

The starting point of any discussion about cyber security (or any kind of security) is the identification of the things you need to protect. You can choose to protect everything, but protection

costs money and takes time and effort. You need to recognize that all assets are not created equal and that the consequences of a cyber attack on a PC in the accounting department are not the same as the consequences of a cyber attack on a DCS system controlling an explosive and unstable process. (But we don't want to let that accounting PC provide a platform for launching an attack on that DCS system either!) You can also choose not to protect anything and live with the risk and potential consequences. Of course your insurance underwriters and board of directors might frown on that decision, and government regulations might take that option off the table. So it is probably a better business decision to make an inventory of computer-based automation systems and devices and then perform a consequence analysis to determine which ones you really can't afford to have compromised.

Many people use a combination of consequence and likelihood to determine if a given asset should be protected. [ $Risk = consequence \times likelihood$ .] The problem is that they have little or no data on which to base the likelihood value. Often the end result is that they determine that it is highly unlikely that an asset could be compromised and thus the risk is minimal even though the consequence of compromise would be very serious. Personally, I like to use connectivity and complexity as the basis for establishing a likelihood factor. The more wired/wireless communication connections a critical system or digital device has with other systems and devices (both permanent and temporary) the greater the likelihood of an exploitable pathway of attack. If a system is truly 'air gapped' then SneakerNet (manual access) is the only pathway that has to be considered and attack likelihood is reduced. If a system is on an isolated and physically-secured (hard-wired) LAN segment with a few other systems/devices then attack likelihood is slightly greater. If a system is connected on a LAN or WAN with lots of other systems and maybe even with wireless connectivity then attack likelihood is much greater.

# SECURITY SESSIONS

On the other hand, if a device cannot be easily field-reprogrammed – and I am not talking about configuration parameters and settings, I mean making software changes to the device in the field that add, modify, degrade or remove functionality (e.g. a smart transmitter or digital panel indicator) then it is of low complexity and again the likelihood of cyber attack is minimal. Whereas a computer system with a Linux/Windows operating system and Ethernet-TCP/IP networking is of high complexity and far more susceptible to cyber attack because its software can easily be modified, even quite extensively, ‘in the field’. So it may be possible to make a better guesstimate of ‘likelihood’ by looking at complexity and available communication pathways when evaluating a critical system or digital device.

Today, any senior manager who believes that the ‘bad guys’ wouldn’t bother targeting their plant or systems is making a serious and potentially expensive mistake. Recent investigations have shown a pervasive pattern of system compromises across almost every industrial sector for the purpose of obtaining intellectual property, trade secrets and competitive information, as well as establishing a ‘back door’ in systems that can be used in the future to cause problems if that is deemed to be necessary. I won’t name names but this activity is being perpetrated by a major nation state and a couple of not-so-major ones. The days of security through obscurity are long gone. You really must take steps to protect your vital assets against cyber threats. Another reason for concern is that most industrial facilities have connections to their corporate network which has connections to the Internet. This so-called vertical integration provides a potential communication pathway from across the Internet potentially all the way down to the instruments and control elements, if your plant is now using the Ethernet-TCP/IP versions of some fieldbus or PLC data highway. Something to consider in your security planning is the creation of a DMZ (demilitarized zone) between the plant and the corporate WAN. Another thing to consider is the liberal use of internal firewalls to segment your various systems and sub-systems and to control and monitor the communications permitted between and among those systems and sub-systems.

Once you have identified the assets you need to protect (based on consequence and likelihood), and the potential attack pathways that could be used for such an attack, the next step is to look at ways to block those attack pathways. This may involve using technical ‘controls’ such as firewalls and data diodes, or physical controls such as locked rooms and cabinets, or the use of administrative controls such as personnel training

and policies and procedures. You probably will end up needing a judicious mix of all three. Don’t presume that the best solutions are always the high-tech ones. The application of security controls has a cost, and not just a one-time cost, there will be on-going support costs as well. These controls need to provide a good return on investment. Some of these controls will be aimed at defending against cyber attacks and making your systems less vulnerable. Some will be used to detect cyber attacks, whether successful or not. Others will be used to mitigate the impact of an attack that was partially to fully successful and to restore plant operations. I like to point out that attackers are constantly changing their methods and that it is therefore impossible to be 100 percent effective in providing cyber security. Thus the ability to detect that you have been (are being) attacked is as important as putting defenses in place to block attacks.

One of the ways in which industrial automation cyber security get more interesting and complicated than IT cyber security is the use of all kinds of ‘smart’ devices. In a large plant facility it is likely that you will find distributed controllers, remote terminal units (RTUs) and programmable logic controllers (PLCs) as well as smart transmitters, smart control elements, computer-based subsystems such as tank inventory systems, analytical and laboratory systems, emission monitoring systems, and even digital protective relays and motor control centers (MCC.) Most of these things will be foreign to an IT person, and just because they contain a microprocessor and stored programming doesn’t mean that they can be treated in the same manner as an actual ‘computer.’ You will need to identify any such systems/devices whose compromise would lead to unacceptable consequence and consider how best to provide them with cyber security protections. Again, it may be that non-technical controls (such as physical protective means) can achieve the goal.

I want to point out that I keep talking about the ‘compromise’ of a critical system or device, not their failure or shutting them down. That is because in the cyber world it is usually more desirable to use a system or device of which you have gained control than it is to merely shut them down. When considering consequences you need to think about all of the possible ways in which a bad guy could mess with a critical system. I like to tell plant managers to think about what could happen if a smart, evil person took over their control room and started using the operator and engineering consoles to mess with the plant equipment and control strategies.

# SECURITY SESSIONS

So now that you have identified the assets, you need to protect and select the controls and measures you will use to protect them. You can't do everything at once and you may not be able to fund everything in one fiscal year's budget. So you will need to prioritize and take care of the most critical assets first. Look for the security enhancements that give you the greatest reduction in risk and give them priority. You will also need to think about the on-going support of your cyber security. Many technical security mechanisms require periodic updating to keep current with new threats. Technology changes and what kept you safe last year may not be adequate this year. You are not making a one-shot commitment to cyber security; you are making it a business process and committing budget dollars and manpower to establish an on-going cyber security program.

You also need to keep in mind that untrained people can be the weakest link in your cyber security. Spear phishing attacks and malicious email and web sites are becoming the leading means for launching a cyber attack. Personnel need training in basic cyber security and social engineering methods in order to prevent them from inadvertently compromising your cyber security. There are many simple and inexpensive ways to keep personnel aware of the need for cyber security and sensitive to the threat. But that will have to be the subject matter for a future column.

## ABOUT THE AUTHOR

**Dr. Shaw** is a Certified Information Systems Security Professional (CISSP), a Certified Ethical Hacker (CIEH) a Certified Penetration Tester (CPT) and has been active in designing and installing industrial automation for more than 35 years. He is the author of Computer Control of BATCH Processes and CYBERSECURITY for SCADA Systems. Shaw is a prolific writer of papers and articles on a wide range of technical topics and has also contributed to several other books. Shaw has also developed, and is also an instructor for, a number of ISA courses. 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 [timshaw4@verizon.net](mailto:timshaw4@verizon.net).



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## The Clean Energy Kingdom

Saudi Arabia's Plan to Procure up to 54 GW of Renewable Energy

By Stuart Solsky and Stephen Matthews, Baker Botts

Guest Editorial >



The Kingdom of Saudi Arabia ("KSA") is pursuing an ambitious strategy to diversify the country's energy portfolio over the next 20 years by procuring up to 54 gigawatts ("GW") of electrical energy from renewable sources. The initiative is intended to diversify the country's energy mix, introduce renewable energy as a major component of that energy mix, reduce the country's reliance on fossil fuels and diversify the Saudi Arabian economy. It will be implemented and overseen by the King Abdullah City for Atomic and Renewable Energy ("K.A.CARE").

While Saudi Arabia remains the world's largest exporter of crude oil, steadily increasing domestic demand for electricity and desalinated water is rapidly eating into reserves. Various forecasts have predicted that, under projected rates of consumption, Saudi Arabia would become a net importer of oil within 25 years. Saudi Arabia's effort to foster renewable energy development is one strategy to deal with this reality and counteract the nation's current dependence on the oil industry. KSA recognizes the hazards of failing to adapt to its changing energy landscape and is proactively focused on transitioning to a more balanced energy mix as a means of preserving wealth and stability, in part by creating jobs for its growing population in the technology and other sectors important to its future.

### The White Paper and Symposium

On February 25, 2013, K.A.CARE released a White Paper to stakeholders seeking feedback on the proposed renewable energy procurement process that will be administered initially by K.A.CARE and subsequently by another government-guaranteed entity, the Sustainable Energy Procurement Company ("SEPC"). SEPC will execute and manage standardized power purchase agreements ("PPAs") under the program and purchase the associated electricity. The plan will be subject to the Saudi Arabian Council of Minister's formal empowerment of K.A.CARE, expected to be given in conjunction with the program's official launch.

According to the White Paper, renewable energy projects under the initiative would include solar, wind, geothermal and waste to energy ("WTE") technologies, with each proposal being assessed according to technology type. The plan calls for installation of 25 GW of solar thermal, 16 GW of solar photovoltaics ("PV") and an aggregate of 9 GW of wind, geothermal, and WTE. K.A.CARE's projections envision adding 24 GW capacity from renewable sources by 2020 and up to 54 GW capacity by 2032.

On April 23 and 24, 2013, K.A.CARE held a symposium to present the procurement process and to introduce Saudi companies and stakeholders to interested foreign participants. It presented the Saudi sustainable energy program highlighting the opportunities for both the local industry and global partners in the service and manufacturing sectors. Also showcased was the localization program and how it would lead to success in the nuclear and renewable energy fields. International vendors met local Saudi companies to forge working relationships and determine best practices.

### The Bidding Process

In an introductory round set to open later this year, and thereafter in successive bidding rounds conducted along two to three year timelines targeting up to 7 GW per round, developers will be invited to submit offers on standardized 20-year renewable PPAs. During the introductory round, bidders will be given up to six months to prepare proposals; in subsequent bidding rounds, the response periods will be shortened as the program and renewable energy industry in the KSA mature. Bidding entities must be 'organized and existing under Saudi Arabian law' or in the process of registering for such status and be formed consistent with the business of developing renewable power projects in KSA. Each bidding round will include a request for qualification ("RFQ") prior to the issuance of a request for proposal ("RFP"). Registered proponents will be given the opportunity to comment on the draft RFP and PPA.

Proposals will be evaluated for compliance with Saudi Arabian law and certain mandatory program requirements as well as on their relative merits in comparison with other proposals for a given project. Because one of the major goals of the procurement process is to enhance KSA's native abilities in the renewable energy industry rather than simply balancing the energy portfolio, the extent to which bidders focus on the use of local goods and services, including the employment of Saudi Arabian nationals, will enhance a given bid's score in the procurement process. In addition, bids that feature strong financial capability, extensive developer experience and established project status will be given favorable consideration, with emphasis placed on financial capability and experience especially during the initial round. Transmission costs will be included in proposal evaluation. Projects must have a minimum 5 MW nameplate capacity, with the potential for smaller aggregated projects that share a common metering point.

### Selected Issues to be considered by Potential Investors

Based on Saudi Arabian law and our extensive experience in Saudi Arabian project development, we have identified a number of issues that should be considered by potential investors in a renewable energy project in KSA. This is not intended to be an exhaustive analysis of all issues a prospective bidder should consider, and we do not purport to offer any legal advice herein. Rather, this list is offered to stimulate thought and generate discussion about the K.A.CARE initiative.

**1. Corporate Structure.** As noted above, the White Paper states that bidding entities must be 'organized and existing under Saudi Arabian law' or in the process of registering for such status. Limited liability companies and joint stock companies are referenced expressly in the White Paper and, although not specifically ruled out, both a branch of a foreign company and an 'unincorporated project company' might be deemed ineligible depending on how K.A.CARE construes the term 'organized and existing under Saudi Arabian law.' A clarification from K.A.CARE has been sought on this point during the White Paper feedback process and will need to be factored into any corporate structuring. We note that bidders often choose joint venture and consortium agreements for the purposes of submitting a bid, and form a limited liability company thereafter. Each approach has unique advantages and disadvantages.

**2. The Site.** After the introductory round, proponents will be required to source their own site and demonstrate their ability to operate the project thereon. An ideal project site should be appropriately sized and attractively located (from SEPC's perspective) to achieve project objectives. Careful consideration should be given to the manner in which the proponent obtains the rights (through lease, purchase or license) to land suitable for the project to ensure its enforceability under Saudi Arabian law. Because specific performance and other equitable remedies are generally not available under Saudi Arabian law, the proponent would be limited to bringing a lawsuit for monetary damages against the defaulting party. However, this would provide only limited relief, as only direct, proven damages are recoverable under the Hanbali school of Islamic jurisprudence predominant in Saudi Arabia. Speculative damages, including in the nature of lost profits, are not recoverable in KSA. On a practical note, foreign developers that lack the local business relationships in Saudi Arabia requisite to select and obtain a suitable project site will find it beneficial to partner with a local entity that is responsible for sourcing a proposed project site.

**3. Local Content.** Partnering with a local entity or entities could also foster business relationships helpful in further satisfying K.A.CARE's express local content requirements. The Saudi Arabian government is committed to increasing the proportion of Saudi Arabian nationals in the domestic workforce, especially in managerial and technical positions. A commitment to employing Saudi Arabian citizens and utilizing locally-manufactured equipment will put a proponent at a significant advantage in the bid process. Bidders should ideally adopt a concerted strategy to accomplish local content objectives early, such as entering into local joint ventures for the manufacture and procurement of project equipment and establishing robust employment, recruitment and training programs for Saudi Arabian citizens.

**4. Proposal Security.** Based on the forms of proposal security described in the White Paper, we expect that a proponent would require an ongoing commercial banking relationship with a bank in Saudi Arabia. The bid bond or letter of credit will likely take the form prescribed by the Saudi Arabian Monetary Agency for performance security used in government tenders. As a general rule, the issuing bank is required to pay funds to the government agency upon receiving a demand against these instruments.

**5. Power Purchase Agreement.** Proponents should plan to develop their full set of comments to the PPA as soon as it is available. SEPC will field comments on the PPA prior to issuing the RFP, but thereafter will not negotiate the terms of PPAs on an individual basis. Below are some PPA-related topics highlighted in the White Paper:

- **Local Funding.** Designation of Saudi Riyals as the currency of payment for the PPA will require the bidding entity to heavily favor local funding and payments to contractors in local currency in order to reduce finance costs.

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- **Governing Law.** Similarly, designation of Saudi Common Law as the governing law represents a concern to potential financiers. Previous power projects in the region have used English law as the governing law of the PPA. The choice of Saudi Common Law may restrict the pool of banks willing to assume the associated risks, even though K.A.CARE has mitigated them to some extent through the associated government guarantee (something becoming less common in the region).
- **Performance Security.** A proponent risks forfeiting the performance security if it cancels a project or fails to reach commercial operation in accordance with the PPA. It is unclear whether forfeiture of the performance security will be the sole damages that SEPC would seek. Under the Saudi Arabian Competition and Procurement Law, SEPC could seek damages for the cost of replacing the contractor to perform the project.

The assessment of different types of renewable energy as they relate to availability, source, geography, climate, and sustainability is a vital aspect of this long-term program. Both the National Renewable Energy Laboratory and the Battelle Memorial Institute from the United States will work in tandem with national authorities of the Kingdom to implement the project and ensure its success.

### ABOUT THE AUTHORS


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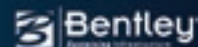
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VIZIMAX INC.  
Tel: (450) 679-0003  
www.vizimax.com

## AUGERS - DRILLING ACCESSORIES

MABEY INC.  
Tel: (800) 956-2239  
www.mabey.com

## AUGERS - EARTH

GENERAL EQUIPMENT COMPANY  
Tel: (800) 533-0524  
www.generalequip.com

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

## AUTOMATION PRODUCTS

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

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
www.osii.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SCHWEITZER ENGINEERING LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

SENSUS  
Tel: (800) 638-3748  
sensus.com/resilient

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
www.tnb.com

THOMAS & BETTS CANADA - UTILITY DIVISION  
Tel: (450) 466-1102, x234  
1-800-466-1102, x234  
www.tnb.ca

## AUTOMATION SYSTEMS

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

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
www.osii.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SENSUS  
Tel: (800) 638-3748  
sensus.com/resilient

## B

## BATTERIES - DC SUPPLY FOR SWITCHGEAR

ENERSYS  
Tel: (610) 208-1991  
www.enersys.com

## BATTERIES - DISCHARGE/ MONITORING TEST SYSTEMS

PROGUSA, LLC  
Tel: (407) 332-8678  
www.progusa.net

## BATTERIES - STATIONARY

ENERSYS  
Tel: (610) 208-1991  
www.enersys.com

## BATTERIES - TELECOMMUNICATION

ENERSYS  
Tel: (610) 208-1991  
www.enersys.com

## BATTERY - BACKUP SYSTEMS

ENERSYS  
Tel: (610) 208-1991  
www.enersys.com

## BATTERY CHARGERS

ENERSYS  
Tel: (610) 208-1991  
www.enersys.com

## BAYONETS - POLE EXTENSIONS

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

## BELTS - SAFETY AND BODY

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

## BILLING/CUSTOMER CARE

DST OUTPUT  
Tel: (800) 441-7587  
www.dstoutput.com

## BIRD CONTROL

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

## BLOCKS - CONDUCTOR STRINGING

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

MACLEAN POWER SYSTEMS  
Tel: (803) 628-4321  
www.macleanpower.com

## PRODUCTS AND SERVICES

### TALLMAN EQUIPMENT CO

Tel: (630) 860-5666

[www.tallmanequipment.com](http://www.tallmanequipment.com)

### WAGNER-SMITH EQUIPMENT COMPANY

Tel: (800) 666-6567

[www.wagnersmithequipment.com](http://www.wagnersmithequipment.com)

### BLOCKS - HOIST

### CONDUX TESMEC INC.

Tel: (507) 387-8069 • 1-877-854-1750

[www.conduxtesmec.com](http://www.conduxtesmec.com)

### HUGHES BROTHERS INC.

Tel: (402) 643-2991

[www.hughesbros.com](http://www.hughesbros.com)

### BLOWERS - EXHAUST

### CALIFORNIA TURBO, INC.

Tel: (909) 854-2800

[www.californiaturbo.com](http://www.californiaturbo.com)

### BLOWERS - PARTS & ACCESSORIES

### CALIFORNIA TURBO, INC.

Tel: (909) 854-2800

[www.californiaturbo.com](http://www.californiaturbo.com)

### BLOWERS - PORTABLE - CONFINED SPACE

### CALIFORNIA TURBO, INC.

Tel: (909) 854-2800

[www.californiaturbo.com](http://www.californiaturbo.com)

### BLOWERS - UNDERGROUND VAULTS - OTHER PUMPS ETC. - COOLING

### CALIFORNIA TURBO, INC.

Tel: (909) 854-2800

[www.californiaturbo.com](http://www.californiaturbo.com)

### BLOWERS - UNDERGROUND VAULTS - TRANSFORMERS - COOLING

### CALIFORNIA TURBO, INC.

Tel: (909) 854-2800

[www.californiaturbo.com](http://www.californiaturbo.com)

### BOX PADS

### CONCAST INC.

Tel: (507) 732-4095

[www.concastinc.com](http://www.concastinc.com)

### HIGHLINE MANUFACTURING LTD

Tel: (306) 258-2233

[www.highlinemfg.com](http://www.highlinemfg.com)

### BRACES - CROSSARM

### ALUMA-FORM INC

Tel: (901) 362-0100

[www.alumaform.com](http://www.alumaform.com)

### DIS-TRAN WOOD PRODUCTS, LLC

Tel: (318) 448-0274

[www.distran.com](http://www.distran.com)

### GEOTEK, INC. PUI DIVISION

Tel: (507) 533-6076 • 1-800-533-1680

[www.geotekinc.com](http://www.geotekinc.com)

### HUGHES BROTHERS INC.

Tel: (402) 643-2991

[www.hughesbros.com](http://www.hughesbros.com)

### MACLEAN POWER SYSTEMS

Tel: (803) 628-4321

[www.maclepower.com](http://www.maclepower.com)

### THOMAS & BETTS - STEEL STRUCTURES DIVISION

Tel: 1-877-2TB-MEYER

[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

### THOMAS & BETTS CANADA - STEEL STRUCTURES DIVISION

Tel: 905-858-1010, x3783

[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

### BRACKETS - ARRESTER

### HUGHES BROTHERS INC.

Tel: (402) 643-2991

[www.hughesbros.com](http://www.hughesbros.com)

### MACLEAN POWER SYSTEMS

Tel: (803) 628-4321

[www.maclepower.com](http://www.maclepower.com)

### BRACKETS - CABLE

### HUGHES BROTHERS INC.

Tel: (402) 643-2991

[www.hughesbros.com](http://www.hughesbros.com)

### UNDERGROUND DEVICES INC.

Tel: (847) 205-9000

[www.udevices.com](http://www.udevices.com)

### WINOLA INDUSTRIAL INC.

Tel: (570) 378-3808

[www.winolaindustrial.com](http://www.winolaindustrial.com)

### BRACKETS - CAPACITOR

### HUGHES BROTHERS INC.

Tel: (402) 643-2991

[www.hughesbros.com](http://www.hughesbros.com)

### BRACKETS - CLUSTER-MOUNT

### ALUMA-FORM INC

Tel: (901) 362-0100

[www.alumaform.com](http://www.alumaform.com)

### HUGHES BROTHERS INC.

Tel: (402) 643-2991

[www.hughesbros.com](http://www.hughesbros.com)

### BRACKETS - CONDUIT

### UNDERGROUND DEVICES INC.

Tel: (847) 205-9000

[www.udevices.com](http://www.udevices.com)

### BRACKETS - CROSSARMS

### HUGHES BROTHERS INC.

Tel: (402) 643-2991

[www.hughesbros.com](http://www.hughesbros.com)

### LAMINATED WOOD SYSTEMS INC.

Tel: (402) 643-4708 • 1-800-949-3526

[www.binary.net/lws](http://www.binary.net/lws)

### BRACKETS - CUTOUT

### ALUMA-FORM INC

Tel: (901) 362-0100

[www.alumaform.com](http://www.alumaform.com)

### HUGHES BROTHERS INC.

Tel: (402) 643-2991

[www.hughesbros.com](http://www.hughesbros.com)

# PRODUCTS AND SERVICES

## BRACKETS - EXTENSION

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

## BRACKETS - INSULATOR

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

## BRACKETS - POTHEAD

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

## BRACKETS - TRANSFORMER

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

## BRACKETS - TRANSFORMER, MOUNTING

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

## BUCKET LINERS - AERIAL LIFT ACCESSORIES

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
www.hfgp.com

## BUILDING - PREFABRICATED

EASI-SET BUILDINGS  
Tel: (866) 252-8210  
www.easisetbuildings.com

FIBREBOND CORPORATION  
Tel: (318) 377-1030  
www.fibrebond.com

SABRE BUILDING SYSTEMS BY CELLXION  
Tel: (318) 213-2900 • 877-213-2900  
www.sabrebuildingsystems.com

## BUILDING MODULAR - PREFABRICATED

EASI-SET BUILDINGS  
Tel: (866) 252-8210  
www.easisetbuildings.com

FIBREBOND CORPORATION  
Tel: (318) 377-1030  
www.fibrebond.com

SABRE BUILDING SYSTEMS BY CELLXION  
Tel: (318) 213-2900 • 877-213-2900  
www.sabrebuildingsystems.com

## BUILDINGS - PRE-ENGINEERED

EASI-SET BUILDINGS  
Tel: (866) 252-8210  
www.easisetbuildings.com

FIBREBOND CORPORATION  
Tel: (318) 377-1030  
www.fibrebond.com

SABRE BUILDING SYSTEMS BY CELLXION  
Tel: (318) 213-2900 • 877-213-2900  
www.sabrebuildingsystems.com

TRACHTE PREFABRICATED BUILDINGS  
Tel: (608) 835-5707  
www.trachteusa.com

## BUS CONDUCTOR - ALUMINUM

AFL  
Tel: (864) 433-0333  
www.aflglobal.com

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
www.ctcglobal.com

## BUSHINGS

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

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

## BUSHINGS - CONDENSER-TYPE-CAST EPOXY

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

## BUSHINGS - DISTRIBUTION APPARATUS (THROUGH 34.5KV)

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

## BUSHINGS - HIGH VOLTAGE APPARATUS (OVER 34.5KV)

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

## C

## CABLE - ALUMINUM

AMERICAN WIRE GROUP, INC.  
Tel: (954) 455-3050 • 800-342-7215  
www.buyawg.com

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
www.ctcglobal.com

## CABLE - CONTROL

AMERICAN WIRE GROUP, INC.  
Tel: (954) 455-3050 • 800-342-7215  
www.buyawg.com

BELDEN INC  
Tel: (314) 854-8000  
www.belden.com

OKONITE COMPANY, THE\*  
Tel: (201) 825-0300  
www.okonite.com

OLDCASTLE ENCLOSURE SOLUTIONS  
Tel: (303) 209-8000  
www.oldcastleprecast.com/enclosure.solutions

# PRODUCTS AND SERVICES

## CABLE - COPPER

AMERICAN WIRE GROUP, INC.  
Tel: (954) 455-3050 • 800-342-7215  
[www.buyawg.com](http://www.buyawg.com)

PRIMUS CABLE  
Tel: (951) 824-1571  
[www.primuscable.com](http://www.primuscable.com)

## CABLE - FIBER OPTIC

AFL  
Tel: (864) 433-0333  
[www.aflglobal.com](http://www.aflglobal.com)

AMERICAN WIRE GROUP, INC.  
Tel: (954) 455-3050 • 800-342-7215  
[www.buyawg.com](http://www.buyawg.com)

BELDEN INC  
Tel: (314) 854-8000  
[www.belden.com](http://www.belden.com)

OLDCASTLE ENCLOSURE SOLUTIONS  
Tel: (303) 209-8000  
[www.oldcastleprecast.com/enclosure.solutions](http://www.oldcastleprecast.com/enclosure.solutions)

## CABLE - GROUNDING

AMERICAN WIRE GROUP, INC.  
Tel: (954) 455-3050 • 800-342-7215  
[www.buyawg.com](http://www.buyawg.com)

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
[www.hfgp.com](http://www.hfgp.com)

TALLMAN EQUIPMENT CO  
Tel: (630) 860-5666  
[www.tallmanequipment.com](http://www.tallmanequipment.com)

## CABLE - JUMPER

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
[www.hfgp.com](http://www.hfgp.com)

## CABLE - OPTICAL GROUND WIRE

AFL  
Tel: (864) 433-0333  
[www.aflglobal.com](http://www.aflglobal.com)

## CABLE - PREASSEMBLED CABLE DUCT

OLDCASTLE ENCLOSURE SOLUTIONS  
Tel: (303) 209-8000  
[www.oldcastleprecast.com/enclosure.solutions](http://www.oldcastleprecast.com/enclosure.solutions)

## CABLE - PULLING

CONDUX TESMEC INC.  
Tel: (507) 387-8069 • 1-877-854-1750  
[www.conduxtesmec.com](http://www.conduxtesmec.com)

TALLMAN EQUIPMENT CO  
Tel: (630) 860-5666  
[www.tallmanequipment.com](http://www.tallmanequipment.com)

## CABLE - RESTORATION

NOVINIUM CABLE LIFE EXTENSION  
Tel: (206) 529-4828  
[www.novinium.com](http://www.novinium.com)

UTILX  
Tel: (253) 395-0200  
[www.utilx.com](http://www.utilx.com)

## CABLE - SHIELDED

BELDEN INC  
Tel: (314) 854-8000  
[www.belden.com](http://www.belden.com)

OKONITE COMPANY, THE\*  
Tel: (201) 825-0300  
[www.okonite.com](http://www.okonite.com)

## CABLE - SUBMARINE

NOVINIUM CABLE LIFE EXTENSION  
Tel: (206) 529-4828  
[www.novinium.com](http://www.novinium.com)

OKONITE COMPANY, THE\*  
Tel: (201) 825-0300  
[www.okonite.com](http://www.okonite.com)

## CABLE - TEMPORARY GROUND

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
[www.hfgp.com](http://www.hfgp.com)

## CABLE - UNDERGROUND, POLYMER-INSULATED

DOW ELECTRICAL & TELECOMMUNICATIONS  
Tel: 1-800-441-4DOW  
[www.dow.com/electrical](http://www.dow.com/electrical)

OLDCASTLE ENCLOSURE SOLUTIONS  
Tel: (303) 209-8000  
[www.oldcastleprecast.com/enclosure.solutions](http://www.oldcastleprecast.com/enclosure.solutions)

## CABLE - UNDERGROUND, RESIDENTIAL

NOVINIUM CABLE LIFE EXTENSION  
Tel: (206) 529-4828  
[www.novinium.com](http://www.novinium.com)

OLDCASTLE ENCLOSURE SOLUTIONS  
Tel: (303) 209-8000  
[www.oldcastleprecast.com/enclosure.solutions](http://www.oldcastleprecast.com/enclosure.solutions)

## CABLE ACCESSORIES - URD

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
[www.tnb.com](http://www.tnb.com)

THOMAS & BETTS CANADA - UTILITY DIVISION  
Tel: (450) 466-1102, x234  
1-800-466-1102, x234  
[www.tnb.ca](http://www.tnb.ca)

## CABLE CUTTERS - HYDRAULIC

TALLMAN EQUIPMENT CO  
Tel: (630) 860-5666  
[www.tallmanequipment.com](http://www.tallmanequipment.com)

## CABLE FAULT LOCATING - EQUIPMENT

ELSYS INSTRUMENTS, LLC  
Tel: (845) 238-3933  
[www.elsys-instruments.com](http://www.elsys-instruments.com)

HIPOTRONICS INC.  
Tel: (845) 279-3644  
[www.hipotronics.com](http://www.hipotronics.com)

# PRODUCTS AND SERVICES

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118  
[www.phenixtech.com](http://www.phenixtech.com)

VON CORPORATION (THE)  
Tel: (205) 788-2437  
[www.voncorp.com](http://www.voncorp.com)

## CABLE LASHERS (SPINNERS)

TALLMAN EQUIPMENT CO  
Tel: (630) 860-5666  
[www.tallmanequipment.com](http://www.tallmanequipment.com)

## CABLE PULLING ACCESSORIES

CONDUX TESMEC INC.  
Tel: (507) 387-8069 • 1-877-854-1750  
[www.conduxtesmec.com](http://www.conduxtesmec.com)

## CABLE TRAY

OLDCASTLE ENCLOSURE SOLUTIONS  
Tel: (303) 209-8000  
[www.oldcastleprecast.com/enclosure.solutions](http://www.oldcastleprecast.com/enclosure.solutions)

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
[www.tnb.com](http://www.tnb.com)

## CABLES

AMERICAN WIRE GROUP, INC.  
Tel: (954) 455-3050 • 800-342-7215  
[www.buyawg.com](http://www.buyawg.com)

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
[www.ctcglobal.com](http://www.ctcglobal.com)

## CABLES - BARE COPPER

AMERICAN WIRE GROUP, INC.  
Tel: (954) 455-3050 • 800-342-7215  
[www.buyawg.com](http://www.buyawg.com)

## CABLES - HIGH TEMPERATURE

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
[www.ctcglobal.com](http://www.ctcglobal.com)

## CABLES - HIGH VOLTAGE

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
[www.ctcglobal.com](http://www.ctcglobal.com)

OKONITE COMPANY, THE\*  
Tel: (201) 825-0300  
[www.okonite.com](http://www.okonite.com)

## CABLES - HIGH VOLTAGE - XLPE

DOW ELECTRICAL & TELECOMMUNICATIONS  
Tel: 1-800-441-4DOW  
[www.dow.com/electrical](http://www.dow.com/electrical)

## CABLES - MEDIUM VOLTAGE

AMERICAN WIRE GROUP, INC.  
Tel: (954) 455-3050 • 800-342-7215  
[www.buyawg.com](http://www.buyawg.com)

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
[www.ctcglobal.com](http://www.ctcglobal.com)

DOW ELECTRICAL & TELECOMMUNICATIONS  
Tel: 1-800-441-4DOW  
[www.dow.com/electrical](http://www.dow.com/electrical)

NOVINIUM CABLE LIFE EXTENSION  
Tel: (206) 529-4828  
[www.novinium.com](http://www.novinium.com)

OKONITE COMPANY, THE\*  
Tel: (201) 825-0300  
[www.okonite.com](http://www.okonite.com)

## CABLES - SPECIALTY

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
[www.ctcglobal.com](http://www.ctcglobal.com)

## CALIBRATION AND TEST EQUIPMENT

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118  
[www.phenixtech.com](http://www.phenixtech.com)

TECHNICAL SYSTEMS 2002 INC.  
Tel: (866) 327-8731  
[www.technical-sys.com](http://www.technical-sys.com)

## CAPACITORS - CONTROLS

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
[www.sandc.com](http://www.sandc.com)

## CAPACITORS - SWITCHES

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
[www.southernstatesllc.com](http://www.southernstatesllc.com)

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
[www.tnb.com](http://www.tnb.com)

THOMAS & BETTS CANADA - UTILITY DIVISION  
Tel: (450) 466-1102, x234  
1-800-466-1102, x234  
[www.tnb.ca](http://www.tnb.ca)

## CAPS - POLE-TOP

HUGHES BROTHERS INC.  
Tel: (402) 643-2991  
[www.hughesbros.com](http://www.hughesbros.com)

## CHEMICALS - SPRAYING, CLEARING

DUPONT LAND MANAGEMENT  
Tel: (302) 999-2916  
[www.landmanagement.dupont.com](http://www.landmanagement.dupont.com)

## CIRCUIT BREAKER COMPONENTS

SPX TRANSFORMER SOLUTIONS, INC.  
FKA WAUKESHA ELECTRIC SYSTEMS, INC.  
Tel: (800) 835-2732  
[www.spxwaukesha.com](http://www.spxwaukesha.com)

## CIRCUIT BREAKERS - OIL

TJH2B ANALYTICAL SERVICES  
Tel: (916) 361-7177  
[www.tjh2b.com](http://www.tjh2b.com)

## CIRCUIT BREAKERS - SF6

MISTRAS GROUP  
[www.mistrasgroup.com](http://www.mistrasgroup.com)

TJH2B ANALYTICAL SERVICES  
Tel: (916) 361-7177  
[www.tjh2b.com](http://www.tjh2b.com)

# PRODUCTS AND SERVICES

## 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

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

MACLEAN POWER SYSTEMS  
Tel: (803) 628-4321  
www.macleaupower.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: (803) 628-4321  
www.macleaupower.com

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

## CLOCKS AND TIME DISPLAYS

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## CLOTHING - FLAME RESISTANT

TYNDALE COMPANY, INC.  
Tel: (800) 356-3433  
www.tyndaleusa.com

## COATINGS

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

## COATINGS - ANIMAL GUARD

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

## COATINGS - BUS BAR

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

## COATINGS - CORROSION PREVENTION

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

TIANJIN ZHONGXIN CHEMTECH  
CO., LTD.  
Tel: 86-22-89880739  
www.tjzxchem.com

## COATINGS - FIRE RESISTANT

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

## COATINGS - HEAT RESISTANT

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

## COATINGS - PROTECTIVE

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

## COATINGS - SEMICONDUCTING

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

## COATINGS - SILICONE

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

## COILS - HIGH AND LOW VOLTAGE MANUFACTURING AND INSTALLATION

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## COMMUNICATION SYSTEMS

BLACK & VEATCH  
TELECOMMUNICATIONS  
Tel: (913) 458-2000  
www.bv.com

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

RFL ELECTRONICS INC.  
Tel: (973) 334-3100  
www.rflect.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SISCO, INC.  
Tel: (586) 254-0020  
www.sisconet.com

## COMMUNICATION SYSTEMS - PROTECTIVE RELAYS

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

# PRODUCTS AND SERVICES

NOVATECH, LLC  
Tel: (410) 753-8300 • (800) 253-3842  
[www.novatechweb.com](http://www.novatechweb.com)

RFL ELECTRONICS INC.  
Tel: (973) 334-3100  
[www.rflect.com](http://www.rflect.com)

## COMPRESSION DIES

TALLMAN EQUIPMENT CO  
Tel: (630) 860-5666  
[www.tallmanequipment.com](http://www.tallmanequipment.com)

## COMPUTER CONTROLS AND AUTOMATION

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
[www.osii.com](http://www.osii.com)

SCHWEITZER ENGINEERING LABORATORIES INC.  
Tel: (509) 332-1890  
[www.selinc.com](http://www.selinc.com)

## COMPUTER TELEPHONY SYSTEMS

EXELIS C4I  
Tel: (571) 203-1000  
[www.c4i.com](http://www.c4i.com)

## COMPUTERS - EQUIPMENT

SCHWEITZER ENGINEERING LABORATORIES INC.  
Tel: (509) 332-1890  
[www.selinc.com](http://www.selinc.com)

## COMPUTERS - RUGGED MOBILE

DATASOURCE MOBILITY  
Tel: (931) 266-4242  
[www.datasourcemobility.com](http://www.datasourcemobility.com)

## COMPUTERS - SOFTWARE

VANGUARD SYSTEMS  
Tel: (610) 891-7703 (8am - 5pm EST)  
[www.vansystems.com](http://www.vansystems.com)

## CONCRETE - POLES

THE STRESSCRETE GROUP  
Tel: (905) 632-9301 • 1-800-268-7809  
[www.stresscretegroup.com](http://www.stresscretegroup.com)

## CONDITION ASSESMENT SYSTEMS

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
[www.doble.com](http://www.doble.com)

MORGAN SCHAFFER  
Tel: (514) 739-1967  
[www.morganschaffer.com](http://www.morganschaffer.com)

## CONDITION MONITORING EQUIPMENT

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
[www.doble.com](http://www.doble.com)

INCON POWER RELIABILITY PRODUCTS  
Tel: (207) 283-0156  
[www.incon.com](http://www.incon.com)

MORGAN SCHAFFER  
Tel: (514) 739-1967  
[www.morganschaffer.com](http://www.morganschaffer.com)

## CONDUCTOR - ALUMINUM - ACSR

AFL  
Tel: (864) 433-0333  
[www.aflglobal.com](http://www.aflglobal.com)

AMERICAN WIRE GROUP, INC.  
Tel: (954) 455-3050 • 800-342-7215  
[www.buyawg.com](http://www.buyawg.com)

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
[www.ctcglobal.com](http://www.ctcglobal.com)

MIDAL CABLES  
Tel: (905) 402-3225  
[www.midalcable.com](http://www.midalcable.com)

## CONDUCTOR - HIGH CAPACITY, LOW SAG - ACCC

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
[www.ctcglobal.com](http://www.ctcglobal.com)

## CONDUCTOR, STEEL - ALUMINUM - CLAD

AMERICAN WIRE GROUP, INC.  
Tel: (954) 455-3050 • 800-342-7215  
[www.buyawg.com](http://www.buyawg.com)

## CONDUCTOR, STEEL - COPPER-CLAD

AMERICAN WIRE GROUP, INC.  
Tel: (954) 455-3050 • 800-342-7215  
[www.buyawg.com](http://www.buyawg.com)

## CONDUIT - ACCESSORIES

CHAMPION FIBERGLASS, INC.  
Tel: (281) 655-8900  
[www.championfiberglass.com](http://www.championfiberglass.com)

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
[www.tnb.com](http://www.tnb.com)

THOMAS & BETTS CANADA - UTILITY DIVISION  
Tel: (450) 466-1102, x234  
1-800-466-1102, x234  
[www.tnb.ca](http://www.tnb.ca)

UNDERGROUND DEVICES INC.  
Tel: (847) 205-9000  
[www.udevices.com](http://www.udevices.com)

## CONDUIT - PLASTIC

CHAMPION FIBERGLASS, INC.  
Tel: (281) 655-8900  
[www.championfiberglass.com](http://www.championfiberglass.com)

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
[www.tnb.com](http://www.tnb.com)

## CONNECTORS - BOLTED - DISTRIBUTION

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
[www.tnb.com](http://www.tnb.com)

# PRODUCTS AND SERVICES

## CONNECTORS - COMPRESSION, DISTRIBUTION

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
www.ctcglobal.com

MACLEAN POWER SYSTEMS  
Tel: (803) 628-4321  
www.maclepower.com

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
www.tnb.com

## CONNECTORS - COMPRESSION, TRANSMISSION

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
www.ctcglobal.com

MACLEAN POWER SYSTEMS  
Tel: (803) 628-4321  
www.maclepower.com

## CONNECTORS - DEADEND, TRANSMISSION

CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
www.ctcglobal.com

## CONNECTORS - ELECTRICAL

GULF CONNECTORS, INC.  
Tel: (239) 657-2986  
www.cytolok.com

## CONNECTORS - FIBER OPTIC

BELDEN INC  
Tel: (314) 854-8000  
www.belden.com

## CONNECTORS - GROUNDING

BURNDY LLC  
Tel: (800) 346-4175  
www.burndy.com

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
www.tnb.com

THOMAS & BETTS CANADA - UTILITY DIVISION  
Tel: (450) 466-1102, x234  
1-800-466-1102, x234  
www.tnb.ca

## CONNECTORS - HIGH AMPERAGE, QUICK-DISCONNECT

SUPERIOR ELECTRIC  
Tel: (860) 507-2025  
www.superiorelectric.com

## CONNECTORS - PLUG-IN

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
www.tnb.com

## CONNECTORS - SERVICE

MELNI, LLC  
Tel: (208) 736-4276  
www.melni.org

## CONNECTORS - SUBSTATION

AFL  
Tel: (864) 433-0333  
www.aflglobal.com

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
www.tnb.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  
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www.tnb.com

## CONNECTORS, UNDERGROUND - TERMINATING

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

THOMAS & BETTS CANADA - UTILITY DIVISION  
Tel: (450) 466-1102, x234  
1-800-466-1102, x234  
www.tnb.ca

## CONSTRUCTION - POWER LINE AND SUBSTATION - 25 TO 735KV

MICHELS CORPORATION  
Tel: (920) 583-3132  
www.michels.us

## CONSTRUCTION AND PROJECT ENGINEERING

MABEY INC.  
Tel: (800) 956-2239  
www.mabey.com

MICHELS CORPORATION  
Tel: (920) 583-3132  
www.michels.us

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

URS CORPORATION  
Tel: (609) 720-2000  
www.urs.com

WELLCO INDUSTRIES, INC  
Tel: (760) 295-4773  
www.wellcoindustries.com

## CONSTRUCTION SERVICES

AEVENIA, INC.  
Tel: (218) 284-9500  
www.aevenia.com

MABEY INC.  
Tel: (800) 956-2239  
www.mabey.com

MICHELS CORPORATION  
Tel: (920) 583-3132  
www.michels.us

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

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SURVEYING AND MAPPING, INC. (SAM, INC.)

Tel: (512) 685-3597

www.saminc.biz

UTILICON SOLUTIONS, LTD

Tel: (215) 784-1406 • (877) 884-5426

www.utiliconltd.com

## CONSTRUCTION SPECIALIZED

MABEY INC.

Tel: (800) 956-2239

www.mabey.com

MICHELS CORPORATION

Tel: (920) 583-3132

www.michels.us

NAES CORPORATION

Tel: (425) 961-4700

www.naes.com

QUANTA SERVICES

Tel: (713) 629-7600

www.quantaservices.com

S & C ELECTRIC COMPANY

Tel: (773) 338-1000

www.sandc.com

## CONSULTANTS - POWER QUALITY

S & C ELECTRIC COMPANY

Tel: (773) 338-1000

www.sandc.com

## CONSULTANTS - SCADA/EMS ENGINEERING

AESI ACUMEN ENGINEERED SOLUTIONS INTL. INC.

Tel: (905) 875-2075

www.aesi-inc.com

## CONSULTANTS - SUBSTATION DESIGN & ENGINEERING

PMA ENGINEERING LIMITED

Tel: (416) 471-7748

www.pmaeng.com

S & C ELECTRIC COMPANY

Tel: (773) 338-1000

www.sandc.com

SARGENT & LUNDY LLC

Tel: (312) 269-2000

www.sargentlundy.com

## CONSULTANTS - T&D ENGINEERING

AESI ACUMEN ENGINEERED SOLUTIONS INTL. INC.

Tel: (905) 875-2075

www.aesi-inc.com

CTC GLOBAL CORPORATION

Tel: (949) 428-8500

www.ctcglobal.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

## CONSULTANTS - UNDERGROUND AND UNDERWATER CABLE

SARGENT & LUNDY LLC

Tel: (312) 269-2000

www.sargentlundy.com

## CONSULTING

CN UTILITY CONSULTING

Tel: (707) 829-1018

www.cnutility.com

S & C ELECTRIC COMPANY

Tel: (773) 338-1000

www.sandc.com

## CONSULTING ENGINEERING

A.I. ORLOFF ELECTRICAL ENGINEER

Tel: (949) 232-4023

www.ocsoft.us

DOBLE ENGINEERING CO.

Tel: (617) 926-4900

www.doble.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

## CONTACTORS

MICHELS CORPORATION

Tel: (920) 583-3132

www.michels.us

## CONTACTORS - DC/AC

MERSEN CANADA TORONTO INC.

Tel: (416) 252-9371

www.ep-ca.mersen.com

MICHELS CORPORATION

Tel: (920) 583-3132

www.michels.us

## CONTRACT SERVICES - FIELD INVENTORY - AUDIT SERVICES

CN UTILITY CONSULTING

Tel: (707) 829-1018

www.cnutility.com

## CONTRACTORS

MICHELS CORPORATION

Tel: (920) 583-3132

www.michels.us

S & C ELECTRIC COMPANY

Tel: (773) 338-1000

www.sandc.com

WRIGHT TREE SERVICE

Tel: (800) 882-1216

www.wrighttree.com

## CONTRACTORS - CONSTRUCTION

MABEY INC.

Tel: (800) 956-2239

www.mabey.com

# PRODUCTS AND SERVICES

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Tel: (920) 583-3132

[www.michels.us](http://www.michels.us)

## UTILICON SOLUTIONS, LTD

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[www.utiliconltd.com](http://www.utiliconltd.com)

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## WINOLA INDUSTRIAL INC.

Tel: (570) 378-3808

[www.winolaindustrial.com](http://www.winolaindustrial.com)

## CONTROL - ROOM DISPLAY SYSTEMS

## CHRISTIE

Tel: (800) 221-8025

[controlrooms.christiedigital.com](http://controlrooms.christiedigital.com)

## PLANAR SYSTEMS, INC.

Tel: (866) 475-2627

[www.planar.com](http://www.planar.com)

## CONTROL CENTER DESIGN

## CHRISTIE

Tel: (800) 221-8025

[controlrooms.christiedigital.com](http://controlrooms.christiedigital.com)

## CONTROL SYSTEM

## CHRISTIE

Tel: (800) 221-8025

[controlrooms.christiedigital.com](http://controlrooms.christiedigital.com)

## OPAL-RT TECHNOLOGIES INC.

Tel: (514) 935-2323

[www.opal-rt.com](http://www.opal-rt.com)

## CONTROL SYSTEMS - ELECTRIC/ELECTRONIC

## S & C ELECTRIC COMPANY

Tel: (773) 338-1000

[www.sandc.com](http://www.sandc.com)

## CONTROL TRANSFORMERS

## PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000

[www.prolecge.com](http://www.prolecge.com)

## CONTROLLERS/CONTROLS - PROGRAMMABLE

## CONTROL TECHNOLOGY CORP.

Tel: (888) 818-9595

[www.ctc-control.com](http://www.ctc-control.com)

## S & C ELECTRIC COMPANY

Tel: (773) 338-1000

[www.sandc.com](http://www.sandc.com)

## SCHWEITZER ENGINEERING LABORATORIES INC.

Tel: (509) 332-1890

[www.selinc.com](http://www.selinc.com)

## CONTROLS

## S & C ELECTRIC COMPANY

Tel: (773) 338-1000

[www.sandc.com](http://www.sandc.com)

## SENSUS

Tel: (800) 638-3748

[sensus.com/resilient](http://sensus.com/resilient)

## CONTROLS - CAPACITORS

## S & C ELECTRIC COMPANY

Tel: (773) 338-1000

[www.sandc.com](http://www.sandc.com)

## SENSUS

Tel: (800) 638-3748

[sensus.com/resilient](http://sensus.com/resilient)

## CONTROLS - CONTROL BOXES FOR TRANSFORMER COOLING FANS - SINGLE OR MULTI STAGES / EXPLOSION PROOF

## CALIFORNIA TURBO, INC.

Tel: (909) 854-2800

[www.californiaturbo.com](http://www.californiaturbo.com)

## CONTROLS - LTC TRANSFORMER

## PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000

[www.prolecge.com](http://www.prolecge.com)

## CONTROLS - REGULATOR TAP CHANGER

## ICMI, INC.

Tel: (513) 752-4731

[icmiinc.com](http://icmiinc.com)

## CONTROLS - SUPERVISORY

## NOVATECH, LLC

Tel: (410) 753-8300 • (800) 253-3842

[www.novatechweb.com](http://www.novatechweb.com)

## S & C ELECTRIC COMPANY

Tel: (773) 338-1000

[www.sandc.com](http://www.sandc.com)

## CONTROLS - TEMPERATURE

## CALIFORNIA TURBO, INC.

Tel: (909) 854-2800

[www.californiaturbo.com](http://www.californiaturbo.com)

## KRENZ & COMPANY INCORPORATED

Tel: (262) 255-2310

[www.krenzvent.com](http://www.krenzvent.com)

## CONTROLS - VAR

## S & C ELECTRIC COMPANY

Tel: (773) 338-1000

[www.sandc.com](http://www.sandc.com)

## THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282

[www.tnb.com](http://www.tnb.com)

## THOMAS & BETTS CANADA - UTILITY DIVISION

Tel: (450) 466-1102, x234

1-800-466-1102, x234

[www.tnb.ca](http://www.tnb.ca)

## COOLERS - TRANSFORMER OIL

## PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000

[www.prolecge.com](http://www.prolecge.com)

## CORONA EQUIPMENT - SALES

## OFIL LTD

Tel: 972-8-940-7953 x 212

[www.ofilsystems.com](http://www.ofilsystems.com)

# PRODUCTS AND SERVICES

## SPECIALIZED CAMERA SALES - OX CREEK ENERGY ASSOC INC

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

## CRANES - MANUFACTURERS/ DISTRIBUTORS

### ELLIOTT EQUIPMENT COMPANY

Tel: (402) 592-4500  
www.elliottequip.com

## CRIMPING TOOLS - ELECTRICAL

### RIPLEY COMPANY

Tel: (860) 635-2200 • 1-800-528-8665  
www.ripley-tools.com

### 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

### FABRIMET INC.

Tel: (819) 472-1164  
www.fabrimet.com

### GEOTEK, INC. PUPI DIVISION

Tel: (507) 533-6076 • 1-800-533-1680  
www.geotekinc.com

### HUGHES BROTHERS INC.

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

### LOCWELD

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, x3783  
www.meyersteelstructures.com

## CROSSARMS - FIBERGLASS - REINFORCED

### ALUMA-FORM INC

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

### GEOTEK, INC. PUPI DIVISION

Tel: (507) 533-6076 • 1-800-533-1680  
www.geotekinc.com

### HUGHES BROTHERS INC.

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

### MACLEAN POWER SYSTEMS

Tel: (803) 628-4321  
www.macleanpower.com

## CROSSARMS, WOOD - LAMINATED

### DIS-TRAN WOOD PRODUCTS, LLC

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

### HUGHES BROTHERS INC.

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

### LAMINATED WOOD SYSTEMS INC.

Tel: (402) 643-4708 • 1-800-949-3526  
www.binary.net/lws

## CROSSARMS, WOOD - SOLID

### DIS-TRAN WOOD PRODUCTS, LLC

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

### HUGHES BROTHERS INC.

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

## CURRENT SENSORS

### AWESENSE

Tel: (604) 259-2850 • 1-888-868-4607  
www.awesense.com

### S & C ELECTRIC COMPANY

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

## CUTOUTS, FUSED - OPEN, LOADBREAK

### S & C ELECTRIC COMPANY

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

## CUTOUTS, LOADBREAK

### S & C ELECTRIC COMPANY

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www.sandc.com

## CUTTERS - CABLE AND WIRE

### RIPLEY COMPANY

Tel: (860) 635-2200 • 1-800-528-8665  
www.ripley-tools.com

### TALLMAN EQUIPMENT CO

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

## D

## DATA ACQUISITION SYSTEMS

### LIVEDATA, INC.

Tel: (617) 576-6900 • 800-570-6211  
www.livedata.com

### NOVATECH, LLC

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

## DATA CONVERSION

### ELSYS INSTRUMENTS, LLC

Tel: (845) 238-3933  
www.elsys-instruments.com

### NOVATECH, LLC

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

## DATA SET - FIBER OPTICS

### H&L INSTRUMENTS

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

## PRODUCTS AND SERVICES

### DEADENDS WOOD, LAMINATED

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

### DETECTORS - FAULT

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

### DETECTORS - LEAK

MISTRAS GROUP  
  
www.mistrasgroup.com

### DETECTORS - PARTIAL DISCHARGE

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
www.doble.com

MISTRAS GROUP  
  
www.mistrasgroup.com

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

PROGUSA, LLC  
Tel: (407) 332-8678  
www.progusa.net

### DIAGNOSTIC EQUIPMENT

AWESENSE  
Tel: (604) 259-2850 • 1-888-868-4607  
www.awesense.com

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
www.doble.com

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

### DISPATCH SYSTEMS - COMPUTER-AIDED

UTILOCATE DISPATCH, INC.  
Tel: (877) 395-1122  
www.utilocatedispatch.ca

### DISTRIBUTED CONTROL SYSTEMS

CHRISTIE  
Tel: (800) 221-8025  
controlrooms.christiedigital.com

### DISTRIBUTION AUTOMATION - COMMUNICATIONS

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

LIVEDATA, INC.  
Tel: (617) 576-6900 • 800-570-6211  
www.livedata.com

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

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SENSUS  
Tel: (800) 638-3748  
sensus.com/resilient

### DISTRIBUTION AUTOMATION SYSTEMS

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Tel: (410) 753-8300 • (800) 253-3842  
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OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
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S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

SENSUS  
Tel: (800) 638-3748  
sensus.com/resilient

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
www.tnb.com

THOMAS & BETTS CANADA - UTILITY  
DIVISION  
Tel: (450) 466-1102, x234  
1-800-466-1102, x234  
www.tnb.ca

VIZIMAX INC.  
Tel: (450) 679-0003  
www.vizimax.com

### DISTRIBUTION MANAGEMENT SYSTEMS

CHRISTIE  
Tel: (800) 221-8025  
controlrooms.christiedigital.com

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
www.osii.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

UTILITY INTEGRATION SOLUTIONS INC.  
(UISOL)  
Tel: 303-520-2513  
www.uisol.com

### DOCUMENT MANAGEMENT & WORKFLOW SOLUTIONS

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

### DUCT

TRENWA, INC.  
Tel: (859) 781-0831  
www.trenwa.com

### DUCT - FITTINGS

CHAMPION FIBERGLASS, INC.  
Tel: (281) 655-8900  
www.championfiberglass.com

# PRODUCTS AND SERVICES

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

## DUCT - PLASTIC

CHAMPION FIBERGLASS, INC.  
Tel: (281) 655-8900  
www.championfiberglass.com

## E

## EMERGENCY POWER CONTROL SYSTEM

CHRISTIE  
Tel: (800) 221-8025  
controlrooms.christiedigital.com

## EMERGENCY RESPONSE TRAINING

CHRISTIE  
Tel: (800) 221-8025  
controlrooms.christiedigital.com

## ENCLOSURES - CABINETS

SABRE BUILDING SYSTEMS BY CELLXION  
Tel: (318) 213-2900 • 877-213-2900  
www.sabrebuildingsystems.com

## ENCLOSURES - FIBERGLASS-REINFORCED

CONCAST INC.  
Tel: (507) 732-4095  
www.concastinc.com

MERSEN CANADA TORONTO INC.  
Tel: (416) 252-9371  
www.ep-ca.mersen.com

OLDCASTLE ENCLOSURE SOLUTIONS  
Tel: (303) 209-8000  
www.oldcastleprecast.com/enclosure.solutions

## ENCLOSURES - METAL

SABRE BUILDING SYSTEMS BY CELLXION  
Tel: (318) 213-2900 • 877-213-2900  
www.sabrebuildingsystems.com

## ENCLOSURES - METERING EQUIPMENT

AE PRODUCTS, INC.  
Tel: (888) 848-7756  
www.aeproducts.net

SATEC INC.  
Tel: (908) 686-9510  
www.satec-global.com

## ENCLOSURES - POLYMER CONCRETE

OLDCASTLE ENCLOSURE SOLUTIONS  
Tel: (303) 209-8000  
www.oldcastleprecast.com/enclosure.solutions

## ENERGY MANAGEMENT SYSTEMS

CHRISTIE  
Tel: (800) 221-8025  
controlrooms.christiedigital.com

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
www.osii.com

SATEC INC.  
Tel: (908) 686-9510  
www.satec-global.com

## ENGINEERING

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SARGENT & LUNDY LLC  
Tel: (312) 269-2000  
www.sargentlundy.com

URS CORPORATION  
Tel: (609) 720-2000  
www.urs.com

## ENGINEERING - CONSULTANTS

AESI ACUMEN ENGINEERED SOLUTIONS INTL. INC.  
Tel: (905) 875-2075  
www.aesi-inc.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SARGENT & LUNDY LLC  
Tel: (312) 269-2000  
www.sargentlundy.com

## ENGINEERING - CONSULTANTS - CONSTRUCTION

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## ENGINEERING - DESIGN

MACLEAN POWER SYSTEMS  
Tel: (803) 628-4321  
www.macleanpower.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SARGENT & LUNDY LLC  
Tel: (312) 269-2000  
www.sargentlundy.com

SURVEYING AND MAPPING, INC. (SAM, INC.)  
Tel: (512) 685-3597  
www.saminc.biz

W.I.R.E. SERVICES  
Tel: (204) 480-5800  
www.wireservices.ca

## ENGINEERING - EQUIPMENT

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SEPAC CORP  
Tel: (305) 718-3369  
www.sepaccorp.com

## ENGINEERING - PROFESSIONAL SERVICES

A FOX ENGINEERING  
Tel: (304) 372-3705  
www.foxengineering.net

## PRODUCTS AND SERVICES

### AESI ACUMEN ENGINEERED SOLUTIONS INTL. INC.

Tel: (905) 875-2075  
www.aesi-inc.com

### SARGENT & LUNDY LLC

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

### SURVEYING AND MAPPING, INC. (SAM, INC.)

Tel: (512) 685-3597  
www.saminc.biz

### URS CORPORATION

Tel: (609) 720-2000  
www.urs.com

### W.I.R.E. SERVICES

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

### ENGINEERING - SERVICES

#### ABB

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

### AESI ACUMEN ENGINEERED SOLUTIONS INTL. INC.

Tel: (905) 875-2075  
www.aesi-inc.com

### DOBLE ENGINEERING CO.

Tel: (617) 926-4900  
www.doble.com

### S & C ELECTRIC COMPANY

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

### SURVEYING AND MAPPING, INC. (SAM, INC.)

Tel: (512) 685-3597  
www.saminc.biz

### W.I.R.E. SERVICES

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

### ENGINEERING - SERVICES - T & D

### AESI ACUMEN ENGINEERED SOLUTIONS INTL. INC.

Tel: (905) 875-2075  
www.aesi-inc.com

### CTC GLOBAL CORPORATION

Tel: (949) 428-8500  
www.ctcglobal.com

### HUGHES BROTHERS INC.

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

### QUANTA SERVICES

Tel: (713) 629-7600  
www.quantaservices.com

### S & C ELECTRIC COMPANY

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

### SABRE TUBULAR STRUCTURES

Tel: (817) 852-1700 • 866-254-3707  
www.sabretubularstructures.com

### SARGENT & LUNDY LLC

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

### SOUTHERN STATES, LLC.

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

### W.I.R.E. SERVICES

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

### ENVIRONMENTAL - MONITORING

### ASENTRIA CORPORATION

Tel: (206) 344-8800  
www.asentria.com

### CHRISTIE

Tel: (800) 221-8025  
controlrooms.christiedigital.com

### INCON POWER RELIABILITY PRODUCTS

Tel: (207) 283-0156  
www.incon.com

### ENVIRONMENTAL SERVICES

#### MABEY INC.

Tel: (800) 956-2239  
www.mabey.com

### SEC-SYSTEMS ENGINEERING CO.

Tel: (800) 846-4539  
systemsengineeringcompany.net

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### ETHERNET

#### BELDEN INC

Tel: (314) 854-8000  
www.belden.com

### RAD DATA COMMUNICATIONS, INC.

Tel: (201) 529-1100  
www.radusa.com

### EXIT SIGNS

#### AMERICAN PERMALIGHT, INC.

Tel: (310) 891-0924  
www.americanpermalight.com

## F

### FANS

#### KRENZ & COMPANY INCORPORATED

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

### PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

### FANS - BUILDING VAULT VENTILATION

#### CALIFORNIA TURBO, INC.

Tel: (909) 854-2800  
www.californiaturbo.com

### FANS - INSPECTION, REPAIRS & PARTS

#### CALIFORNIA TURBO, INC.

Tel: (909) 854-2800  
www.californiaturbo.com

#### KRENZ & COMPANY INCORPORATED

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

### PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

# PRODUCTS AND SERVICES

## FANS - PORTABLE UTILITY

CALIFORNIA TURBO, INC.  
Tel: (909) 854-2800  
www.californiaturbo.com

## FANS - TRANSFORMER - COOLING - PARTS & ACCESSORIES

CALIFORNIA TURBO, INC.  
Tel: (909) 854-2800  
www.californiaturbo.com

## FANS - TRANSFORMER-COOLING

CALIFORNIA TURBO, INC.  
Tel: (909) 854-2800  
www.californiaturbo.com

KRENZ & COMPANY INCORPORATED  
Tel: (262) 255-2310  
www.krenzvent.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## FASTENERS

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

WINOLA INDUSTRIAL INC.  
Tel: (570) 378-3808  
www.winolaindustrial.com

## FASTENERS - SPECIAL

WINOLA INDUSTRIAL INC.  
Tel: (570) 378-3808  
www.winolaindustrial.com

## FAULT ANALYSIS

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
www.doble.com

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

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

## FIBER OPTIC - COMPONENTS AND ACCESSORIES

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

INTEGRA NETWORKS  
Tel: (877) 402-3850  
integranetworks.net

## FIBER OPTIC - SENSORS

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

QUALITROL / NEOPTIX  
Tel: (585) 586-1515  
www.qualitrolcorp.com

## FIBER OPTIC COMMUNICATIONS

ASION TECHNOLOGY(HK) CO., LIMITED  
Tel: (86) 755-86501736  
www.asionoptic.com

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

## FIBER OPTICS

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

## FIBERGLASS - PIPE, TANK

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
www.hfgp.com

## FIELD AUTOMATION

INCON POWER RELIABILITY PRODUCTS  
Tel: (207) 283-0156  
www.incon.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SENSUS  
Tel: (800) 638-3748  
sensus.com/resilient

## FIELD INSTALLATION SERVICES

MABEY INC.  
Tel: (800) 956-2239  
www.mabey.com

NAES CORPORATION  
Tel: (425) 961-4700  
www.naes.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
www.southernstatesllc.com

## FILTRATION SYSTEMS - OIL

BARON USA  
Tel: (931) 528-8476  
www.baronusa.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## FIRE PROTECTION EQUIPMENT

LITHFIRE-X, LLC  
Tel: (248) 752-7110  
www.lithfire-x.com

OLDCASTLE PRECAST FOR TRUFIRE  
WALL  
Tel: (303) 209-8000 • 888-965-3227  
www.oldasleprecast.com

## FLUID MANAGEMENT - OIL RECYCLING

BARON USA  
Tel: (931) 528-8476  
www.baronusa.com

# PRODUCTS AND SERVICES

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000 [www.prolecge.com](http://www.prolecge.com)

## FUSELINK - CUTOUTS

MACLEAN POWER SYSTEMS

Tel: (803) 628-4321

[www.maclepower.com](http://www.maclepower.com)

S & C ELECTRIC COMPANY

Tel: (773) 338-1000

[www.sandc.com](http://www.sandc.com)

## FUSES

MERSEN CANADA TORONTO INC.

Tel: (416) 252-9371

[www.ep-ca.mersen.com](http://www.ep-ca.mersen.com)

S & C ELECTRIC COMPANY

Tel: (773) 338-1000

[www.sandc.com](http://www.sandc.com)

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282

[www.tnb.com](http://www.tnb.com)

THOMAS & BETTS CANADA - UTILITY  
DIVISION

Tel: (450) 466-1102, x234

1-800-466-1102, x234

[www.tnb.ca](http://www.tnb.ca)

## G

## GAS DETECTION - SF6

MORGAN SCHAFFER

Tel: (514) 739-1967

[www.morganschaffer.com](http://www.morganschaffer.com)

## GAS MONITORS - PORTABLE

MORGAN SCHAFFER

Tel: (514) 739-1967

[www.morganschaffer.com](http://www.morganschaffer.com)

## GAUGES - PRESSURE

REINHAUSEN MANUFACTURING INC.

Tel: (731) 562-4127

[www.reinhausen.com](http://www.reinhausen.com)

## GENERAL CONTRACTORS

MICHELS CORPORATION

Tel: (920) 583-3132

[www.michels.us](http://www.michels.us)

S & C ELECTRIC COMPANY

Tel: (773) 338-1000

[www.sandc.com](http://www.sandc.com)

## GENERAL CONTRACTORS - CONSTRUCTION

MICHELS CORPORATION

Tel: (920) 583-3132

[www.michels.us](http://www.michels.us)

S & C ELECTRIC COMPANY

Tel: (773) 338-1000

[www.sandc.com](http://www.sandc.com)

## GIS - ENGINEERING SERVICES

ESRI

Tel: (909) 793-2853

[www.esri.com](http://www.esri.com)

SURVEYING AND MAPPING, INC. (SAM,  
INC.)

Tel: (512) 685-3597

[www.saminc.biz](http://www.saminc.biz)

## GIS - SOFTWARE

3-GIS

Tel: (256) 560-0744

[www.3-gis.com](http://www.3-gis.com)

BENTLEY SYSTEMS, INC.

Tel: (610) 458-5000

[www.bentley.com](http://www.bentley.com)

ESRI

Tel: (909) 793-2853

[www.esri.com](http://www.esri.com)

SURVEYING AND MAPPING, INC. (SAM,  
INC.)

Tel: (512) 685-3597

[www.saminc.biz](http://www.saminc.biz)

## GLOVES - TESTING

PHENIX TECHNOLOGIES INC.

Tel: (301) 746-8118

[www.phenixtech.com](http://www.phenixtech.com)

## GRIPS - CABLE-PULLING

HASTINGS FIBERGLASS PRODUCTS INC.

Tel: (269) 945-9541

[www.hfgp.com](http://www.hfgp.com)

## GROUND RODS - COPPERWELD

GALVAN INDUSTRIES, INC.

Tel: (704) 455-5102

[www.galvanelectrical.com](http://www.galvanelectrical.com)

THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282

[www.tnb.com](http://www.tnb.com)

## GROUNDING - EQUIPMENT

HASTINGS FIBERGLASS PRODUCTS INC.

Tel: (269) 945-9541

[www.hfgp.com](http://www.hfgp.com)

MACLEAN POWER SYSTEMS

Tel: (803) 628-4321

[www.maclepower.com](http://www.maclepower.com)

## GROUNDS - TRAVELING

TALLMAN EQUIPMENT CO

Tel: (630) 860-5666

[www.tallmanequipment.com](http://www.tallmanequipment.com)

## GUARDS - ANIMAL AND BIRDS

HUGHES BROTHERS INC.

Tel: (402) 643-2991

[www.hughesbros.com](http://www.hughesbros.com)

VANQUISH FENCING INCORPORATED

Tel: (215) 295-2863

[www.vanquishfencing.com](http://www.vanquishfencing.com)

## H

## HANDHOLES AND MANHOLES

TRENWA, INC.

Tel: (859) 781-0831

[www.trenwa.com](http://www.trenwa.com)

# PRODUCTS AND SERVICES

## HARDWARE - POLELINE

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

MACLEAN POWER SYSTEMS  
Tel: (803) 628-4321  
www.macleanpower.com

## HARDWARE - TRANSMISSION LINE

ANTI-GALLOPING SOLUTIONS  
Tel: (587) 984-5106  
www.anti-galloping.com

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

MACLEAN POWER SYSTEMS  
Tel: (803) 628-4321  
www.macleanpower.com

RASHTRAUDHYOG LTD.  
Tel: +913322230377  
www.rashtraltld.com

WINOLA INDUSTRIAL INC.  
Tel: (570) 378-3808  
www.winolaindustrial.com

## HEALTH AND SAFETY PRODUCTS AND EQUIPMENT

MABEY INC.  
Tel: (800) 956-2239  
www.mabey.com

## HEAT EXCHANGERS

PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## HEAT EXCHANGERS - AIR-COOLED

PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## HERBICIDES - VEGETATION CONTROL

DUPONT LAND MANAGEMENT  
Tel: (302) 999-2916  
www.landmanagement.dupont.com

## HOISTS

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

## HUB SWITCHES

BELDEN INC  
Tel: (314) 854-8000  
www.belden.com

## IMAGING

SURVEYING AND MAPPING, INC. (SAM, INC.)  
Tel: (512) 685-3597  
www.saminc.biz

## INDICATORS - FAULT

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
www.tnb.com

THOMAS & BETTS CANADA - UTILITY DIVISION  
Tel: (450) 466-1102, x234  
1-800-466-1102, x234  
www.tnb.ca

## INDICATORS, PORTABLE - FAULT

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

## INFORMATION TECHNOLOGY AND MANAGEMENT CONSULTING

CHRISTIE  
Tel: (800) 221-8025  
controlrooms.christiedigital.com

UTILITY INTEGRATION SOLUTIONS INC. (UISOL)  
Tel: 303-520-2513  
www.uisol.com

## INSPECTION - FIELD SERVICES

MISTRAS GROUP  
www.mistrasgroup.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SURVEYING AND MAPPING, INC. (SAM, INC.)  
Tel: (512) 685-3597  
www.saminc.biz

## INSPECTION SERVICES

ARBORMETRICS SOLUTIONS LTD  
Tel: (407) 339-1733 • (866) 685-1880  
www.arbormetricssolutions.com

SURVEYING AND MAPPING, INC. (SAM, INC.)  
Tel: (512) 685-3597  
www.saminc.biz

## INSTRUMENTS - ON LINE MEASURING

AWESENSE  
Tel: (604) 259-2850 • 1-888-868-4607  
www.awesense.com

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
www.doble.com

ELSYS INSTRUMENTS, LLC  
Tel: (845) 238-3933  
www.elsys-instruments.com

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

OPTISENSE NETWORK, LLC  
Tel: (866) 530-4698  
www.optisense.net

# PRODUCTS AND SERVICES

## INSTRUMENTS TRANSFORMERS - CURRENT AND VOLTAGE FOR ANALOGUE METERS

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

TRENCH LIMITED

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

## INSULATED HAND TOOLS

TALLMAN EQUIPMENT CO

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

## INSULATING OIL

BARON USA

Tel: (931) 528-8476  
www.baronusa.com

PETRO-CANADA LUBRICANTS INC.

Tel: 1-800-268-5850  
www.lubricants.petro-canada.ca

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## INSULATORS - GUY STRAIN - FIBERGLASS - REINFORCED

ALUMA-FORM INC

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

HUGHES BROTHERS INC.

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

MACLEAN POWER SYSTEMS

Tel: (803) 628-4321  
www.maclepower.com

## INSULATORS - PIN-TYPES

HUGHES BROTHERS INC.

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

## INSULATORS - POLYMER

MACLEAN POWER SYSTEMS

Tel: (803) 628-4321  
www.maclepower.com

S & C ELECTRIC COMPANY

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

## INSULATORS - POST- HORIZONTAL

MACLEAN POWER SYSTEMS

Tel: (803) 628-4321  
www.maclepower.com

## INSULATORS - SUSPENSION

MACLEAN POWER SYSTEMS

Tel: (803) 628-4321  
www.maclepower.com

SEDIWER CANADA INC.

Tel: (514) 739-3385  
www.sediver.fr

## IRON - METAL FABRICATION

WINOLA INDUSTRIAL INC.

Tel: (570) 378-3808  
www.winolaindustrial.com

## J

## JUMPERS

AE PRODUCTS, INC.

Tel: (888) 848-7756  
www.aeproducts.net

## L

## LABELS

UTICOM SYSTEMS, INC.

Tel: (610) 857-2655-800-548-5321  
www.uticom.ne

## LABORATORIES

DOBLE ENGINEERING CO.

Tel: (617) 926-4900  
www.doble.com

MORGAN SCHAFFER

Tel: (514) 739-1967  
www.morganschaffer.com

TJH2B ANALYTICAL SERVICES

Tel: (916) 361-7177  
www.tjh2b.com

TRINITY ANALYTICAL LABORATORIES,  
INC.

Tel: (620) 328-3222  
www.e-trinitylabs.com

## LABORATORY EQUIPMENT AND SUPPLIES

ELSYS INSTRUMENTS, LLC

Tel: (845) 238-3933  
www.elsys-instruments.com

RTDS TECHNOLOGIES, INC.

Tel: (204) 989-9700  
www.rtds.com

## LADDERS

WINOLA INDUSTRIAL INC.

Tel: (570) 378-3808  
www.winolaindustrial.com

## LADDERS - INDUSTRIAL

HASTINGS FIBERGLASS PRODUCTS INC.

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

WINOLA INDUSTRIAL INC.

Tel: (570) 378-3808  
www.winolaindustrial.com

## LADDERS - MANHOLE

WINOLA INDUSTRIAL INC.

Tel: (570) 378-3808  
www.winolaindustrial.com

## PRODUCTS AND SERVICES

### LADDERS - TOWERS

WINOLA INDUSTRIAL INC.  
Tel: (570) 378-3808  
www.winolaindustrial.com

### LANYARDS, SHOCK ABSORBING

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
www.hfgp.com

### LEAK CONTROL

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

### LED PRODUCTS

EVLUMA  
Tel: (206) 720-1798  
www.evluma.com

THE STRESSCRETE GROUP  
Tel: (905) 632-9301 • 1-800-268-7809  
www.stresscretegroup.com

### LEVEL, DENSITY, WEIGHT, MOISTURE

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

### LIDAR - INSPECTION

ARBORMETRICS SOLUTIONS LTD  
Tel: (407) 339-1733 • (866) 685-1880  
www.arbormetricssolutions.com

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

SURVEYING AND MAPPING, INC. (SAM, INC.)  
Tel: (512) 685-3597  
www.saminc.biz

W.I.R.E. SERVICES  
Tel: (204) 480-5800  
www.wireservices.ca

### LIDAR - SURVEY

GEODIGITAL INTERNATIONAL INC.  
Tel: (905) 667-7322  
www.geodigital.com

SURVEYING AND MAPPING, INC. (SAM, INC.)  
Tel: (512) 685-3597  
www.saminc.biz

W.I.R.E. SERVICES  
Tel: (204) 480-5800  
www.wireservices.ca

### LIFTS - AERIAL BUCKET

BRONTO SKYLIFT  
Tel: (352) 895-1109  
www.bronto.fi

### LIFTS - AERIAL, PLATFORM - TYPE

BRONTO SKYLIFT  
Tel: (352) 895-1109  
www.bronto.fi

### LIGHTING

EVLUMA  
Tel: (206) 720-1798  
www.evluma.com

### LIGHTING - CONTROLS - INCANDESCENT DIMMER

SUPERIOR ELECTRIC  
Tel: (860) 507-2025  
www.superiorelectric.com

### LIGHTING - FIXTURES - MANUFACTURERS & WHOLESALE

EVLUMA  
Tel: (206) 720-1798  
www.evluma.com

### LIGHTING - OUTDOOR

EVLUMA  
Tel: (206) 720-1798  
www.evluma.com

THE STRESSCRETE GROUP  
Tel: (905) 632-9301 • 1-800-268-7809  
www.stresscretegroup.com

### LIGHTS

THE STRESSCRETE GROUP  
Tel: (905) 632-9301 • 1-800-268-7809  
www.stresscretegroup.com

### LINESMEN - EQUIPMENT

RIPLEY COMPANY  
Tel: (860) 635-2200 • 1-800-528-8665  
www.ripley-tools.com

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

### LOAD MANAGEMENT - COMMUNICATIONS

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

### LOCKING DEVICES

INNER-TITE CORP.  
Tel: (508) 829-6361  
www.inner-tite.com

### LOCKOUT SYSTEMS

TECH PRODUCTS, INC.  
Tel: (718) 442-4900 • 1-800-221-1311  
www.techproducts.com

### LUBE OIL

PETRO-CANADA LUBRICANTS INC.  
Tel: 1-800-268-5850  
www.lubricants.petro-canada.ca

### LUBRICANTS

BRONTO SKYLIFT  
Tel: (352) 895-1109  
www.bronto.fi

# PRODUCTS AND SERVICES

## PETRO-CANADA LUBRICANTS INC.

Tel: 1-800-268-5850

[www.lubricants.petro-canada.ca](http://www.lubricants.petro-canada.ca)

## LUBRICANTS - ENVIRONMENT FRIENDLY

## PETRO-CANADA LUBRICANTS INC.

Tel: 1-800-268-5850

[www.lubricants.petro-canada.ca](http://www.lubricants.petro-canada.ca)

## M

## MACHINE SHOPS - WELDING, MANUFACTURING, MAINTENANCE

## WINOLA INDUSTRIAL INC.

Tel: (570) 378-3808

[www.winolaindustrial.com](http://www.winolaindustrial.com)

## MAINTENANCE - PREVENTIVE MAINTENANCE EQUIPMENT

## BARON USA

Tel: (931) 528-8476

[www.baronusa.com](http://www.baronusa.com)

## ENERGY MAINTENANCE TECHNOLOGIES LTD (EMT)

Tel: 0044 (0)7535 900214

[www.emt.uk.com](http://www.emt.uk.com)

## MORGAN SCHAFFER

Tel: (514) 739-1967

[www.morganschaffer.com](http://www.morganschaffer.com)

## MAINTENANCE - SERVICES AND PRODUCTS

## DIVERSIFIED PRODUCTS

Tel: (254) 757-1177

[www.diversifiedproduct.com](http://www.diversifiedproduct.com)

## DUPONT LAND MANAGEMENT

Tel: (302) 999-2916 [www.landmanagement.dupont.com](http://www.landmanagement.dupont.com)

## NOVINIUM CABLE LIFE EXTENSION

Tel: (206) 529-4828 [www.novinium.com](http://www.novinium.com)

## MAINTENANCE - UNDERGROUND, OVERHEAD

## DUPONT LAND MANAGEMENT

Tel: (302) 999-2916

[www.landmanagement.dupont.com](http://www.landmanagement.dupont.com)

## MANAGEMENT CONSULTING

## AESI ACUMEN ENGINEERED SOLUTIONS INTL. INC.

Tel: (905) 875-2075

[www.aesi-inc.com](http://www.aesi-inc.com)

## NAVIGANT

Tel: (202) 481-7336

[www.navigant.com](http://www.navigant.com)

## MANHOLES - ELECTRIC

## TRENWA, INC.

Tel: (859) 781-0831

[www.trenwa.com](http://www.trenwa.com)

## MAPPING SERVICES

## ESRI

Tel: (909) 793-2853

[www.esri.com](http://www.esri.com)

## MAPPING SYSTEMS - MOBILE

## ARBORMETRICS SOLUTIONS LTD

Tel: (407) 339-1733 • (866) 685-1880

[www.arbormetricssolutions.com](http://www.arbormetricssolutions.com)

## BENTLEY SYSTEMS, INC.

Tel: (610) 458-5000

[www.bentley.com](http://www.bentley.com)

## GEODIGITAL INTERNATIONAL INC.

Tel: (905) 667-7322

[www.geodigital.com](http://www.geodigital.com)

## MARKERS

## CREATIVE SAFETY SUPPLY

Tel: (866) 777-1360

[www.creativesafety.com](http://www.creativesafety.com)

## TECH PRODUCTS, INC.

Tel: (718) 442-4900 • 1-800-221-1311

[www.techproducts.com](http://www.techproducts.com)

## MARKERS - CABLE

## TECH PRODUCTS, INC.

Tel: (718) 442-4900 • 1-800-221-1311

[www.techproducts.com](http://www.techproducts.com)

## UTICOM SYSTEMS, INC.

Tel: (610) 857-2655 • 800-548-5321

[www.uticom.net](http://www.uticom.net)

## MARKERS - FIBER OPTIC

## TECH PRODUCTS, INC.

Tel: (718) 442-4900 • 1-800-221-1311

[www.techproducts.com](http://www.techproducts.com)

## MARKERS - POLES

## TECH PRODUCTS, INC.

Tel: (718) 442-4900 • 1-800-221-1311

[www.techproducts.com](http://www.techproducts.com)

## UTICOM SYSTEMS, INC.

Tel: (610) 857-2655 • 800-548-5321

[www.uticom.net](http://www.uticom.net)

## MARKERS - TRANSMISSION POLES

## TECH PRODUCTS, INC.

Tel: (718) 442-4900 • 1-800-221-1311

[www.techproducts.com](http://www.techproducts.com)

## METAL - CUSTOM FABRICATION

## WINOLA INDUSTRIAL INC.

Tel: (570) 378-3808

[www.winolaindustrial.com](http://www.winolaindustrial.com)

## METAL - CUSTOM MADE PARTS

## WINOLA INDUSTRIAL INC.

Tel: (570) 378-3808

[www.winolaindustrial.com](http://www.winolaindustrial.com)

## METER READING EQUIPMENT (AMR) - AUTOMATIC

## TSTM

Tel: (605) 334-2924

# PRODUCTS AND SERVICES

## METERS - KILOWATTHOUR

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## METERS - MICRO-OHMMETER

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

## METERS - PHASE

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
www.hfgp.com

## METERS - POWER FACTOR

HIPOTRONICS INC.  
Tel: (845) 279-3644  
www.hipotronics.com

## METERS - POWER QUALITY

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## METERS - RATIO

HIPOTRONICS INC.  
Tel: (845) 279-3644  
www.hipotronics.com

## METERS - TEST SETS - TEST EQUIPMENT

AWESENSE  
Tel: (604) 259-2850 • 1-888-868-4607  
www.awesense.com

HIPOTRONICS INC.  
Tel: (845) 279-3644  
www.hipotronics.com

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

## METERS - TIME-OF-USE

SATEC INC.  
Tel: (908) 686-9510  
www.satec-global.com

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## METERS - VOLT

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
www.hfgp.com

## MINERAL OIL RECYCLING

BARON USA  
Tel: (931) 528-8476  
www.baronusa.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## MOBILE WORKFORCE MANAGEMENT

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

## MODEMS - DATA COMMUNICATION

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

RAYMAR TELENETICS  
Tel: (916) 580-1400  
www.raymarinc.com

## MONITORING - COMMUNICATIONS

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## MONITORING - EQUIPMENT

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

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

OPTISENSE NETWORK, LLC  
Tel: (866) 530-4698  
www.optisense.net

## MONITORING - GENERATORS

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

## MONITORING - TRANSFORMERS

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

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

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## MONITORING SECURITY SYSTEMS

CHRISTIE  
Tel: (800) 221-8025  
controlrooms.christiedigital.com

SYSTEMS WITH INTELLIGENCE INC.  
Tel: (289) 562-0126  
www.systemswithintelligence.com

## MONITORS - FAULT GAS (TRANSFORMERS, CIRCUIT BREAKERS)

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

# PRODUCTS AND SERVICES

## MULTIPLEXERS - DATA COMMUNICATIONS

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

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

RFL ELECTRONICS INC.  
Tel: (973) 334-3100  
www.rflect.com

## MULTIPLEXERS - FIBER OPTICS

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

RFL ELECTRONICS INC.  
Tel: (973) 334-3100  
www.rflect.com

## MULTIPLEXERS - VOICE COMMUNICATIONS

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

## N

## NONDESTRUCTIVE - TESTING

MISTRAS GROUP  
www.mistrasgroup.com

## O

## OIL - CONTAINMENT EQUIPMENT

C.I.AGENT SOLUTIONS  
Tel: (502) 267-0101  
www.ciagent.com

## OIL - LUBRICATION

PETRO-CANADA LUBRICANTS INC.  
Tel: 1-800-268-5850  
www.lubricants.petro-canada.ca

PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## OIL - SOLIDIFIERS

C.I.AGENT SOLUTIONS  
Tel: (502) 267-0101  
www.ciagent.com

## OIL ABSORBANTS - PADS, ROLLS, BOOMS, SOCKS

C.I.AGENT SOLUTIONS  
Tel: (502) 267-0101  
www.ciagent.com

## OIL PURIFYING - RECLAIMING SYSTEMS

BARON USA  
Tel: (931) 528-8476  
www.baronusa.com

PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## OIL SPILL EQUIPMENT

C.I.AGENT SOLUTIONS  
Tel: (502) 267-0101  
www.ciagent.com

## OIL TESTING - DISSOLVED GAS ANALYSIS

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900 www.doble.com

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

TJH2B ANALYTICAL SERVICES  
Tel: (916) 361-7177  
www.tjh2b.com

## ON-LINE MONITORING

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

OPTISENSE NETWORK, LLC  
Tel: (866) 530-4698  
www.optisense.net

## OPERATION AND MAINTENANCE SERVICES

NAES CORPORATION  
Tel: (425) 961-4700  
www.naes.com

QUANTA SERVICES  
Tel: (713) 629-7600  
www.quantaservices.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
www.southernstatesllc.com

## OPERATION SUPPORT SYSTEMS

NAES CORPORATION  
Tel: (425) 961-4700  
www.naes.com

## OUTAGE MANAGEMENT SYSTEMS

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
www.osii.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

UTILITY INTEGRATION SOLUTIONS INC. (UISOL)  
Tel: 303-520-2513  
www.uisol.com

W.I.R.E. SERVICES  
Tel: (204) 480-5800  
www.wireservices.ca

# PRODUCTS AND SERVICES

## P

### PADS - BOX

CONCAST INC.  
Tel: (507) 732-4095  
www.concastinc.com

### PADS - PADMOUNTED TRANSFORMERS

PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

### PANELS (POWER DISTRIBUTION)

MEGA POWER SYSTEMS  
Tel: (909) 548-4169  
www.megapowersystems.com

### PAPER INSULATING MATERIALS

PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

### PARTIAL DISCHARGE ANALYSIS, DETECTION

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
www.doble.com

MISTRAS GROUP  
www.mistrasgroup.com

OMICRON ELECTRONICS CORP. USA (WALTHAM)  
Tel: (781) 672-6200 • 1-800-OMICRON  
www.omicronusa.com

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

PROGUSA, LLC  
Tel: (407) 332-8678  
www.progusa.net

### PCB SITE SERVICES-TRANSPORT & DISPOSAL

PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

### PLATFORMS - LINEMAN'S

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

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
www.hfgp.com

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

### PLATFORMS - TRANSFORMERS

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

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

PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

### POLE - WOOD/PRESERVATIVES

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

### POLE LINE HARDWARE

HAMBY YOUNG  
Tel: (330) 562-8444 • (800) 726-8444  
www.hambyyoung.com

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

MACLEAN POWER SYSTEMS  
Tel: (803) 628-4321  
www.macleanpower.com

WINOLA INDUSTRIAL INC.  
Tel: (570) 378-3808  
www.winolaindustrial.com

### POLE MAINTENANCE

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

UTILICON SOLUTIONS, LTD  
Tel: (215) 784-1406 • (877) 884-5426  
www.utiliconltd.com

### POLE TOP - EXTENSIONS

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

### POLE-HOLE FILLER

CROSSLINK TECHNOLOGY INC.  
Tel: (800) 563-3769  
www.crosslinktech.com

### POLES - DISTRIBUTION - COMPOSITE

RS TECHNOLOGIES INC.  
Tel: (877) 219-8002  
www.rs poles.com

### POLES - DISTRIBUTION - CONCRETE

THE STRESSCRETE GROUP  
Tel: (905) 632-9301 • 1-800-268-7809  
www.stresscretegroup.com

VALMONT NEWMARK  
Tel: (205) 968-7200  
www.valmont-newmark.com

### POLES - DISTRIBUTION - STEEL

DIS-TRAN STEEL, LLC  
Tel: (318) 448-0274  
www.distran.com

SABRE TUBULAR STRUCTURES  
Tel: (817) 852-1700 • 866-254-3707  
www.sabretubularstructures.com

## PRODUCTS AND SERVICES

### THOMAS & BETTS - STEEL STRUCTURES DIVISION

Tel: 1-877-2TB-MEYER  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

### THOMAS & BETTS CANADA – STEEL STRUCTURES DIVISION

Tel: 905-858-1010, x3783  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

### VALMONT NEWMARK

Tel: (205) 968-7200  
[www.valmont-newmark.com](http://www.valmont-newmark.com)

### POLES - DISTRIBUTION - WOOD, LAMINATED

#### LAMINATED WOOD SYSTEMS INC.

Tel: (402) 643-4708 • 1-800-949-3526  
[www.binary.net/lws](http://www.binary.net/lws)

### POLES - LIGHTING - ALUMINUM

#### THE STRESSCRETE GROUP

Tel: (905) 632-9301 • 1-800-268-7809  
[www.stresscretegroup.com](http://www.stresscretegroup.com)

### POLES - LIGHTING - CONCRETE

#### THE STRESSCRETE GROUP

Tel: (905) 632-9301 • 1-800-268-7809  
[www.stresscretegroup.com](http://www.stresscretegroup.com)

### POLES - LIGHTING - STEEL

### THOMAS & BETTS - STEEL STRUCTURES DIVISION

Tel: 1-877-2TB-MEYER  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

### POLES - LIGHTING - WOOD, LAMINATED

#### HUGHES BROTHERS INC.

Tel: (402) 643-2991  
[www.hughesbros.com](http://www.hughesbros.com)

#### LAMINATED WOOD SYSTEMS INC.

Tel: (402) 643-4708 • 1-800-949-3526  
[www.binary.net/lws](http://www.binary.net/lws)

### POLES - TRANSMISSION

#### DIS-TRAN STEEL, LLC

Tel: (318) 448-0274  
[www.distran.com](http://www.distran.com)

#### RS TECHNOLOGIES INC.

Tel: (877) 219-8002  
[www.rsroles.com](http://www.rsroles.com)

#### SABRE TUBULAR STRUCTURES

Tel: (817) 852-1700 • 866-254-3707  
[www.sabretubularstructures.com](http://www.sabretubularstructures.com)

#### THE STRESSCRETE GROUP

Tel: (905) 632-9301 • 1-800-268-7809  
[www.stresscretegroup.com](http://www.stresscretegroup.com)

### THOMAS & BETTS - STEEL STRUCTURES DIVISION

Tel: 1-877-2TB-MEYER  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

### THOMAS & BETTS CANADA – STEEL STRUCTURES DIVISION

Tel: 905-858-1010, x3783  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

#### VALMONT NEWMARK

Tel: (205) 968-7200  
[www.valmont-newmark.com](http://www.valmont-newmark.com)

### POLES - TRANSMISSION - COMPOSITE

#### RS TECHNOLOGIES INC.

Tel: (877) 219-8002  
[www.rsroles.com](http://www.rsroles.com)

### POLES - TRANSMISSION - CONCRETE

#### THE STRESSCRETE GROUP

Tel: (905) 632-9301 • 1-800-268-7809  
[www.stresscretegroup.com](http://www.stresscretegroup.com)

#### VALMONT NEWMARK

Tel: (205) 968-7200  
[www.valmont-newmark.com](http://www.valmont-newmark.com)

### POLES - TRANSMISSION - STEEL

#### DIS-TRAN STEEL, LLC

Tel: (318) 448-0274  
[www.distran.com](http://www.distran.com)

#### LOCWELD

Tel: (450) 659-9661  
[www.locweld.com](http://www.locweld.com)

#### SABRE TUBULAR STRUCTURES

Tel: (817) 852-1700 • 866-254-3707  
[www.sabretubularstructures.com](http://www.sabretubularstructures.com)

### THOMAS & BETTS - STEEL STRUCTURES DIVISION

Tel: 1-877-2TB-MEYER  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

### THOMAS & BETTS CANADA – STEEL STRUCTURES DIVISION

Tel: 905-858-1010, x3783  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

#### VALMONT NEWMARK

Tel: (205) 968-7200  
[www.valmont-newmark.com](http://www.valmont-newmark.com)

### POLES - TRANSMISSION - WOOD, LAMINATED

#### LAMINATED WOOD SYSTEMS INC.

Tel: (402) 643-4708 • 1-800-949-3526  
[www.binary.net/lws](http://www.binary.net/lws)

### POLES - UTILITY

#### DIS-TRAN STEEL, LLC

Tel: (318) 448-0274  
[www.distran.com](http://www.distran.com)

#### SABRE TUBULAR STRUCTURES

Tel: (817) 852-1700 • 866-254-3707  
[www.sabretubularstructures.com](http://www.sabretubularstructures.com)

#### THE STRESSCRETE GROUP

Tel: (905) 632-9301 • 1-800-268-7809  
[www.stresscretegroup.com](http://www.stresscretegroup.com)

### THOMAS & BETTS - STEEL STRUCTURES DIVISION

Tel: 1-877-2TB-MEYER  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

### THOMAS & BETTS CANADA – STEEL STRUCTURES DIVISION

Tel: 905-858-1010, x3783  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

#### VALMONT NEWMARK

Tel: (205) 968-7200  
[www.valmont-newmark.com](http://www.valmont-newmark.com)

# PRODUCTS AND SERVICES

## POWER - LINE CARRIER EQUIPMENT - SYSTEMS

INCON POWER RELIABILITY PRODUCTS  
Tel: (207) 283-0156  
[www.incon.com](http://www.incon.com)

TRENCH LIMITED  
Tel: (416) 298-8108  
[www.trenchgroup.com](http://www.trenchgroup.com)

## POWER - MANAGEMENT SYSTEM

CHRISTIE  
Tel: (800) 221-8025  
[controlrooms.christiedigital.com](http://controlrooms.christiedigital.com)

## POWER CONDITIONING EQUIPMENT

SUPERIOR ELECTRIC  
Tel: (860) 507-2025  
[www.superiorelectric.com](http://www.superiorelectric.com)

## POWER DISTRIBUTION AND/OR TRANSMISSION POLES

DIS-TRAN STEEL, LLC  
Tel: (318) 448-0274  
[www.distran.com](http://www.distran.com)

LOCWELD  
Tel: (450) 659-9661  
[www.locweld.com](http://www.locweld.com)

RS TECHNOLOGIES INC.  
Tel: (877) 219-8002  
[www.rs poles.com](http://www.rs poles.com)

SABRE TUBULAR STRUCTURES  
Tel: (817) 852-1700 • 866-254-3707  
[www.sabretubularstructures.com](http://www.sabretubularstructures.com)

THOMAS & BETTS - STEEL STRUCTURES DIVISION  
Tel: 1-877-2TB-MEYER  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

THOMAS & BETTS CANADA - STEEL STRUCTURES DIVISION  
Tel: 905-858-1010, x3783  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

VALMONT NEWMARK  
Tel: (205) 968-7200  
[www.valmont-newmark.com](http://www.valmont-newmark.com)

## POWER FACTOR CORRECTION

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
[www.southernstatesllc.com](http://www.southernstatesllc.com)

## POWER LOSS DETECTION

AWESENSE  
Tel: (604) 259-2850 • 1-888-868-4607  
[www.awesense.com](http://www.awesense.com)

## POWER QUALITY - TEST EQUIPMENT

ELECTRO RENT CORP  
Tel: (877) 581-3384  
[www.electrorent.com](http://www.electrorent.com)

## POWER QUALITY EQUIPMENT

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
[www.sandc.com](http://www.sandc.com)

## POWER SUPPLIES - UNINTERRUPTIBLE

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
[www.sandc.com](http://www.sandc.com)

SUPERIOR ELECTRIC  
Tel: (860) 507-2025  
[www.superiorelectric.com](http://www.superiorelectric.com)

## PRESERVATIVES, WOOD - POLE

COPPER CARE WOOD PRESERVATIVES, INC.  
Tel: (402) 563-2663  
[www.coppercare.com](http://www.coppercare.com)

## PROJECT ENGINEERING

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
[www.sandc.com](http://www.sandc.com)

SARGENT & LUNDY LLC  
Tel: (312) 269-2000  
[www.sargentlundy.com](http://www.sargentlundy.com)

URS CORPORATION  
Tel: (609) 720-2000  
[www.urs.com](http://www.urs.com)

## PROJECT MANAGEMENT AND CONSULTING

CORIX UTILITIES  
Tel: (414) 203-8700  
[www.corix.com/meter-services](http://www.corix.com/meter-services)

NAES CORPORATION  
Tel: (425) 961-4700  
[www.naes.com](http://www.naes.com)

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
[www.sandc.com](http://www.sandc.com)

SARGENT & LUNDY LLC  
Tel: (312) 269-2000  
[www.sargentlundy.com](http://www.sargentlundy.com)

URS CORPORATION  
Tel: (609) 720-2000  
[www.urs.com](http://www.urs.com)

W.I.R.E. SERVICES  
Tel: (204) 480-5800  
[www.wireservices.ca](http://www.wireservices.ca)

## PROTECTION AND CONTROL

OLDCASTLE PRECAST FOR TRUFIRE WALL  
Tel: (303) 209-8000 • 888-965-3227  
[www.oldcastleprecast.com](http://www.oldcastleprecast.com)

RTDS TECHNOLOGIES, INC.  
Tel: (204) 989-9700  
[www.rtds.com](http://www.rtds.com)

SCHWEITZER ENGINEERING LABORATORIES INC.  
Tel: (509) 332-1890  
[www.selinc.com](http://www.selinc.com)

VIZIMAX INC.  
Tel: (450) 679-0003  
[www.vizimax.com](http://www.vizimax.com)

## PULLERS - CABLE

CONDUX TESMEC INC.  
Tel: (507) 387-8069 • 1-877-854-1750  
[www.conduxtesmec.com](http://www.conduxtesmec.com)

# PRODUCTS AND SERVICES

## PULLERS - CABLE, AERIAL

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

## PULLERS - CABLE, UNDERGROUND

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

## PULLERS - CONDUCTOR

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

## PULLERS - ROPE

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

## PUMPS - DEWATERING

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

## R

## RADIATORS - TRANSFORMER

PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## RADIO COMMUNICATIONS

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SENSUS  
Tel: (800) 638-3748  
sensus.com/resilient

## RADIO TWO-WAY - FIXED

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## RADIO TWO-WAY - PORTABLE - ACCESSORIES

PRYME RADIO PRODUCTS  
Tel: (714) 257-0300  
www.pryme.com

## REACTORS

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

## REACTORS - AIR CORE

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

## REACTORS - CURRENT - LIMITING

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

## REACTORS - SERIES

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

## REACTORS - SHUNT

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

## REACTORS - SHUNT FILTER

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

## RECLOSERS

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
www.tnb.com

THOMAS & BETTS CANADA - UTILITY DIVISION  
Tel: (450) 466-1102, x234  
1-800-466-1102, x234  
www.tnb.ca

## RECLOSERS - CONTROLS

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SCHWEITZER ENGINEERING LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## RECLOSERS - SINGLE-PHASE

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## RECLOSERS - THREE-PHASE

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## RECORDERS - EVENT

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

## REELS - CONDUCTOR STRINGING

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

## REELS - HANDLING EQUIPMENT

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

## REELS - WIRE, GROUNDING

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
www.hfgp.com

# PRODUCTS AND SERVICES

## RELAYS - FEEDER PROTECTION

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## RELAYS - GENERATOR PROTECTION

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## RELAYS - LINE PROTECTION

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## RELAYS - MOTOR PROTECTION

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## RELAYS - PROTECTION

MEGA POWER SYSTEMS  
Tel: (909) 548-4169  
www.megapowersystems.com

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## RELAYS - SUBSTATION AUTOMATION

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

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## RELAYS - TRANSFORMER DIFFERENTIAL

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## RELAYS - TRANSFORMER OVERLOAD

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

## REMOTE - SITE MONITORING

BELDEN INC  
Tel: (314) 854-8000  
www.belden.com

## REMOTE CONTROL - EQUIPMENT

VIZIMAX INC.  
Tel: (450) 679-0003  
www.vizimax.com

## REMOTE INFORMATION SYSTEMS - AUTOMATIC

INCON POWER RELIABILITY PRODUCTS  
Tel: (207) 283-0156  
www.incon.com

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
www.osii.com

## REMOTE TERMINAL UNITS

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

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
www.osii.com

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

SENSUS  
Tel: (800) 638-3748  
sensus.com/resilient

VIZIMAX INC.  
Tel: (450) 679-0003  
www.vizimax.com

## REMOTE TERMINAL UNITS - COMMUNICATIONS

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

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

## REMOTE VIDEO INSPECTION SYSTEMS

SYSTEMS WITH INTELLIGENCE INC.  
Tel: (289) 562-0126  
www.systemswithintelligence.com

## ROPE - WIRE

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

WIRECO WORLDGROUP  
Tel: (816) 270-4700  
www.wirecoworldgroup.com

## S

## SAFETY - ENVIRONMENTAL - EQUIPMENT

IMTEK | NOODOR.COM  
Tel: (770) 667-8621  
noodor.com

MABEY INC.  
Tel: (800) 956-2239  
www.mabey.com

## SAFETY - EQUIPMENT

UNITECH  
Tel: (650) 965-1228  
www.ut-power.com

# PRODUCTS AND SERVICES

## SAFETY - LINEMEN EQUIPMENT

ESTEX MANUFACTURING CO. INC.  
Tel: (770) 964-3322  
www.estexmfg.com

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
www.hfgp.com

SALISBURY BY HONEYWELL  
Tel: (630) 343-3800  
www.salisburybyhoneywell.com

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

## SAFETY - SUPPLIES

TECH PRODUCTS, INC.  
Tel: (718) 442-4900 • 1-800-221-1311  
www.techproducts.com

## SAFETY - TOOLS

MACLEAN POWER SYSTEMS  
Tel: (803) 628-4321  
www.macleanpower.com

## SAFETY ATTACHMENT DEVICES

WINOLA INDUSTRIAL INC.  
Tel: (570) 378-3808  
www.winolaindustrial.com

## SCADA - COMMUNICATIONS

BELDEN INC  
Tel: (314) 854-8000  
www.belden.com

H&L INSTRUMENTS  
Tel: (603) 964-1818  
www.hlinstruments.com

LIVEDATA, INC.  
Tel: (617) 576-6900 • 800-570-6211  
www.livedata.com

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

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## SCADA - EMS ENGINEERING

AESI ACUMEN ENGINEERED SOLUTIONS  
INTL. INC.  
Tel: (905) 875-2075  
www.aesi-inc.com

OPAL-RT TECHNOLOGIES INC.  
Tel: (514) 935-2323  
www.opal-rt.com

## SCADA - ENERGY CONTROL SYSTEMS

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
www.osii.com

## SCADA - INSTALLATION SERVICES

NAES CORPORATION  
Tel: (425) 961-4700  
www.naes.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## SCADA SYSTEMS

CHRISTIE  
Tel: (800) 221-8025  
controlrooms.christiedigital.com

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

OPAL-RT TECHNOLOGIES INC.  
Tel: (514) 935-2323  
www.opal-rt.com

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
www.osii.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SENSUS  
Tel: (800) 638-3748  
sensus.com/resilient

SYSTEMS WITH INTELLIGENCE INC.  
Tel: (289) 562-0126  
www.systemswithintelligence.com

## SEALS - METERS

INNER-TITE CORP.  
Tel: (508) 829-6361  
www.inner-tite.com

## SEALS - SECURITY

INNER-TITE CORP.  
Tel: (508) 829-6361  
www.inner-tite.com

## SECURITY - EQUIPMENT

INNER-TITE CORP.  
Tel: (508) 829-6361  
www.inner-tite.com

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
www.selinc.com

SYSTEMS WITH INTELLIGENCE INC.  
Tel: (289) 562-0126  
www.systemswithintelligence.com

## SENSORS - CURRENT + VOLTAGE

OPTISENSE NETWORK, LLC  
Tel: (866) 530-4698  
www.optisense.net

## SENSORS - FIBER OPTIC

OPTISENSE NETWORK, LLC  
Tel: (866) 530-4698  
www.optisense.net

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## SF6 GAS INSULATED SWITCHGEAR

INCON POWER RELIABILITY PRODUCTS  
Tel: (207) 283-0156  
www.incon.com

# PRODUCTS AND SERVICES

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
[www.sandc.com](http://www.sandc.com)

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## **SHEAVES - CONDUCTOR - STRINGING**

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CONDUX TESMEC INC.  
Tel: (507) 387-8069 • 1-877-854-1750  
[www.conduxtesmec.com](http://www.conduxtesmec.com)

WAGNER-SMITH EQUIPMENT COMPANY  
Tel: (800) 666-6567  
[www.wagnersmithequipment.com](http://www.wagnersmithequipment.com)

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## **SIGNS**

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TECH PRODUCTS, INC.  
Tel: (718) 442-4900 • 1-800-221-1311  
[www.techproducts.com](http://www.techproducts.com)

UTICOM SYSTEMS, INC.  
Tel: (610) 857-2655 • 800-548-5321  
[www.uticom.net](http://www.uticom.net)

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## **SIGNS - WARNING**

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TECH PRODUCTS, INC.  
Tel: (718) 442-4900 • 1-800-221-1311  
[www.techproducts.com](http://www.techproducts.com)

UTICOM SYSTEMS, INC.  
Tel: (610) 857-2655 • 800-548-5321  
[www.uticom.net](http://www.uticom.net)

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## **SIMULATORS - REAL-TIME**

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OPAL-RT TECHNOLOGIES INC.  
Tel: (514) 935-2323  
[www.opal-rt.com](http://www.opal-rt.com)

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## **SMART GRID SOLUTIONS**

---

OPAL-RT TECHNOLOGIES INC.  
Tel: (514) 935-2323  
[www.opal-rt.com](http://www.opal-rt.com)

SISCO, INC.  
Tel: (586) 254-0020  
[www.sisconet.com](http://www.sisconet.com)

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## **SOFTWARE - APPLICATION**

---

OPAL-RT TECHNOLOGIES INC.  
Tel: (514) 935-2323  
[www.opal-rt.com](http://www.opal-rt.com)

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
[www.osii.com](http://www.osii.com)

TERRA SPECTRUM TECHNOLOGIES  
Tel: (866) 619-5444  
[www.terra-spectrum.com](http://www.terra-spectrum.com)

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## **SOFTWARE - DESIGN**

---

OPAL-RT TECHNOLOGIES INC.  
Tel: (514) 935-2323  
[www.opal-rt.com](http://www.opal-rt.com)

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## **SOFTWARE - DOCUMENT MANAGEMENT**

---

VANGUARD SYSTEMS  
Tel: (610) 891-7703 (8am - 5pm EST)  
[www.vansystems.com](http://www.vansystems.com)

---

## **SOFTWARE - ELECTRIC DESIGN AUTOMATION**

---

OPAL-RT TECHNOLOGIES INC.  
Tel: (514) 935-2323  
[www.opal-rt.com](http://www.opal-rt.com)

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## **SOFTWARE - ENGINEERING**

---

OPAL-RT TECHNOLOGIES INC.  
Tel: (514) 935-2323  
[www.opal-rt.com](http://www.opal-rt.com)

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## **SOFTWARE - T&D LINE DESIGN**

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CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
[www.ctcglobal.com](http://www.ctcglobal.com)

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## **SOFTWARE INTEGRATION**

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LIVEDATA, INC.  
Tel: (617) 576-6900 • 800-570-6211  
[www.livedata.com](http://www.livedata.com)

SISCO, INC.  
Tel: (586) 254-0020  
[www.sisconet.com](http://www.sisconet.com)

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## **SOFTWARE SOLUTIONS**

---

AGENTIS INC.  
Tel: (630) 359-6210  
[www.agentisenergy.com](http://www.agentisenergy.com)

BENTLEY SYSTEMS, INC.  
Tel: (610) 458-5000  
[www.bentley.com](http://www.bentley.com)

LIVEDATA, INC.  
Tel: (617) 576-6900 • 800-570-6211  
[www.livedata.com](http://www.livedata.com)

OPEN ACCESS TECHNOLOGY INTERNATIONAL, INC. (OATI)  
Tel: (763) 201-2000  
[www.oati.com](http://www.oati.com)

VANGUARD SYSTEMS  
Tel: (610) 891-7703 (8am - 5pm EST)  
[www.vansystems.com](http://www.vansystems.com)

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## **SPACERS - DUCT**

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UNDERGROUND DEVICES INC.  
Tel: (847) 205-9000  
[www.udevices.com](http://www.udevices.com)

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## **SPACERS - UNDERGROUND CABLE AND CONDUIT**

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UNDERGROUND DEVICES INC.  
Tel: (847) 205-9000  
[www.udevices.com](http://www.udevices.com)

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## **SPILLS RESPONSE KIT**

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C.I.AGENT SOLUTIONS  
Tel: (502) 267-0101  
[www.ciagent.com](http://www.ciagent.com)

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## **SPLICES & ACCESSORIES - COMPRESSION JOINT**

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CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
[www.ctcglobal.com](http://www.ctcglobal.com)

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## **SPLICES & ACCESSORIES - TENSION**

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CTC GLOBAL CORPORATION  
Tel: (949) 428-8500  
[www.ctcglobal.com](http://www.ctcglobal.com)

MACLEAN POWER SYSTEMS  
Tel: (803) 628-4321  
[www.maclepower.com](http://www.maclepower.com)

## PRODUCTS AND SERVICES

### SPLINTS - POLE-REINFORCING

LAMINATED WOOD SYSTEMS INC.  
Tel: (402) 643-4708 • 1-800-949-3526  
[www.binary.net/lws](http://www.binary.net/lws)

### STEEL - MANUFACTURERS

DIS-TRAN STEEL, LLC  
Tel: (318) 448-0274  
[www.distran.com](http://www.distran.com)

HUGHES BROTHERS INC.  
Tel: (402) 643-2991  
[www.hughesbros.com](http://www.hughesbros.com)

LOCWELD  
Tel: (450) 659-9661  
[www.locweld.com](http://www.locweld.com)

SABRE TUBULAR STRUCTURES  
Tel: (817) 852-1700 • 866-254-3707  
[www.sabretubularstructures.com](http://www.sabretubularstructures.com)

### STEEL - STRUCTURAL

DIS-TRAN  
Tel: (318) 448-0274  
[www.distran.com](http://www.distran.com)

DIS-TRAN STEEL, LLC  
Tel: (318) 448-0274  
[www.distran.com](http://www.distran.com)

HAMBY YOUNG  
Tel: (330) 562-8444 • (800) 726-8444  
[www.hambyyoung.com](http://www.hambyyoung.com)

HUGHES BROTHERS INC.  
Tel: (402) 643-2991  
[www.hughesbros.com](http://www.hughesbros.com)

SABRE TUBULAR STRUCTURES  
Tel: (817) 852-1700 • 866-254-3707  
[www.sabretubularstructures.com](http://www.sabretubularstructures.com)

THOMAS & BETTS - STEEL STRUCTURES  
DIVISION  
Tel: 1-877-2TB-MEYER  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

THOMAS & BETTS CANADA - STEEL  
STRUCTURES DIVISION  
Tel: 905-858-1010, x3783  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

### STEEL PRODUCTS - CUSTOM FABRICATION

DIS-TRAN STEEL, LLC  
Tel: (318) 448-0274  
[www.distran.com](http://www.distran.com)

HUGHES BROTHERS INC.  
Tel: (402) 643-2991  
[www.hughesbros.com](http://www.hughesbros.com)

LOCWELD  
Tel: (450) 659-9661  
[www.locweld.com](http://www.locweld.com)

WINOLA INDUSTRIAL INC.  
Tel: (570) 378-3808  
[www.winolaindustrial.com](http://www.winolaindustrial.com)

### STICKS - DISCONNECT

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
[www.hfgp.com](http://www.hfgp.com)

### STICKS - HOT

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
[www.hfgp.com](http://www.hfgp.com)

TALLMAN EQUIPMENT CO  
Tel: (630) 860-5666  
[www.tallmanequipment.com](http://www.tallmanequipment.com)

### STRIPPERS - CABLE INSULATION

RIPLEY COMPANY  
Tel: (860) 635-2200 • 1-800-528-8665  
[www.ripley-tools.com](http://www.ripley-tools.com)

### STRUCTURE - PREFABRICATED

EASI-SET BUILDINGS  
Tel: (866) 252-8210  
[www.easisetbuildings.com](http://www.easisetbuildings.com)

FIBREBOND CORPORATION  
Tel: (318) 377-1030  
[www.fibrebond.com](http://www.fibrebond.com)

LAMINATED WOOD SYSTEMS INC.  
Tel: (402) 643-4708 • 1-800-949-3526  
[www.binary.net/lws](http://www.binary.net/lws)

OLDCASTLE PRECAST FOR TRUFIRE  
WALL  
Tel: (303) 209-8000 • 888-965-3227  
[www.oldasleprecast.com](http://www.oldasleprecast.com)

THOMAS & BETTS - STEEL STRUCTURES  
DIVISION  
Tel: 1-877-2TB-MEYER  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

TRACHTE PREFABRICATED BUILDINGS  
Tel: (608) 835-5707  
[www.trachteusa.com](http://www.trachteusa.com)

### SUBSTATION

DIS-TRAN  
Tel: (318) 448-0274  
[www.distran.com](http://www.distran.com)

EASI-SET BUILDINGS  
Tel: (866) 252-8210  
[www.easisetbuildings.com](http://www.easisetbuildings.com)

HAMBY YOUNG  
Tel: (330) 562-8444 • (800) 726-8444  
[www.hambyyoung.com](http://www.hambyyoung.com)

MEGA POWER SYSTEMS  
Tel: (909) 548-4169  
[www.megapowersystems.com](http://www.megapowersystems.com)

OLDCASTLE PRECAST FOR TRUFIRE  
WALL  
Tel: (303) 209-8000 • 888-965-3227  
[www.oldasleprecast.com](http://www.oldasleprecast.com)

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
[www.sandc.com](http://www.sandc.com)

SABRE TUBULAR STRUCTURES  
Tel: (817) 852-1700 • 866-254-3707  
[www.sabretubularstructures.com](http://www.sabretubularstructures.com)

VALMONT NEWMARK  
Tel: (205) 968-7200  
[www.valmont-newmark.com](http://www.valmont-newmark.com)

VANQUISH FENCING INCORPORATED  
Tel: (215) 295-2863  
[www.vanquishfencing.com](http://www.vanquishfencing.com)

# PRODUCTS AND SERVICES

## SUBSTATION - CAD DRAFTING SUPPORT

### OLDCASTLE PRECAST FOR TRUFIRE WALL

Tel: (303) 209-8000•888-965-3227  
www.oldasleprecast.com

### S & C ELECTRIC COMPANY

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

## SUBSTATION - COMMUNICATION EQUIPMENT

### H&L INSTRUMENTS

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

### NOVATECH, LLC

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

### OLDCASTLE PRECAST FOR TRUFIRE WALL

Tel: (303) 209-8000•888-965-3227  
www.oldasleprecast.com

### RFL ELECTRONICS INC.

Tel: (973) 334-3100  
www.rflect.com

### S & C ELECTRIC COMPANY

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

## SUBSTATION - COMMUNICATIONS

### BELDEN INC

Tel: (314) 854-8000  
www.belden.com

### 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

### SISCO, INC.

Tel: (586) 254-0020  
www.sisconet.com

## SUBSTATION - GAS-INSULATED

### MISTRAS GROUP

www.mistrasgroup.com

## SUBSTATION - METAL-ENCLOSED

### S & C ELECTRIC COMPANY

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

## SUBSTATION - MOBILE

### DELTA STAR, INC. (LYNCHBURG)

Tel: (800) 368-3017  
www.deltastar.com

## SUBSTATION - PACKAGED ASSEMBLIES

### DIS-TRAN

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

### HAMBY YOUNG

Tel: (330) 562-8444•(800) 726-8444  
www.hambyyoung.com

## SUBSTATION - STEEL, STRUCTURE

### DIS-TRAN

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

### DIS-TRAN STEEL, LLC

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

### FABRIMET INC.

Tel: (819) 472-1164  
www.fabrimet.com

### HAMBY YOUNG

Tel: (330) 562-8444•(800) 726-8444  
www.hambyyoung.com

### LOCWELD

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

### SABRETUBULAR STRUCTURES

Tel: (817) 852-1700•866-254-3707  
www.sabretubularstructures.com

### THOMAS & BETTS - STEEL STRUCTURES DIVISION

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

### TRACHTE PREFABRICATED BUILDINGS

Tel: (608) 835-5707  
www.trachteusa.com

### VALMONT NEWMARK

Tel: (205) 968-7200  
www.valmont-newmark.com

## SUBSTATION - UNIT

### DIS-TRAN

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

## SUBSTATION - WOOD, TREATED

### HUGHES BROTHERS INC.

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

### LAMINATED WOOD SYSTEMS INC.

Tel: (402) 643-4708•1-800-949-3526  
www.binary.net/lws

## SUBSTATION AUTOMATION

### BELDEN INC

Tel: (314) 854-8000  
www.belden.com

### BENTLEY SYSTEMS, INC.

Tel: (610) 458-5000  
www.bentley.com

### MORGAN SCHAFFER

Tel: (514) 739-1967  
www.morganschaffer.com

### NOVATECH, LLC

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

## PRODUCTS AND SERVICES

OPEN SYSTEMS INTERNATIONAL, INC.  
Tel: (763) 551-0559  
[www.osii.com](http://www.osii.com)

PHOENIX ELECTRIC CORPORATION  
Tel: (781) 821-0200  
[www.pec-usa.biz](http://www.pec-usa.biz)

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
[www.sandc.com](http://www.sandc.com)

SATEC INC.  
Tel: (908) 686-9510  
[www.satec-global.com](http://www.satec-global.com)

SCHWEITZER ENGINEERING  
LABORATORIES INC.  
Tel: (509) 332-1890  
[www.selinc.com](http://www.selinc.com)

VIZIMAX INC.  
Tel: (450) 679-0003  
[www.vizimax.com](http://www.vizimax.com)

### SUBSTATION CONTROL BUILDINGS

FIBREBOND CORPORATION  
Tel: (318) 377-1030  
[www.fibrebond.com](http://www.fibrebond.com)

OLDCASTLE PRECAST FOR  
TRUFIRE WALL  
Tel: (303) 209-8000•888-965-3227  
[www.oldasleprecast.com](http://www.oldasleprecast.com)

SABRE BUILDING SYSTEMS BY CELLXION  
Tel: (318) 213-2900•877-213-2900  
[www.sabrebuildingsystems.com](http://www.sabrebuildingsystems.com)

TRACHTE PREFABRICATED BUILDINGS  
Tel: (608) 835-5707  
[www.trachteusa.com](http://www.trachteusa.com)

### SUBSTATION DESIGN & CONSTRUCTION

BENTLEY SYSTEMS, INC.  
Tel: (610) 458-5000  
[www.bentley.com](http://www.bentley.com)

MICHELS CORPORATION  
Tel: (920) 583-3132  
[www.michels.us](http://www.michels.us)

NAES CORPORATION  
Tel: (425) 961-4700  
[www.naes.com](http://www.naes.com)

QUANTA SERVICES  
Tel: (713) 629-7600  
[www.quantaservices.com](http://www.quantaservices.com)

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
[www.sandc.com](http://www.sandc.com)

TRACHTE PREFABRICATED BUILDINGS  
Tel: (608) 835-5707  
[www.trachteusa.com](http://www.trachteusa.com)

### SUBSTATION FENCING: ANIMAL DETERRENT

VANQUISH FENCING INCORPORATED  
Tel: (215) 295-2863  
[www.vanquishfencing.com](http://www.vanquishfencing.com)

### SUBSTATION FENCING: SECURITY

VANQUISH FENCING INCORPORATED  
Tel: (215) 295-2863  
[www.vanquishfencing.com](http://www.vanquishfencing.com)

### SUPPRESSORS - SURGE - TRANSIENT VOLTAGE

FEDERAL ENERGY PRODUCTS  
Tel: (800) 621-7050  
[www.federalenergyproducts.com](http://www.federalenergyproducts.com)

### SURGE PROTECTION DEVICES

MERSEN CANADA TORONTO INC.  
Tel: (416) 252-9371  
[www.ep-ca.mersen.com](http://www.ep-ca.mersen.com)

### SURGE PROTECTORS

AE PRODUCTS, INC.  
Tel: (888) 848-7756  
[www.aeproducts.net](http://www.aeproducts.net)

SUPERIOR ELECTRIC  
Tel: (860) 507-2025  
[www.superiorelectric.com](http://www.superiorelectric.com)

### SURVEYING, INSTRUMENTS AND EQUIPMENT

SURVEYING AND MAPPING, INC.  
(SAM, INC.)  
Tel: (512) 685-3597  
[www.saminc.biz](http://www.saminc.biz)

### SUSPENSION ARMS, POLE - STEEL

DIS-TRAN STEEL, LLC  
Tel: (318) 448-0274  
[www.distran.com](http://www.distran.com)

HUGHES BROTHERS INC.  
Tel: (402) 643-2991  
[www.hughesbros.com](http://www.hughesbros.com)

THOMAS & BETTS - STEEL STRUCTURES  
DIVISION  
Tel: 1-877-2TB-MEYER  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

THOMAS & BETTS CANADA - STEEL  
STRUCTURES DIVISION  
Tel: 905-858-1010, x3783  
[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

VALMONT NEWMARK  
Tel: (205) 968-7200  
[www.valmont-newmark.com](http://www.valmont-newmark.com)

### SWITCHES

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
[www.sandc.com](http://www.sandc.com)

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
[www.southernstatesllc.com](http://www.southernstatesllc.com)

### SWITCHES - AIR, GROUP-OPERATED

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
[www.sandc.com](http://www.sandc.com)

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
[www.southernstatesllc.com](http://www.southernstatesllc.com)

# PRODUCTS AND SERVICES

## SWITCHES - CAPACITORS

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
www.southernstatesllc.com

## SWITCHES - DISCONNECT

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
www.southernstatesllc.com

## SWITCHES - DISCONNECT 25 TO 800KV

MERSEN CANADA TORONTO INC.  
Tel: (416) 252-9371  
www.ep-ca.mersen.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
www.southernstatesllc.com

## SWITCHES - HOOKSTICK, DISCONNECTING

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
www.southernstatesllc.com

## SWITCHES - ISOLATION

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
www.southernstatesllc.com

## SWITCHES - PADMOUNTED

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## SWITCHES - REGULATOR, BYPASS

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## SWITCHES - SUBMERSIBLE

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## SWITCHES - SUBSTATION, DISCONNECTING

MEGA POWER SYSTEMS  
Tel: (909) 548-4169  
www.megapowersystems.com

MERSEN CANADA TORONTO INC.  
Tel: (416) 252-9371  
www.ep-ca.mersen.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

SOUTHERN STATES, LLC.  
Tel: (770) 946-4562  
www.southernstatesllc.com

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
www.tnb.com

THOMAS & BETTS CANADA – UTILITY DIVISION  
Tel: (450) 466-1102, x234  
1-800-466-1102, x234  
www.tnb.ca

## SWITCHES - TEST

MEGA POWER SYSTEMS  
Tel: (909) 548-4169  
www.megapowersystems.com

## SWITCHES - THROWOVER, AUTOMATIC

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282  
www.tnb.com

THOMAS & BETTS CANADA – UTILITY DIVISION  
Tel: (450) 466-1102, x2341-800-466-1102, x234  
www.tnb.ca

## SWITCHGEAR - ARC RESISTANT - MEDIUM VOLTAGE

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## SWITCHGEAR - DC TRACTION

MERSEN CANADA TORONTO INC.  
Tel: (416) 252-9371  
www.ep-ca.mersen.com

## SWITCHGEAR - MEDIUM VOLTAGE RANGE UP TO 44 KV

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

THOMAS & BETTS - UTILITY GROUP  
Tel: (800) 326-5282w  
www.tnb.com

THOMAS & BETTS CANADA – UTILITY DIVISION  
Tel: (450) 466-1102, x234  
1-800-466-1102, x234  
www.tnb.ca

## SWITCHGEAR - METAL ENCLOSED

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## SWITCHGEAR - REBUILDING AND REPAIR SERVICE

NAES CORPORATION  
Tel: (425) 961-4700  
www.naes.com

## SWITCHGEAR - SF6

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

# PRODUCTS AND SERVICES

## THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282

www.tnb.com

## THOMAS & BETTS CANADA – UTILITY DIVISION

Tel: (450) 466-1102, x234

1-800-466-1102, x234

www.tnb.ca

## SWITCHGEAR - VACUUM

## THOMAS & BETTS - UTILITY GROUP

Tel: (800) 326-5282

www.tnb.com

## THOMAS & BETTS CANADA – UTILITY DIVISION

Tel: (450) 466-1102, x234

1-800-466-1102, x234

www.tnb.ca

## SYSTEMS INTEGRATOR

## NOVATECH, LLC

Tel: (410) 753-8300 • (800) 253-3842

www.novatechweb.com

## S & C ELECTRIC COMPANY

Tel: (773) 338-1000

www.sandc.com

## SISCO, INC.

Tel: (586) 254-0020

www.sisconet.com

## UTILITY INTEGRATION SOLUTIONS INC. (UISOL)

Tel: 303-520-2513

www.uisol.com

## VANGUARD SYSTEMS

Tel: (610) 891-7703 (8am - 5pm EST)

www.vansystems.com

## T

## TAP CHANGERS

## PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000

www.prolecge.com

## TAP CHANGERS - CONTROLS

## PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000

www.prolecge.com

## TAP CHANGERS - TRANSFORMERS - LOAD, NO-LOAD

## PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000

www.prolecge.com

## SPX TRANSFORMER SOLUTIONS, INC.

## FKA WAUKESHA ELECTRIC SYSTEMS, INC.

Tel: (800) 835-2732

www.spxwaukesha.com

## TAPE - MARKING

## TECH PRODUCTS, INC.

Tel: (718) 442-4900 • 1-800-221-1311

www.techproducts.com

## TAPE - UNDERGROUND MARKING

## TECH PRODUCTS, INC.

Tel: (718) 442-4900 • 1-800-221-1311

www.techproducts.com

## TELECOMMUNICATIONS

## DOW ELECTRICAL & TELECOMMUNICATIONS

Tel: 1-800-441-4DOW

www.dow.com/electrical

## OLDCASTLE ENCLOSURE SOLUTIONS

Tel: (303) 209-8000

www.oldcastleprecast.com/enclosure.solutions

## OLDCASTLE PRECAST FOR TRUFIRE WALL

Tel: (303) 209-8000 • 888-965-3227

www.oldasleprecast.com

## TELECOMMUNICATIONS - MICROWAVES, RADIO SYSTEMS/ SERVICES

## CARLSON WIRELESS TECHNOLOGIES

Tel: (707) 822-7000

www.carlsonwireless.com

## TEMPERATURE MONITORING

## OPTOCON AG

Tel: 49-351-3101957

www.optocon.de

## TEMPORARY BRIDGES

## MABEY INC.

Tel: (800) 956-2239

www.mabey.com

## TEMPORARY ROADWAYS

## MABEY INC.

Tel: (800) 956-2239

www.mabey.com

## TEST - MEASURING EQUIPMENT

## ELSYS INSTRUMENTS, LLC

Tel: (845) 238-3933

www.elsys-instruments.com

## MORGAN SCHAFFER

Tel: (514) 739-1967

www.morganschaffer.com

## PHENIX TECHNOLOGIES INC.

Tel: (301) 746-8118

www.phenixtech.com

## TEST & MEASUREMENT - SF6 GAS ANALYSER

## ELECTRO RENT CORP

Tel: (877) 581-3384

www.electrorent.com

## TEST EQUIPMENT

## DOBLE ENGINEERING CO.

Tel: (617) 926-4900

www.doble.com

## PRODUCTS AND SERVICES

OMICRON ELECTRONICS CORP.  
USA (WALTHAM)  
Tel: (781) 672-6200 • 1-800-OMICRON  
[www.omicronusa.com](http://www.omicronusa.com)

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118  
[www.phenixtech.com](http://www.phenixtech.com)

RTDS TECHNOLOGIES, INC.  
Tel: (204) 989-9700  
[www.rtds.com](http://www.rtds.com)

### TEST EQUIPMENT - AERIAL LIFT

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118  
[www.phenixtech.com](http://www.phenixtech.com)

VON CORPORATION (THE)  
Tel: (205) 788-2437  
[www.voncorp.com](http://www.voncorp.com)

### TEST EQUIPMENT - BLANKET

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118  
[www.phenixtech.com](http://www.phenixtech.com)

### TEST EQUIPMENT - CIRCUIT BREAKER

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
[www.doble.com](http://www.doble.com)

ELECTRO RENT CORP  
Tel: (877) 581-3384  
[www.electrorent.com](http://www.electrorent.com)

HIGH VOLTAGE INC.  
Tel: (518) 329-3275  
[www.hvinc.com](http://www.hvinc.com)

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118w  
[www.phenixtech.com](http://www.phenixtech.com)

PROGUSA, LLC  
Tel: (407) 332-8678  
[www.progusa.net](http://www.progusa.net)

### TEST EQUIPMENT - CURRENT TRANSFORMER TESTERS

ELECTRO RENT CORP  
Tel: (877) 581-3384  
[www.electrorent.com](http://www.electrorent.com)

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
[www.prolecge.com](http://www.prolecge.com)

### TEST EQUIPMENT - ELECTRICAL

HIGH VOLTAGE INC.  
Tel: (518) 329-3275  
[www.hvinc.com](http://www.hvinc.com)

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118  
[www.phenixtech.com](http://www.phenixtech.com)

### TEST EQUIPMENT - FAULT

HIGH VOLTAGE INC.  
Tel: (518) 329-3275  
[www.hvinc.com](http://www.hvinc.com)

MORGAN SCHAFFER  
Tel: (514) 739-1967  
[www.morganschaffer.com](http://www.morganschaffer.com)

### TEST EQUIPMENT - GLOVE

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118  
[www.phenixtech.com](http://www.phenixtech.com)

VON CORPORATION (THE)  
Tel: (205) 788-2437  
[www.voncorp.com](http://www.voncorp.com)

### TEST EQUIPMENT - HIGH VOLTAGE

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
[www.doble.com](http://www.doble.com)

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
[www.hfgp.com](http://www.hfgp.com)

HIGH VOLTAGE INC.  
Tel: (518) 329-3275  
[www.hvinc.com](http://www.hvinc.com)

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118  
[www.phenixtech.com](http://www.phenixtech.com)

### TEST EQUIPMENT - HV IMPULSE

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118  
[www.phenixtech.com](http://www.phenixtech.com)

### TEST EQUIPMENT - HV TEST SETS, PORTABLE

HASTINGS FIBERGLASS PRODUCTS INC.  
Tel: (269) 945-9541  
[www.hfgp.com](http://www.hfgp.com)

HD ELECTRIC COMPANY  
Tel: (847) 473-4980  
[www.hdelectriccompany.com](http://www.hdelectriccompany.com)

HIGH VOLTAGE INC.  
Tel: (518) 329-3275  
[www.hvinc.com](http://www.hvinc.com)

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118  
[www.phenixtech.com](http://www.phenixtech.com)

VON CORPORATION (THE)  
Tel: (205) 788-2437  
[www.voncorp.com](http://www.voncorp.com)

### TEST EQUIPMENT - INSTRUMENT TRANSFORMER

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
[www.prolecge.com](http://www.prolecge.com)

### TEST EQUIPMENT - INSULATION

ELECTRO RENT CORP  
Tel: (877) 581-3384  
[www.electrorent.com](http://www.electrorent.com)

HIGH VOLTAGE INC.  
Tel: (518) 329-3275  
[www.hvinc.com](http://www.hvinc.com)

PHENIX TECHNOLOGIES INC.  
Tel: (301) 746-8118  
[www.phenixtech.com](http://www.phenixtech.com)

# PRODUCTS AND SERVICES

## TEST EQUIPMENT - LIGHTNING ARRESTERS

HIGH VOLTAGE INC.  
Tel: (518) 329-3275  
www.hvinc.com

## TEST EQUIPMENT - METER TEST SETS

OMICRON ELECTRONICS CORP. USA  
(WALTHAM)  
Tel: (781) 672-6200 • 1-800-OMICRON  
www.omicronusa.com

## TEST EQUIPMENT - MOISTURE

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

## TEST EQUIPMENT - OIL

HIGH VOLTAGE INC.  
Tel: (518) 329-3275  
www.hvinc.com

MORGAN SCHAFFER  
Tel: (514) 739-1967  
www.morganschaffer.com

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

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## TEST EQUIPMENT - RECLOSERS

HIGH VOLTAGE INC.  
Tel: (518) 329-3275  
www.hvinc.com

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

## TEST EQUIPMENT - RELAY

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
www.doble.com

ELECTRO RENT CORP  
Tel: (877) 581-3384  
www.electrorent.com

OMICRON ELECTRONICS CORP. USA  
(WALTHAM)  
Tel: (781) 672-6200 • 1-800-OMICRON  
www.omicronusa.com

PROGUSA, LLC  
Tel: (407) 332-8678  
www.progusa.net

RTDS TECHNOLOGIES, INC.  
Tel: (204) 989-9700  
www.rtds.com

## TEST EQUIPMENT - RENTAL

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
www.doble.com

ELECTRO RENT CORP  
Tel: (877) 581-3384  
www.electrorent.com

## TEST EQUIPMENT - SLEEVE, RUBBER

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

VON CORPORATION (THE)  
Tel: (205) 788-2437  
www.voncorp.com

## TEST EQUIPMENT - TRANSFORMERS

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
www.doble.com

ELECTRO RENT CORP  
Tel: (877) 581-3384  
www.electrorent.com

HIGH VOLTAGE INC.  
Tel: (518) 329-3275  
www.hvinc.com

MISTRAS GROUP  
www.mistrasgroup.com

OMICRON ELECTRONICS CORP. USA  
(WALTHAM)  
Tel: (781) 672-6200 • 1-800-OMICRON  
www.omicronusa.com

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

PROGUSA, LLC  
Tel: (407) 332-8678  
www.progusa.net

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## TEST SYSTEMS/COMPONENTS - HIGH VOLTAGE, HIGH CURRENT, HIGH POWER

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

## TESTING - REGULATORS

RTDS TECHNOLOGIES, INC.  
Tel: (204) 989-9700  
www.rtds.com

## TESTING - TRANSFORMERS, LIQUID

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## TESTING SERVICES

DOBLE ENGINEERING CO.  
Tel: (617) 926-4900  
www.doble.com

RTDS TECHNOLOGIES, INC.  
Tel: (204) 989-9700  
www.rtds.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

# PRODUCTS AND SERVICES

## TESTING SERVICES - ELECTRICAL

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

## TESTING SERVICES - OIL

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

TJH2B ANALYTICAL SERVICES  
Tel: (916) 361-7177  
www.tjh2b.com

## TESTING SERVICES - SALES & RENTAL OF TEST INSTRUMENTS

COMRENT INTERNATIONAL INC.  
Tel: (780) 997-0608  
www.comrent.ca

## THERMAL MANAGEMENT

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

## TOOLS

ANGLESPLITTER  
Tel: (580) 761-7137  
www.anglesplitter.com

MABEY INC.  
Tel: (800) 956-2239  
www.mabey.com

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

## TOOLS - EQUIPMENT/RENTAL

MABEY INC.  
Tel: (800) 956-2239  
www.mabey.com

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

## TOOLS - WIRE & CABLE

RIPLEY COMPANY  
Tel: (860) 635-2200 • 1-800-528-8665  
www.ripley-tools.com

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

WAGNER-SMITH EQUIPMENT COMPANY  
Tel: (800) 666-6567  
www.wagnersmithequipment.com

## TOWER - TRELLIS AND TUBULAR

FABRIMET INC.  
Tel: (819) 472-1164  
www.fabrimet.com

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

THOMAS & BETTS - STEEL STRUCTURES  
DIVISION  
Tel: 1-877-2TB-MEYER  
www.meyersteelstructures.com

## TOWERS - ANTENNA

THOMAS & BETTS - STEEL STRUCTURES  
DIVISION  
Tel: 1-877-2TB-MEYER  
www.meyersteelstructures.com

## TOWERS - EMERGENCY T & D

QUANTA SERVICES  
Tel: (713) 629-7600  
www.quantaservices.com

THOMAS & BETTS - STEEL STRUCTURES  
DIVISION  
Tel: 1-877-2TB-MEYER  
www.meyersteelstructures.com

THOMAS & BETTS CANADA - STEEL  
STRUCTURES DIVISION  
Tel: 905-858-1010, x3783  
www.meyersteelstructures.com

## TOWERS - POLES

DIS-TRAN STEEL, LLC  
Tel: (318) 448-0274  
www.distran.com

RS TECHNOLOGIES INC.  
Tel: (877) 219-8002  
www.rs poles.com

THOMAS & BETTS - STEEL STRUCTURES  
DIVISION  
Tel: 1-877-2TB-MEYER  
www.meyersteelstructures.com

THOMAS & BETTS CANADA - STEEL  
STRUCTURES DIVISION  
Tel: 905-858-1010, x3783  
www.meyersteelstructures.com

VALMONT NEWMARK  
Tel: (205) 968-7200  
www.valmont-newmark.com

## TOWERS - TELECOMMUNICATION

THOMAS & BETTS - STEEL STRUCTURES  
DIVISION  
Tel: 1-877-2TB-MEYER  
www.meyersteelstructures.com

## TOWERS - WIRELESS

THOMAS & BETTS - STEEL STRUCTURES  
DIVISION  
Tel: 1-877-2TB-MEYER  
www.meyersteelstructures.com

## TOWERS, TRANSMISSION - RETROFIT

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

THOMAS & BETTS - STEEL STRUCTURES  
DIVISION  
Tel: 1-877-2TB-MEYER  
www.meyersteelstructures.com

## TOWERS, TRANSMISSION - STEEL

FABRIMET INC.  
Tel: (819) 472-1164  
www.fabrimet.com

## PRODUCTS AND SERVICES

### LOCWELD

Tel: (450) 659-9661

[www.locweld.com](http://www.locweld.com)

### SABRE TUBULAR STRUCTURES

Tel: (817) 852-1700 • 866-254-3707

[www.sabretubularstructures.com](http://www.sabretubularstructures.com)

### THOMAS & BETTS - STEEL STRUCTURES DIVISION

Tel: 1-877-2TB-MEYER

[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

### THOMAS & BETTS CANADA - STEEL STRUCTURES DIVISION

Tel: 905-858-1010, x3783

[www.meyersteelstructures.com](http://www.meyersteelstructures.com)

### VALMONT NEWMARK

Tel: (205) 968-7200

[www.valmont-newmark.com](http://www.valmont-newmark.com)

### TOWERS, TRANSMISSION - WOOD, LAMINATED

#### HUGHES BROTHERS INC.

Tel: (402) 643-2991

[www.hughesbros.com](http://www.hughesbros.com)

#### LAMINATED WOOD SYSTEMS INC.

Tel: (402) 643-4708 • 1-800-949-3526

[www.binary.net/lws](http://www.binary.net/lws)

### TOWERS, TRANSMISSION - WOOD, SOLID

#### DIS-TRAN WOOD PRODUCTS, LLC

Tel: (318) 448-0274

[www.distran.com](http://www.distran.com)

#### HUGHES BROTHERS INC.

Tel: (402) 643-2991

[www.hughesbros.com](http://www.hughesbros.com)

### TRACKED VEHICLES

#### ASPLUNDH TREE EXPERT CO.

Tel: (800) 248-8733

[www.asplundh.com](http://www.asplundh.com)

### TRAILERS - CABLE REEL

#### CONDUX TESMEC INC.

Tel: (507) 387-8069 • 1-877-854-1750

[www.conduxtesmec.com](http://www.conduxtesmec.com)

### TRAILERS - RENTAL AND LEASING

#### WAGNER-SMITH EQUIPMENT COMPANY

Tel: (800) 666-6567

[www.wagnersmithequipment.com](http://www.wagnersmithequipment.com)

### TRAINING

#### CTC GLOBAL CORPORATION

Tel: (949) 428-8500

[www.ctcglobal.com](http://www.ctcglobal.com)

#### DOBLE ENGINEERING CO.

Tel: (617) 926-4900

[www.doble.com](http://www.doble.com)

#### OMICRON ELECTRONICS CORP. USA (WALTHAM)

Tel: (781) 672-6200 • 1-800-OMICRON

[www.omicronusa.com](http://www.omicronusa.com)

#### S & C ELECTRIC COMPANY

Tel: (773) 338-1000

[www.sandc.com](http://www.sandc.com)

#### SPX TRANSFORMER SOLUTIONS, INC.

FKA WAUKESHA ELECTRIC SYSTEMS, INC.

Tel: (800) 835-2732

[www.spxwaukesha.com](http://www.spxwaukesha.com)

### TRAINING - CORONA

#### CITI - CORONA INSPECTION TRAINING INSTITUTE

Tel: (888) 950-5557

[www.citi-training.com](http://www.citi-training.com)

### TRAINING - GIS

#### ESRI

Tel: (909) 793-2853

[www.esri.com](http://www.esri.com)

### TRAINING - REGULATORY COMPLIANCE

#### CN UTILITY CONSULTING

Tel: (707) 829-1018

[www.cnutility.com](http://www.cnutility.com)

### TRANSDUCERS - ELECTRIC

#### FLEX-CORE DIV.

Tel: (614) 889-6152

[www.flex-core.com](http://www.flex-core.com)

### TRANSFORMER - OIL

#### PETRO-CANADA LUBRICANTS INC.

Tel: 1-800-268-5850

[www.lubricants.petro-canada.ca](http://www.lubricants.petro-canada.ca)

#### PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000

[www.prolecge.com](http://www.prolecge.com)

### TRANSFORMER - UNIT DISTRIBUTION SUBSTATIONS

#### PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000

[www.prolecge.com](http://www.prolecge.com)

### TRANSFORMER - VACUUM DRY-OUT SYSTEMS

#### BARON USA

Tel: (931) 528-8476

[www.baronusa.com](http://www.baronusa.com)

#### PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000

[www.prolecge.com](http://www.prolecge.com)

#### SPX TRANSFORMER SOLUTIONS, INC.

FKA WAUKESHA ELECTRIC SYSTEMS, INC.

Tel: (800) 835-2732

[www.spxwaukesha.com](http://www.spxwaukesha.com)

### TRANSFORMER COMPONENTS

#### PROLEC GE INTERNACIONAL, S. DE R.L. DE C.V.

Tel: +52 818 030 2000

[www.prolecge.com](http://www.prolecge.com)

#### SPX TRANSFORMER SOLUTIONS, INC.

FKA WAUKESHA ELECTRIC SYSTEMS, INC.

Tel: (800) 835-2732

[www.spxwaukesha.com](http://www.spxwaukesha.com)

### TRANSFORMER DIAGNOSIS

#### MORGAN SCHAFFER

Tel: (514) 739-1967

[www.morganschaffer.com](http://www.morganschaffer.com)

# PRODUCTS AND SERVICES

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMER DISPOSAL

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMER MONITORING

MISTRAS GROUP  
www.mistrasgroup.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMER MOUNTING PADS

CONCAST INC.  
Tel: (507) 732-4095  
www.concastinc.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMERS

DELTA STAR, INC. (LYNCHBURG)  
Tel: (800) 368-3017  
www.deltastar.com

MOLONEY ELECTRIC, INC.  
Tel: (416) 534-9226  
www.moloneytx.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

SPX TRANSFORMER SOLUTIONS, INC.  
FKA WAUKESHA ELECTRIC SYSTEMS, INC.  
Tel: (800) 835-2732  
www.spxwaukesha.com

## TRANSFORMERS - AC VOLTAGE REGULATORS

SUPERIOR ELECTRIC  
Tel: (860) 507-2025  
www.superiorelectric.com

## TRANSFORMERS - AUTO TRANSFORMERS

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

SPX TRANSFORMER SOLUTIONS, INC.  
FKA WAUKESHA ELECTRIC SYSTEMS, INC.  
Tel: (800) 835-2732  
www.spxwaukesha.com

## TRANSFORMERS - AUXILIARY - DRY OR LIQUID FILLED TYPE

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMERS - CONTROLS

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMERS - DISTRIBUTION

MOLONEY ELECTRIC, INC.  
Tel: (416) 534-9226  
www.moloneytx.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMERS - DISTRIBUTION, CAST-COIL

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMERS - DISTRIBUTION, PADMOUNTED

MOLONEY ELECTRIC, INC.  
Tel: (416) 534-9226  
www.moloneytx.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMERS - DISTRIBUTION, POLE-TYPE

MOLONEY ELECTRIC, INC.  
Tel: (416) 534-9226  
www.moloneytx.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMERS - DISTRIBUTION, SUBSTATION-TYPE

DELTA STAR, INC. (LYNCHBURG)  
Tel: (800) 368-3017  
www.deltastar.com

MOLONEY ELECTRIC, INC.  
Tel: (416) 534-9226  
www.moloneytx.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMERS - DISTRIBUTION, SUBSURFACE

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.

Tel: +52 818 030 2000  
www.prolecge.com

## TRANSFORMERS - DRY OUT SYSTEMS

BARON USA  
Tel: (931) 528-8476  
www.baronusa.com

## PRODUCTS AND SERVICES

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

### TRANSFORMERS - DRY TYPE

HAMMOND POWER SOLUTIONS INC.  
Tel: (519) 822-2441  
www.hammondpowersolutions.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

### TRANSFORMERS - FALL PROTECTION

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

### TRANSFORMERS - FIELD REPAIRS

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

SPX TRANSFORMER SOLUTIONS, INC.  
FKA WAUKESHA ELECTRIC SYSTEMS, INC.  
Tel: (800) 835-2732  
www.spxwaukesha.com

### TRANSFORMERS - GROUNDING

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

### TRANSFORMERS - INSTRUMENT

FLEX-CORE DIV.  
Tel: (614) 889-6152  
www.flex-core.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

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

TSTM  
Tel: (605) 334-2924

### TRANSFORMERS - INSTRUMENT, CURRENT

FLEX-CORE DIV.  
Tel: (614) 889-6152  
www.flex-core.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

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

### TRANSFORMERS - LARGE POWER

OLDCASTLE ENCLOSURE SOLUTIONS  
Tel: (303) 209-8000  
www.oldcastleprecast.com/enclosure.  
solutions

OLDCASTLE PRECAST FOR TRUFIRE  
WALL  
Tel: (303) 209-8000-888-965-3227  
www.oldasleprecast.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

### TRANSFORMERS - LARGE POWER, 10,001 KVA AND LARGER

DELTA STAR, INC. (LYNCHBURG)  
Tel: (800) 368-3017  
www.deltastar.com

OLDCASTLE PRECAST FOR TRUFIRE  
WALL  
Tel: (303) 209-8000-888-965-3227  
www.oldasleprecast.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

SPX TRANSFORMER SOLUTIONS, INC.  
FKA WAUKESHA ELECTRIC SYSTEMS, INC.  
Tel: (800) 835-2732  
www.spxwaukesha.com

### TRANSFORMERS - LEAK SEALING SERVICES

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

### TRANSFORMERS - MAINTENANCE

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

S & C ELECTRIC COMPANY  
Tel: (773) 338-1000  
www.sandc.com

### TRANSFORMERS - MAINTENANCE/REPAIRS

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

SPX TRANSFORMER SOLUTIONS, INC.  
FKA WAUKESHA ELECTRIC SYSTEMS, INC.  
Tel: (800) 835-2732  
www.spxwaukesha.com

### TRANSFORMERS - MEDIUM & LARGE POWER

DELTA STAR, INC. (LYNCHBURG)  
Tel: (800) 368-3017  
www.deltastar.com

OLDCASTLE PRECAST FOR TRUFIRE  
WALL  
Tel: (303) 209-8000-888-965-3227  
www.oldasleprecast.com

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
www.prolecge.com

SPX TRANSFORMER SOLUTIONS, INC.  
FKA WAUKESHA ELECTRIC SYSTEMS, INC.  
Tel: (800) 835-2732  
www.spxwaukesha.com

# PRODUCTS AND SERVICES

## TRANSFORMERS - MOBILE

DELTA STAR, INC. (LYNCHBURG)  
Tel: (800) 368-3017  
[www.deltastar.com](http://www.deltastar.com)

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
[www.prolecge.com](http://www.prolecge.com)

## TRANSFORMERS - MONITORS

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
[www.prolecge.com](http://www.prolecge.com)

## TRANSFORMERS - NETWORK

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
[www.prolecge.com](http://www.prolecge.com)

## TRANSFORMERS - NONFLAMMABLE LIQUID-FILLED

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
[www.prolecge.com](http://www.prolecge.com)

## TRANSFORMERS - OIL FILLED - LEAD CABLES

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
[www.prolecge.com](http://www.prolecge.com)

## TRANSFORMERS - PAINTING AND FLOW COATING

PROLEC GE INTERNACIONAL, S. DE R.L.  
DE C.V.  
Tel: +52 818 030 2000  
[www.prolecge.com](http://www.prolecge.com)

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