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Electrical Business

JUNE 2012

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CANADA'S 50 BEST MANAGED COMPANIES

We don't need marching orders from legislators, policymakers and regulators.

Getting government out of power

Horizon Utilities' Max Cananzi—current chair of the Electricity Distributors Association—addressed a packed crowd of energy industry professionals at an Ontario Energy Network luncheon on April 23. He spoke about the electricity "system of tomorrow" and how, given the right conditions, local distribution companies (LDCs)—not government—will drive Ontario's second century of electricity.

"We know that Ontario's second century of electricity will be based on a high-technology grid supported by sophisticated software applications and equipment that enable the two-way flow of electricity and information. We know that the electricity infrastructure of tomorrow will go beyond generating stations, transmission towers and powerlines. We know that it will be plugged into our cars, homes, appliances, buildings, and industrial equipment," said Cananzi.

Cananzi highlighted four key outcomes we must achieve if we are going to be able to deliver tomorrow's electricity system. The first is stability, in policy and regulation. "Government must set the course and create conditions for the sector to succeed. And then let business take care of the details."

The second is removing barriers to investing in the system's infrastructure. "We need to remove the barriers: red tape, delayed decisions and access to capital." We must renew and refurbish our aging system and modernize the grid.

Third, we need to reform regulation and oversight. With the mammoth task of renewing and modernizing the grid, we need a flexible system that balances scrutiny with simplicity. "LDCs need to spend more time and resources on delivering results than reporting to regulators," said Cananzi.

"The fourth and final imperative is to find efficiencies to ensure ratepayers continue to enjoy safe, reliable and affordable electricity service," concluded Cananzi. "If these four things are achieved, it will lead to opportunities for all of us in this room."

Essentially, Cananzi argued for market forces—not government—leading the charge in powering our future. "We don't need marching orders from legislators, policymakers and regulators," said Cananzi, adding in closing, "Let's not hold our collective breaths and wait for others to finalize reports or deliver recommendations. We're the experts. We know good ideas when we see them. Let's get out there and get the job done."

Well said, and good advice for all Canadians involved in the electricity market. EB

On the cover

Nedco recently held a grand re-opening of its Keaton branch counter. The event also hosted a packed charity BBQ in support of "Hungry for Change"—a campaign driven by Canada's electrical industry. Photos at www.EBMag.com under Galleries. Photo A. Capkun.

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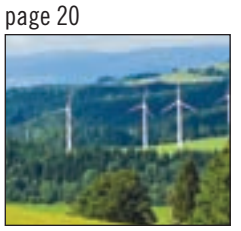

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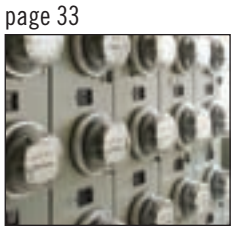

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We acknowledge the financial support of the Government of Canada through the Canada Periodical Fund (CPF) for our publishing activities.
Canada

ABB completes Thomas & Betts acquisition

ABB Ltd. (www.abb.com) has completed its acquisition of Thomas & Betts Corp. (www.tnb.com). ABB says the combination of T&B's electrical components and ABB's low-voltage protection, control and measurement products will create a broader low-voltage offering.

In North America, the combination will double ABB's addressable market to about $24 billion. T&B has a North-American network of more than 6000 distributor locations and wholesalers, which will provide greater access for ABB low-voltage products.

"The acquisition of Thomas & Betts furthers our global strategy and provides substantial opportunities to create value for our shareholders" said Joe Hogan, ABB's CEO.

"Our joint low-voltage electrical components business is globally balanced and has one of the broadest scopes in the industry," said Tarak Mehta, head of ABB's Low Voltage Products division.

Dominic Pileggi will remain chair of T&B and Charles Treadway, previously COO, will take over as CEO. The HQ is in Memphis, Tenn.

WARNING to all B.C. and Quebec EFC-ers involved in Lighting

ELECTRO-FEDERATION CANADA

A recent bulletin from Electro-Federation Canada (www.electrofed.com) warns that B.C. Regulation states that, if you are selling lighting equipment (lamps and/or fixtures) after July 1, 2012, you must be a member of a government-approved regulated program—otherwise you may incur a $200,000 fine, per day.

On July 1, the LightRecycle program will be expanded by Product Care, a non-profit industry association, and will provide a compliance option for all obligated parties. Visit bit.ly/J9yRoT for a detailed PDF.

Similarly, by July 14, 2012, Quebec regulations will require lamp producers to be part of, or have their own, government-approved EPR recycling program for lamps and batteries. Not participating in such a program is in contravention of the law in Quebec. Visit bit.ly/KAK0Q9 for more information.

A lamp producer is defined as "the first importer to the province". It could be a retailer, distributor or a manufacturer. We recommend manufacturers discuss with their retailers and distributors to define how and who will collect and pay the Eco fees, which will be charged on all mercury-containing lamps in British Columbia and Quebec by the program manager upon receipt of sales information provided (in confidence) to the program.

If you have any questions or concerns, contact Wayne Edwards at wedwards@electrofed.com or (647) 258-7483, or Vanessa Groult, PCA Program Coordinator at vanessa@productcare.org or (888) 772-9772 ext. 200.

National Occupational Standards for electricity and renewables sector

National Occupational Standards (NOSs) identify and group the tasks associated with a specific occupation. They describe the knowledge, skills, abilities and aptitudes a worker must demonstrate to be considered competent in that occupation. How can the Electricity Sector Council (www.brightfutures.ca) effectively address your workforce planning needs right now? ESC has developed the following NOSs for your use:

- Electrical Engineering Technician and Technologist
- Electrical Power Station Operator
- Electrical Power Systems Operator
- Utilities Project Manager
- Power Protection and Control Technician
- Wind Turbine Technician
- Geo-Exchange Installer
- Solar Thermal Installer
- Solar Photovoltaic Installer

Well-developed NOSs enable the recognition of workers' knowledge and skills across the entire Canadian labour market and facilitate labour mobility across all Canadian sectors, says ESC. NOSs can form the basis for training, curriculum development and accreditation of training programs, recruitment, performance, improvement and can promote employee retention by identifying career paths.

NOSs for the roles of Utilities Arborist and Cable Splicer are currently underway, and will be available for your use late 2012. Developed and validated with the input of employers, employees, labour and education, all ESC NOSs "have the seal of industry approval".

Babcock & Wilcox Canada wins SaskPower Shand boiler contract

Babcock & Wilcox Canada Ltd. (www.babcock.com) has been awarded a contract valued at more than $25 million from SaskPower to design and replace the upper frontwall and a portion of the reheater at the latter's Shand Power Station near Estevan.

Shand features boiler technology originally designed and supplied by B&W Canada. This retrofit project is an integral part of the coal-fired station's life extension.

"B&W is committed to executing this retrofit project in a safe, timely and efficient manner," said J. Randall Data, Babcock & Wilcox Power Generation Group Inc. president and COO. "We're pleased that SaskPower has chosen us and look forward to providing project support on this important pressure part retrofit at Shand Power Station."

"Shand provides about 300 megawatts of baseload power to Saskatchewan," said Robert Watson, SaskPower president and CEO. "As an integral part of our generating fleet, it's critical that we make sure the station is operating at peak performance."

The project is expected to be completed in June.

Many Canadians lack practical, everyday skills

Skills/Compétences Canada (S/CC, www.skillscanada.com)—a national, not-for-profit organization that promotes careers in skilled trades and technologies—released the findings of a survey conducted by Harris/Decima that shows many Canadians have little to no working knowledge of those everyday activities that require a skilled hand. For example:

- Almost half of Canadians (46%) admit they don't know how to install a bathroom or kitchen faucet.
- About one in three Canadians (31%) aren't sure how to install a light fixture.
- About a quarter of Canadians (28%) don't know how to change a flat tire; almost half of all women (48%) say they cannot.
- 1 in 10 Canadians (14%) have no idea how to turn off the water main in their home.

"There's a serious underlying message here that many Canadians are lacking basic, practical knowledge when it comes to completing everyday skills, admitting they require help," said Shaun Thorson, CEO, Skills/Compétences Canada. "Industries that depend on skilled trade workers are key drivers of the Canadian economy contributing over 50% of Canada's GDP. But the growing shortage of skilled trade workers is not only a concern for industry; it is only a matter of time before every Canadian will feel the impact in their everyday lives."

GE Energy launches Electric Odyssey Tour 2012

GE Energy's Industrial Solutions business kicked off the "Electric Odyssey Tour"—a six-month road show that highlights "innovative product and service offerings". Attendees can experience the technologies that touch all parts of the electrical infrastructure, including low- and medium-voltage switchgear, circuit breakers, transformers, arc flash mitigation products and lifecycle service solutions.

"The Electric Odyssey Tour (www.geindustrial.com/odyssey) is a great way for us to bring our products and services directly to our customers' facilities where they can see, touch and experience them firsthand," said Luis Ramirez, CEO, GE Energy's Industrial Solutions business.

The tour runs from May to October. For specific Canadian dates and locations, visit bit.ly/JPCMFh.

NS Power helps you spy on Oscar and Ethel... with OspreyCam 2012

Oscar, Ethel and the OspreyCam are back! Nova Scotia Power (www.nspower.ca) and the Nova Scotia Museum of Natural History today announced the return of their OspreyCam program for a sixth year.

"Nova Scotia Power is proud to play a role in the conservation and safety of the osprey population in Nova Scotia through our Osprey Relocation Program," said executive vice-president, Strategic Business & Customer Service, Robin McAdam. "Our partnership with the Museum of Natural History goes one step further, and allows people worldwide the opportunity to view our provincial bird in its natural habitat."

For the first time, everyone's favourite feathered friends—Oscar and Ethel—will be viewed as they return to their home in Nova Scotia. The OspreyCam has traditionally been activated after Oscar and Ethel arrive and settle back into their nest. As an added feature this year, the "night life" of Oscar and Ethel will be available through a night-vision camera.

Nova Scotia Power has been working to protect the osprey, once an endangered species, for over 25 years. Through the Osprey Relocation Program, NS Power's powerline technicians relocate threatened nests from atop live utility poles to safer, unused poles placed nearby. NS Power relocated Ethel and Oscar's nest from a utility pole in 2001 after it caught fire. The pair has returned to the nest each year since to hatch their chicks.

The OspreyCam will provide live viewing of Oscar and Ethel as they return to their Nova Scotia home, repair their nest from the damage caused by winter, lay and hatch their eggs, and raise their hatchlings. The Osprey naming contest will also begin once Ethel lays her eggs, so stay tuned for your chance to choose the name of the next generation of celebrity fowl.

The activities of Oscar and Ethel can be followed on the Museum of Natural History's website (bit.ly/JPEkzf).

General Cable acquiring Alcan Cable in $185-million deal

General Cable Corp. (www.generalcable.com) is acquiring Alcan Cable (www.alcancable.com), the wire and cable business of Rio Tinto plc, in a $185-million cash deal. The transaction is expected to close in the second half of 2012, subject to receipt of regulatory approval.

Alcan Cable employs about 1050 associates in its aluminum cable manufacturing and distribution facilities servicing the energy and construction markets in Canada, the United States, Mexico and China. On an annual basis, General estimates the acquisition will contribute about $650-700 million in revenues at current metal prices.

"I have long admired Alcan Cable and their singular and longstanding focus on being superb at their craft. Alcan Cable's Stabiloy and Nual brand names are the gold standard for quality, packaging and service in the North American aluminum cable industry," said Gregory B. Kenny, president and CEO of General Cable.

"Alcan Cable's rich history, like General Cable's, exceeds 100 years," continued Kenny. "We look forward to sharing best practices and creating fresh career opportunities for the very dedicated and professional Alcan Cable team."

"The addition of alu minum construction cables further expands the range of products we offer to distributors serving electrical and industrial contractors, and increases our capacity to efficiently serve our electric utility customers with transmission and distribution products," added Gregory J. Lampert, president and CEO , General Cable North America.

Alcan Cable's operating margin profile is expected to be consistent with General's North American businesses as manufacturing, logistics and purchasing synergies are realized.

GM shows off Chevrolet EN-V 2.0 electric concept vehicle

General Motors showed the company's vision of the Chevrolet (www.chevrolet.ca) EN-V 2.0 concept at Auto China 2012. "Our designers and engineers are exploring a range of options for turning the EN-V concept into a reality," said Kevin Wale, president and managing director of the GM China Group. "The EN-V 2.0 concept would use technologies such as the mobility internet, electrification and telematics to help change the automotive landscape and ensure a sustainable future for our industry."

The original EN-V (electric networked-vehicle) concept was a centrepiece of the SAIC-GM Pavilion at World Expo 2010 Shanghai. The two-seat electric vehicle "pioneered a new automobile DNA" based on the convergence of electrification and connectivity. It was developed to show the possibilities for alleviating concerns surrounding traffic congestion, parking availability air quality and affordability.

The EN-V 2.0 concept adds features that consumers demand, such as in-vehicle climate control and personal storage space. In addition, it would be capable of driving in all weather and city road conditions. GM expects to use EN-V 2.0 prototype models in pilot studies throughout China.

Quebec's David Gagnon representing Electrical at WorldSkills Leipzig 2013

Canada's best and brightest skilled trade and technology students received official recognition for their outstanding performance as Skills/Compétences Canada (S/CC, www.skillscanada.com) announced the results of the Skills Canada National Competition (check out the video here: bit.ly/KjV1m7). A special congratulations to the competitors in the Electrical Installations category, especially Quebec's David Gagnon, who is going on to represent us as part of Team Canada at WorldSkills Leipzig 2013.

The results in the Electrical Installations category are as follows:

Post-secondary
1. David Gagnon, Quebec
2. Gordon Kearns, B.C.
3. Mike Trainor, The Yukon

Secondary
1. Michael Breton, Quebec
2. Steffan Adamchuk, Manitoba
3. Nathan Sampson, Nova Scotia

"The goal of this annual competition is to reward students for excellence in the skilled trades, while directly involving industry leaders and educators in the training process and in evaluating their performance in a way that is relevant to employers' needs," said Shaun Thorson, CEO, Skills Canada.

The closing ceremonies, held in Edmonton, Alta., were highlighted by the parade of champions and the announcement of the Members of Team Canada, whose next stop is WorldSkills Leipzig 2013.

The Skills Canada National Competition is the only national, Olympic-style, multi-trade and technology event of its kind for young students and apprentices in the country. The event took place May 14-15 at the Edmonton Expo Centre, where 40 different assigned projects were showcased in major skilled trade and technology categories. Competitors were evaluated by independent judges from the respective industry sectors, who based their decisions on industry standards and established work practices, including such criteria as quality of work, safety, cleanliness, skill level and creativity.

"The enthusiasm and hard work shown by the competitors throughout the competition has been inspiring, and we want to congratulate each one. We also want to thank and acknowledge the ongoing support from the Government of Canada, sponsors and organizers for working with us to ensure that there is a bright future for Canada's skilled trade and technology workforce," said Thorson.

The 35 members of Team Canada (in photo) heading to WorldSkills Leipzig 2013 will compete in 33 skill categories against more than 900 competitors from 51 member countries/regions. The four-day WorldSkills Competition is the biggest of its kind in the world, and considered the pinnacle of excellence in skilled trades and technologies training.

Skills/Compétences Canada was founded in 1989 as a national, not-for-profit organization that works with employers, educators, labour groups and governments to promote skilled trades and technology careers among Canadian youth.

GE Lighting Solutions facility in Montreal expands to meet LED demand

The GE Lighting Solutions (www.gelightingsolutions.com) product development facility for LED lighting products in Montreal, Que., is expanding to meet "increasing demand for LED products across a broad range of market segments".

"Due to dramatic improvements in technology and the importance now placed on environmental sustainability, we're now seeing impressive growth in demand for new LED products. LED products offer up to 90% energy cost savings, long-lasting performance and a design and construction that is free from mercury, lead and glass," said Robert Spivock, site leader and design manager.

Since 2010, the facility has increased its square footage and manpower by 50%. GE and the Government of Canada are also involved in a joint investment ($1.3 million each) research project with Les Serres St-Laurent (Savoura) and McGill University to develop innovative LED lighting technology for commercial greenhouses to increase crop yields while reducing energy consumption.

On August 7, 2012, GE Lighting Solutions will host the Montreal stop on the 2012 GE Lighting Revolution Tour.

Major acquisition! Eaton to acquire Cooper Industries

Eaton Corp. (www.eatonelectrical.ca) and electrical equipment supplier Cooper Industries plc (www.cooperindustries.com) have entered into a definitive agreement under which Eaton will acquire Cooper in a transaction that will increase the capabilities and geographic breadth of the combined company's power management portfolio and electrical business.

"This compelling combination of Eaton's power distribution and power quality equipment and systems with Cooper's diversified component brands, global reach and international distribution creates a game changer to serve the electrical industry," said Alexander M. Cutler, Eaton's current chair and CEO. "We're excited about bringing together two great companies to create shareholder value and continue our global growth."

Founded in 1833, Cooper is a supplier of electrical equipment with a range of products, including electrical protection, power transmission and distribution, lighting and wiring components. Founded in 1911, Eaton's electrical business is a player in power distribution/quality, control and automation, power monitoring, and energy management products and services.

Eaton and Cooper will be combined under a new company incorporated in Ireland. The newly created company—which is expected to be called Eaton Global Corp. Plc, or a variant thereof—will be led by Cutler.

"We are extremely pleased to become part of Eaton's global electrical business," said Kirk Hachigian, Cooper CEO. "This combination creates endless opportunities to accelerate growth and serve our global customers through combining technology, distribution, penetrating important vertical industries and entering new emerging markets. The two companies are a perfect fit in every respect." EB

BICSI (www.bicsi.org)—an association supporting the information technology systems (ITS) industry—welcomed industry professionals from all over the world to the Scotiabank Convention Centre in Niagara Falls, Ont., for the recent 2012 BICSI Canadian Conference & Exhibition. And EBMag was there! Congratulations to our friend, past BICSI Canadian Region director **Richard Smith**, who won the Ross G.H. Cotton award, which was created in 1992 to recognize the contributions of an individual in Canada toward advancing BICSI's goals and objectives.


Richard Smith

GE Lighting (www.gelighting.com) is aligning its Lighting Solutions sales and applications solutions teams with its North America professional sales teams under a single structure and single leader. "This change enables our business to move more quickly when making key strategic commercial decisions to support our customers with the best solutions for their applications and financial parameters," said **Maryrose Sylvester**, president and CEO. **Jaime Irick**, who has been leading GE Lighting Solutions (GE's LED and lighting fixtures business) is now responsible for all sales activities of all lighting technologies in GE Lighting's commercial and industrial product portfolio as general manager for the new organization named North America Professional Solutions. **Dan Jenkins** will continue to lead GE Lighting's professional sales team that will now be part of this single organization. He and his sales teams will report to Irick.


Maryrose Sylvester

LumenOptix (www.lumenoptix.com) has appointed **Bill Rymer** to the position of chief financial officer. Rymer holds more than 20 years of targeted experience in the financial and operational management arenas. With experience that includes hands-on management of $1 billion publicly-traded and private equity-backed private companies throughout his career, Rymer has held CFO positions at companies, such as MTI Information Technologies, Constar International, and American Pacific Enterprises.


Bill Rymer

Hubbell Canada has announced several management shuffles, including the promotion of **Dave Syer** to vice-president, Marketing and Sales for Hubbell Canada, where he will assume overall marketing and sales responsibility for all promoted brands, including the Hubbell Electrical Systems and Hubbell Lighting brands. **Debbie Drozda** has been appointed to director Strategic Services, Hubbell Electrical Systems, Shelton, Conn. She will oversee the platform's environmental health and safety initiatives, business compliance and assist with acquisition integration at the corporate level. Finally, **Steve Irvine** has been promoted to operations manager. His responsibilities have been expanded to include engineering, quality and manufacturing at the Pickering, Ont., facility, and he will play a role in expanding the product and service footprint.


Dave Syer


Debbie Drozda


Steve Irvine

Nedco (www.nedco.ca, a division of Rexel Canada Electrical Inc.) has promoted **Gerry Drummond** to assistant general manager of Ontario. Drummond has over 30 years of experience with Nedco and, most recently, held the position of business development manager in the Ontario region.


Gerry Drummond

Ambient Corp., a provider of smart grid communications platforms and technologies (www.ambientcorp.com), has appointed **Don Pollock** to the position of global VP of sales and marketing. Prior to joining the company, Pollock was managing director of Customers Matter Ltd., a marketing and research consultancy. For over 20 years he has acted as an executive in or consultant to various businesses, with previous clients including: IBM, Saint Gobain, Baldor, Indesit and Universal Powerline Association. Ambient has also named **Jim Fisher** to the position of VP, business development, the Americas. Fisher brings to the role 20+ years of experience in the energy industry in different roles of management, sales and marketing with Schlumberger and Itron.


Don Pollock


Jim Fisher

Valuelight (www.valuelight.com), a lighting and energy-saving controls manufacturer with headquarters and a factory and distribution centre in Toronto, Ont., has appointed **Alia Emami** its national sales manager. Bringing with her seven years of sales management experience, Emami has developed new sales channels by targeting and building distributor relationships, while challenging the market with innovative ideas, described the company. Emami's new role will focus on growing customer satisfaction and increasing sales at Valuelight nationally across Canada.


Alia Emami

Halco Lighting Technologies (www.halcolighting.com) has appointed **Jeff Emerson** and **Ashwin Seshadri** to the positions of product analyst, where they will be aiding in Halco's product development through researching industry trends and new technologies, as well as testing and analyzing Halco and Sollos products. Emerson will report to product manager **Kristoff Byrd**, while Seshadri will report to product manager **Del Moses**. EB


Jeff Emerson


Ashwin Seshadri

Dave Smith

Maintain your equipment; reduce your risk

Part Three

In my last article, I introduced you to three excellent IEEE standards that are essential for managing an electrical system. Moving to the next stage in the development of your electrical maintenance program will require more detail, and a stellar source is NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance".

Chapter 4 "Why an Effective EPM Program Pays Dividends", Chapter 5 "What is an Effective EPM Program?" and Chapter 6 "Planning and Developing an EPM Program" are valuable, as they provide framework and support to the economic argument of the IEEE standards, as does Chapter 7 "Personnel Safety".

While both NFPA 70B and the IEEE documents are written descriptively, 70B is more pertinent on the equipment level. For instance, clause 6.3.6 speaks directly to alarms:

... Like shutdown devices, alarms fall into at least three categories... The entire team should consider each alarm in the system with the same thoroughness with which they have considered the shutdown circuits... A truly critical alarm should be characterized by its separate sensing device, a separate readout device, and, preferably, separate circuitry and power source. The maintenance department should thoroughly understand the critical level of each alarm. The critical alarms and their significance should be distinctly marked on drawings, in records, and on the operating unit.

Our CSA Z463 Technical Committee debated extensively on the inclusion of alarms in this new standard and, eventually, agreed they were beyond the scope of our document. The $4-billion loss I referenced in my April column, however, was due to the loss of an alarm.

Meters are also excluded from CSA Z463, yet the Fukushima nuclear technicians resorted to raiding vehicle batteries from the parking lot because they were blind without power for their meters; this blindness compounded the reactor explosions they experienced. The IEEE reports of this incident provide a chilling insight that I recommend as required reading for all levels of electrical management.

NFPA 70B Chapter 8 "Fundamentals of Electrical Equipment Maintenance" includes Design to Accommodate Maintenance, Scheduling Maintenance (this is always difficult, but Annex L provides excellent direction for maintenance planners), Equipment Safety, Protective Scheme, Acceptance Testing, Guidelines and Impact of Additions/Rework to Retrofitting Equipment, Equipment Cleaning, Special Handling and Disposal Considerations (a very useful compendium of environmental hazards commonly used in the electrical industry), SCADA (another critical system below the radar of Z463) and Lubrication.

NFPA 70B Chapter 9 "System Studies" illuminates the studies (Short-Circuit, Coordination, Load-Flow and Reliability, including arc flash) that are an integral part of system design, operations and maintenance. For the non-electrical person, Chapter 10 "Power Quality" is a chest of nuggets written in layman's terms on such problems as harmonics, interharmonics, transients, etc.

Chapter 11 "Testing and Test Methods" contains a lifetime of knowledge on Acceptance and Maintenance Tests, As-Found and As-Left Tests, Frequency of Tests, Special Precautions and Safety, Qualifications of Test Operators, Test Equipment, Forms, Insulation Testing, Low-Voltage Circuit Breakers, Transformer Tests, Protective Relays, Grounding Systems, Battery Testing, Switches, Medium- and High-Voltage Circuit Breakers, Infrared Inspection, Fuses, Insulating-Liquid Analysis, Rotating Machine Testing, Cables, Adjustable-Speed Drive Testing, Switchgear and Switchboard Assemblies, Surge Arresters, Power Factor Correction Capacitors and Emergency Systems.

Chapter 12 "Maintenance of Electrical Equipment Subject to Long Intervals Between Shutdowns" is the end result of many losses, such as large rotor machines left unattended and their owners subsequently learning that they will sag and be ruined if the rotor is not incrementally rotated on a regular basis. It is especially useful as it incorporates ancillary systems, such as instrumentation and control.

Chapter 13 "Ground-Fault Protection" and Chapter 14 "Grounding" give an effective overview of these critical systems, but the standard you want in your maintenance library is IEEE 142-2007 "Recommended Practice for Grounding of Industrial and Commercial Power Systems".

The remaining chapters cannot be learned in five lifetimes: 15 "Substations and Switchgear Assemblies", 16 "Motor Control Equipment", 17 "Insulated-Case/Moulded-Case Circuit-Breakers", 18 "Fuses", 19 "Power Cables", 20 "Cable Tray and Busway", 21 "Power and Distribution Transformers", 22 "Electronic Equipment", 23 "Lighting", 24 "Wiring Devices", 25 "Rotating Equipment", 26 "Vibration", 27 "Hazardous Location Electrical Equipment", 28 "UPS Systems", 29 "Portable Electrical Tools and Equipment", 30 "Reliability-Centred Maintenance" and 31 "EPM from Commissioning Through Maintenance" but, properly implemented, they will save thousands of lifetimes.

Until next time, be ready, be careful and be safe.© EB

Canada Training Group has been providing consulting services to industry since 1980; Dave Smith, the president, can be reached at davesmith@canada-training-group.ca. At www.canada-training-group.ca, you will find this article (and others) to help support your own safety initiatives.

RON COLEMAN, B. Comm., FCCA CMC

Like an athlete, get yourself some coaching

When you watch tennis, it's easy to see it as a "one-on-one" competition; but when you listen to the commentators, it becomes very obvious that the game is more than just those two players trying to defeat each other on the court. Behind those two competitors are teams of trainers, coaches and other support people.

Does it strike you as odd that the top players in the world rely on a support system or do you, like me, look at them and say, "Well of course they're surrounded by a strong support network!".

Exactly. You, like the tennis pro, cannot not go it alone expecting victory and championships. You, too, need a support system.

I get my contractors focused on the lifestyle outcomes they desire and the path toward achieving them. A good way to stay on that path is by finding someone—a mentor—who will help keep you on it.

When deciding whether to go for a run, for example, I look at the weather; when it's miserable outside, I won't go—unless, of course, I've made a commitment to run with someone else. I don't want to let my friend down, so despite the miserable weather (and with a lot muttering and whining), I go running. Afterward, I feel very pleased with the achievement—an achievement I would not have made had it not been for my commitment to another person.

I help contractors identify what they expect to get from a mentor, then we look into finding one from among the people they know. I get them to buy into the process by focusing on the outcomes they will achieve, and reminding them that many of the top 25% of contractors are doing just this.

What about peer groups?

I've written before about the loneliness small business owners feel, and how hard it is for them to discuss their issues and concerns with others. With the exception of their competitors—who aren't a practical choice, for obvious reasons—it is difficult to find people who really understand what they are going through.

One option that has been around for many years—and too few contractors exploit—is to join/form a peer group, of which there are numerous variations.

Fundamentally, a peer group consists of non-competing businesses of similar size, usually separated by geography, doing a similar type of work. (And, hey... having at least one of them located in a warm climate with a good golf course nearby doesn't hurt.)

A peer group model I particularly like involves four to eight member companies that meet about every two to three months at each other's place of business (rotating basis) for about three days. The meeting focuses on issues that are important to each member, but really serves as an audit of the host business.

Each company prepares a binder for its own business and, over a two- to three-year period, completes the binder. There would be sections in the binder for all the major areas of the business:

- Sales/estimating/marketing
- Finance and administration
- Human resources
- Operations
- Succession planning

During the three-day visit, peer group members audit the way the host business operates, write individual reports, then share their findings with the group. During this time, previous host companies report on progress from their own audits. Obviously, there has to be a strong sense of accountability, fellowship and commitment.

Ways of getting into/forming a peer group include talking to major suppliers about the idea or raising it at association meetings. I urge you to join a peer group. Find out whether any appropriate peer groups exist and, provided it is a good fit, whether it is possible to join. If not, form your own.

I think you'll agree, commitments to others are far more effective than commitments to ourselves.

The takeaways

- Consider how committing to a mentor could increase your chances of success.
- Would you consider starting or joining a peer group? EB

Ron Coleman, a member of the Institute of Certified Management Consultants of British Columbia, just published his latest book, "Building Your Legacy: Lessons for Success from the Contracting Community", which teaches you how to make more money while having more fun. A noted speaker, he has completed many interfirm financial comparisons of groups of construction companies in Canada and the United States. Ron's numerous published education programs include a 36-hour business management course specifically designed for the Electrical Contractors Association of British Columbia (ECABC). Visit www.ronaldcoleman.ca.

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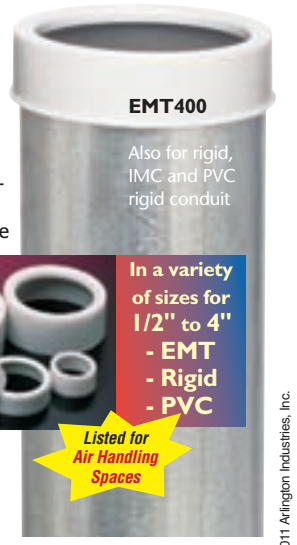

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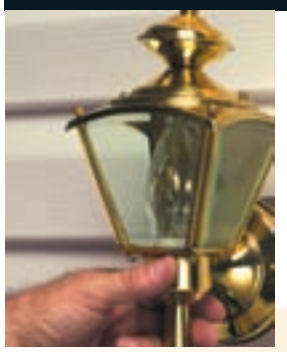

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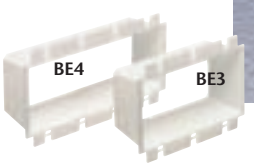

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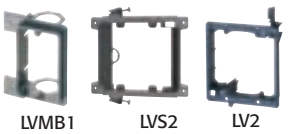

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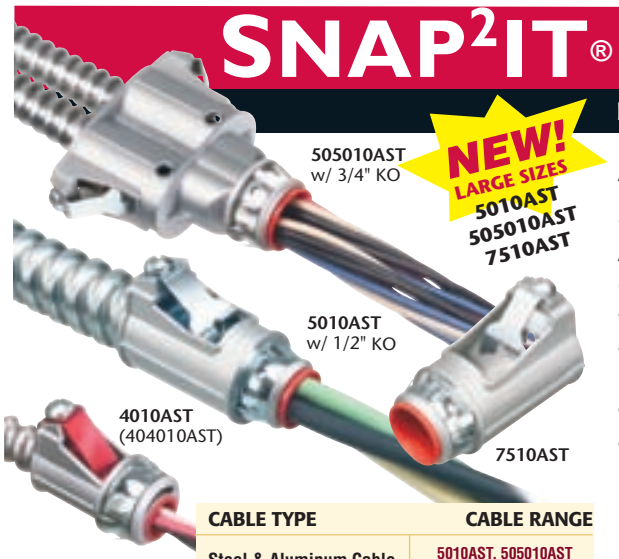

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FIGURE 1

SUBSTATIONS: the great multi-taskers

David Herres

Thomas Edison's early electrical distribution system was DC-based, so long-distance power transmission was not an easy option. Consequently, builders implemented a network consisting of many local generating stations whereby long-distance power transmission would not be required.

It wasn't long before George Westinghouse and Nikola Tesla prevailed and three-phase AC became the norm. Stepped-up voltages made long-distance power transmission possible, and the concept of a large number of local generating stations became obsolete. The existing real estate was still needed, however, for much-less expensive, high-capacity transformers (which had no moving parts) and associated switchgear.

These installations became known as substations, and they are widely used today. Outdoor, above-ground electrical substations are a familiar sight throughout the world. They vary greatly in size and appearance, but share a number of characteristics based on the fact that enormous amounts of power and high voltage levels are present.

Substations are great multi-taskers. They perform several functions simultaneously, and the focus must always be on safety and reliability (Figure 1). An electrical substation, a key component of the generation, transmission and distribution system, performs one or more—quite frequently, all—of these functions:

Transformation

A prominent part of any substation where voltage levels are changed is one or more transformers. These are usually three-phase, sometimes in an array consisting of three (or, in the case of an open delta, two) single-phase units. It is instructive to stand outside the enclosure and see whether you can trace the wiring. Look for a large, overhead three-phase line coming in, and one or more outgoing transmission lines, characterized by three hot conductors at the highest level with a neutral lower down. Relative voltages may be ascertained by observing the size of the insulators, height of the conductors above grade, and construction of the poles or towers.

Short-circuit and overload current protection

This generally consists of large, very expensive circuit breakers. Recloser breakers and fuses are also possibilities. The basic principle is the same as in branch-circuit overcurrent protection in a dwelling but, in actual practice, these units are far more robust and incorporate additional features, such as elaborate means for extinguishing the arc,

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FIGURE 2

a conductive path through ionized gas that would prevent opening a faulted circuit or cause extensive damage in the process.

Circuit breakers may be dead tank or live tank. Dead tank breakers involve a grounded metal enclosure whereas live tank breakers, as the name implies, are at line potential and, as such, must be mounted on insulators. The live tank version requires less insulating oil since insulating the mechanism from a grounded enclosure is not part of the picture.

Switching

It is essential that individual substation loads and equipment can be de-energized and isolated for maintenance and repair while the rest of the substation remains online. This is important so that large numbers of customers do not experience a widespread outage. It is also essential that disconnect and lockout procedures be absolutely failsafe so that workers are not endangered by the awesome voltages and available fault currents that could be present in the event of equipment failure or human error.

A hundred year ago, manually operated knife switches were capable of interrupting the substantially lower voltages then in use. Rising voltage levels made that simple device obsolete in substations, except for isolating previously de-energized circuits. As mentioned earlier in connection with breakers, the problem is the arc. As contacts are separated and drawn apart, current travels through the air, causing ionization. This makes the air more conductive, allowing the arc to persist. In the case of a breaker, the end result would be that it would fail to perform its protective function, and/or it would be destroyed.

Numerous strategies have been implemented to extinguish the arc. These include oil-filled breakers, gas-filled breakers (sulpfur hexafluoride, which is 2.5 times more resistive than air), metal plates or arc chutes, magnetic blowout coils, and compressed air to blow out the arc. Besides arc suppression, breakers and switches must be built to withstand the working voltage, anticipated surge voltage and available fault current.

Metering

This is a vital process within any electrical distribution system. It comes into play when operators have to deal with a flicker problem, or when load balancing is an issue. In recent years, customer loads have become increasingly non-linear as a result of a higher proportion of solid-state equipment in addition to the traditional motor and inductive lighting loads. This usage translates into increased, sometimes unexpected, harmonics and heating of neutral conductors. The first step in dealing with this problem is to step into an information-gathering mode, and that is where metering comes in. And this metering will, for the most part, take place within the substation.

Lightning protection

Our understanding of lightning is far from complete. The precise mechanisms for appearance of charge centres within clouds and ultimate charge separation and deployment of electrical energy in the form of lightning events are vast areas that are subjects of ongoing research. Efforts to mitigate the harmful effects of lightning have been to a large extent successful, but damaging events still occur, especially in areas of high earth resistivity.

The danger in a substation is that insulation flashover will take place. The result can be major damage to substation equipment and even total outage. The remedy is to install direct stroke shielding and surge arrestors. Lightning phenomena can appear in many unexpected and bizarre manifestations. This is due to the high voltage and very fast rise time of the waveform, which causes it to act like a high-frequency current, punching through conventional insulation and derailing at a bend in a conductor due to increased inductive reactance.

Capacitors

Their primary purpose is for power factor correction. Shunt capacitors are placed online during times of peak usage. Series capacitors serve to improve power transferability and are protected by extensive switching capability, by-pass circuit breakers and protective spark gaps.

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Other parameters

Besides voltage level, other electrical parameters within the system may need to be changed, and these changes are accomplished within the substation. Frequency standards (50 Hz, 60 Hz) vary in different localities, and a DC-AC or AC-DC conversion may be necessary due to transmission requirements. These changes take place within the substation and considerable infrastructure is required.

Voltage regulation, lighting, alarm, communication and other functions have a place within the substation. Everything must be organized and documented so that maintenance and upgrades can be planned and executed efficiently.

Grounding is key

For all these functions, extensive grounding is essential. The grounding electrode system in a substation serves more than one purpose, and it may take a variety of forms. The ground electrode system serving a substation will conform to a design that is based on size and layout of the facility, type of equipment (including voltage level and available fault current) and, above all, soil characteristics—which include moisture content and soil type.

It is necessary to perform extensive soil testing before arriving at a design. Moisture content will vary seasonally and from year to year, depending upon rainfall, so a statistical analysis must be performed based upon historical data. Moreover, the soil profile is likely to vary both vertically and, to a lesser extent, horizontally. Sophisticated equipment and extensive training are necessary to ensure the information compiled will be accurate and relevant so that a reliable design can be generated.

The final form of the grounding electrode system could be a mat made of intersecting 4/0 AWG bare copper conductors 0.5 metres below grade, spaced six metres apart, bonded at intersections and extending outside the fence, which would also be bonded to the grid. Ground rods would be placed at corners and throughout the grid.

In the event of a lightning strike or major line to ground fault, considerable electrical energy would be dumped into the ground, and an individual standing outside the fence could be electrocuted because of differential ground potentials. Similarly, the fence itself could be energized. Intense redundant grounding and low-impedance grounding electrode conductors help prevent these hazards. In all cases, the fence itself needs robust grounding, well beyond the metal posts set in concrete in the ground.

Substation layout and monitoring

There are many variations in layout, structure and purpose. Substations are usually thought of as locations where voltage is stepped down, as distribution approaches the neighbourhood of the end user. However, a substation may have step-up transformers when it is located adjacent to a generating station. These are seen at wind farms and hydro-electric installations that are located some distance from the point of use, where higher voltages are necessary for long-distance power transmission. There are also in-line substations where there is no change in voltage level and, therefore, no transformers (except for bucking units that are intended to compensate for line loss).

Most electrical substations are utility owned and operated but, in some instances, the customer owns the substation, as in a large industrial complex where electrical power usage is substantial.

Electrical substations are, for the most part, unattended by onsite technicians. Monitoring and control are accomplished from a distance. It is possible for an individual or small crew to monitor more than one substation from a central location and control its operation electronically or dispatch maintenance and repair persons as needed. Advanced systems provide continuous monitoring and are able to report operating details such as distance to a fault and power system harmonic levels.

SCADA (supervisory control and data acquisition) is definitely the protocol of choice for all of this. It is applicable for many industrial processes, including water treatment, gas and oil pipelines and refineries, wind farms, airports and others. SCADA is very well suited for electrical substation monitoring and control. It includes an advanced human-machine interface (HMI). Programmable logic controllers (PLCs) and remote terminal units (RTUs) control and monitor the facility. They are connected to a computer via radio, telephone, optical fiber, internet, hardwire or other means.

Various SCADA-based software programs are available and any of these may be installed at the monitoring site computer(s). Highly readable, user-friendly graphic displays organize and display the information and control options that are available. Often, appropriate actions may be taken without dispatching human technicians. When it becomes necessary to send workers to the site, they can be prepared and equipped with the tools and supplies necessary to make any repairs or upgrades that may be needed. This procedure is far more economical than having paid workers at each site. Notwithstanding, it is common practice to have a substation located on the same property as a utility warehouse or shop used by the line crew.

Data can be acquired when the substation is polled, or it may come unsolicited. This is a great feature and an important step forward for substation managers because, for many types of faults, time is of the essence in preventing extensive damage. Moreover, SCADA is capable of being configured to be self-testing so that any internal errors will be reported.

In terms of sophistication and supervisory capability, SCADA, along with associated hardware, resembles a large fire alarm system in that both are optimized for failsafe operation and remote monitoring. Both play key roles in our society in promoting human safety and minimizing physical damage to valuable property.

The heart of the monitoring system is a single computer, plus a second computer for redundancy. These machines should be replaced before they get too much age on them, in the interest of reliability. They should be equipped with high-end UPSs (uninterruptible power supplies) with new batteries. The entire facility should have reliable back-up power, preferably diesel. When internet is the means of communication between monitoring facility and substation, consider having more than one internet provider, perhaps one on broadband and one via satellite (Figure 2). The bottom line is you can't afford an outage or any possibility of downtime. EB

A regular contributor to Electrical Business, David Herres is a Master electrician and author of nearly 40 articles on electrical and telecom wiring. He recently authored "2011 National Electrical Code: Chapter-by-Chapter", published by McGraw-Hill and available at Amazon.com.

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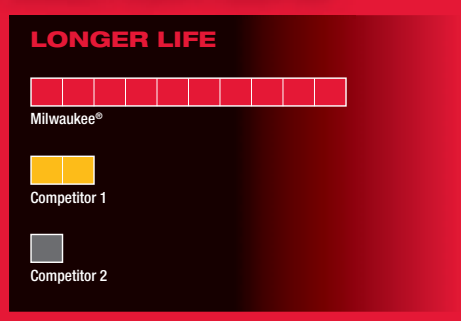

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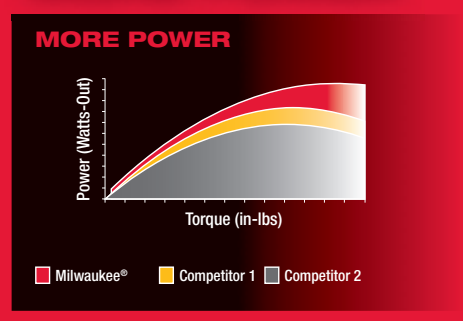

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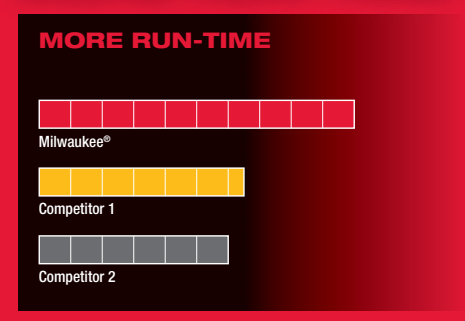

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CSA has your back with renewables

The new Canadian Electrical Code addresses renewable energy applications

With the increased interest in energy generated from renewable sources such as wind and solar, it is important to have established safe practices for installation and maintenance personnel, and to help ensure optimum performance of installed equipment.

The expanding markets for renewable energy systems has also led to a need for electrical safety requirements to ensure public safety and provide a level regulatory playing field for installers and manufacturers.

Revisions to the new 2012 Canadian Electrical Code (CEC) Part I, respond to this market need through the addition of Section 64 "Renewable Energy Systems" and the adoption of required revisions to Section 50 "Solar Photovoltaic Systems". Stakeholders that have developed these requirements for renewable energy for use in Canada are recognized international professionals, including engineers, manufacturers, regulators, utilities, project developers, insurers and academics.

The foundation of the Canadian electrical safety system rests on the installation requirements in CEC-Part I, product safety requirements in the CEC-Part II series of standards, and enforcement of CEC-Part I through adoption as regulation.

In CEC-Part 1, the newly developed Section 64 was formulated through extensive research of existing international documents, and the results reflect the principles of global standards and industry practice. They also address the unique installation requirements for a variety of renewable energy systems including wind, hydrokinetic, micro-hydro and fuel cell systems for Canada.

Through major updates to Section 50 and the addition of Section 64, the 2012 CEC-Part 1 covers electrical installation requirements for renewable energy systems, including off-grid and utility-connected systems.

The new requirements for renewable energy systems cover 15 pages in the 2012 CEC-Part 1, and apply to all types of occupancies, including residential, commercial and industrial establishments. Among the many new requirements contained in Section 64 are requirements for the grounding of renewable energy systems, disconnection means, and the installation and connection of storage batteries.

While Section 64 covers many new technologies, requirements for solar photovoltaic systems in Section 50 have been substantially updated to reflect many technology-specific requirements, including new cabling and connection products, marking requirements, details about permissible voltage drop, safety devices, installation practices, and voltage/current temperature correction calculations.

In support of the new installation rules in CEC-Part I, there is also a great deal of activity in the CEC-Part II series of standards for electrical product safety. New standards are

either under development or have already been published to address a wide variety of new technologies in the PV industry, including purpose-built PV cables, arc fault protection, connectors, combiner boxes and other related electrical products.

In addition to the modifications to CEC Parts I and II, CSA Group has published standards for the wind energy industry that provide requirements for the design, power performance, acoustic noise measurement and lightning protection for wind turbines, along with design requirements for offshore wind turbines.

CSA Group is also currently working with many expert technical committees to adopt existing IEC Wind Energy Standards as National Standards of Canada, and to develop new standards that meet Canadian requirements for the wind industry. Furthermore, CSA Group is in the process of developing PV rooftop installation best practice guidelines for rooftop projects.

Additionally, CSA Group offers training and supporting products to help users understand and apply the over 180 key changes and updates in the 2012 CEC, including: CE Code Update Training in workshop, online or onsite formats; the 2012 CEC Handbook; and the 2012 CEC Calculators. CSA Group provides a range of other electrical-based specialty training, including Installation and Maintenance of Renewable Energy Systems and PV Installation and Safety Requirements.

A word about the 2012 Canadian Electrical Code

Developed by committees of experts representing a spectrum of industry stakeholders from across Canada, the Canadian Electrical Code-Part I is published on a three-year cycle, and adopted as regulation in all provinces and territories. The 22nd edition of the code was published in January 2012 and features over 180 major changes, in addition to the new Section 64. EB

Tim Pope, CET, is a senior project manager in the electrical standards program at CSA, and is responsible for the Canadian Electrical Code, Part I. CSA Group is an independent, not-for-profit membership association dedicated to safety, social good and sustainability. Visit www.csagroup.org.

Forget propane... Let's talk about natural gas-powered vehicles

I was just reading my April edition of Electrical Business and came across an ad appearing to be a story about the benefits of propane vehicles fuelled by Roush (p. 11). Thought I would give you a better story to tell: natural gas for vehicles, Canada's best-kept secret.

I have been driving my service vans for 12 years with it, and have nothing but good to say. I am a huge fan. I fill up at home and it costs me 10% or possibly less than the price of gasoline.

Union Gas in Southern Ontario used to have a whole distribution and conversion system back before 1985 but, unfortunately, let it go and took out all but a few stations and kind of got out of the business.

But that was when gasoline was 50 cents a litre. Get the word out... do a story on natural gas vehicles.

— *Kevin W., Wallaceburg, Ont.*

Reversing motors easier than you think

I would like to bring to your attention some misinformation in the article "The joy of three-phase wiring" by David Herres (April 2012, p. 16). On page 18 he states "A reversible single-phase motor must have separate clockwise and counter-clockwise windings, with separate switchable power to each of these, making for a more costly installation."

This is wrong. Most single-phase motors are easily reversible by interchanging the leads going to the starting winding. In fact, a lot of single-phase motors have the start winding leads brought out to the terminal box for ease of interchanging, and the connections are shown on the motor nameplate.

Alternately, by installing a double-pole, double-throw switch—with the outputs cross-connected in the start winding leads—a single-phase motor can be reversed whenever it is needed, remembering that the motor must be stopped before reversing rotation.

— *Ken T., Red Deer, Alta.*

Oils well that ends well?

Just received your latest edition of the magazine; always a good read. Just wanted to point something out in your article "The joy of three-phase wiring" (April 2012, p.16). The photo used on page 16 is actually a bank of three oil circuit reclosers, and not a bank of single-phase transformers.

— *Greg W., Mississauga, Ont.*

When you get it wrong, everyone notices

I just received the April issue of EB and, when I opened it, I nearly fell off my chair. On the front page you have the headline "Know your ladder" (April 2012, p. 1), and what do I see but a worker apparently climbing an extension ladder that is set up backward! I could not believe my eyes!

Thinking that this may be shown as what *not to do*, I went to the story on page 14 and, again, what do I see, another worker standing on the extension ladder that is also set up backward. I then noticed a footnote after the article saying "Submitted by the American Ladder Institute... dedicated to the proper selection, use and care of ladders". It appears that you need to look for another source of safety information regarding the proper use of ladders.

I am sure mine will not be the only e-mail you receive on this.

— Larry S., Oakville, Ont.

For being the first to notify us that we got something wrong—and to put things right—we shipped Larry S. a new Milwaukee M12 hammer drill valued at $230, courtesy of our friends at Milwaukee Tool (www.milwaukeetool.com).

Speaking of Larry, he was correct in saying that his would not be the only email we receive on this ladder issue. We also heard from:

- *Albert W., Hamilton, Ont.*
- *Bert G., Vernon, B.C.*
- *Darcey N., Richmond, B.C.*
- *Don K., Red Deer, Alta.*
- *Don L., Victoria, B.C.*
- *Erich M. (retired)*
- *Gary M., Winnipeg, Man.*
- *Glen C., Enderby, B.C.*
- *Lindsay B., Sherwood Park, Alta.*
- *Marty R., Thunder Bay, Ont.*
- *Michael L., Welland, Ont.*
- *R.P., Marystown, N.L.*
- *Stan S., Spruce Grove, Alta.*

... among others. Thanks to all of you for reading Electrical Business and being so passionate about getting things right, and for holding us to a higher standard. Meantime, all Letters to the Editor should be sent to Anthony Capkun, acapkun@annexweb.com. EB

IS A UPS ALSO A POWER CONDITIONER?

Power protection devices have traditionally fit neatly into one of two categories: those that alter, change or otherwise control the character of electricity; and those that provide an alternate or secondary source of power in the event of the failure of the primary source.

Products in the first group include surge protectors, filters, voltage regulator, power conditioners and others. The amount of protection varies from device to device.

The operational requirements of LAN systems—along with an emphasis on protecting data, software and processes—have created a significant level of interest in the uninterruptible power supply (UPS) products that fall into the second group. While it is possible for a UPS to also function as a power conditioner, such capabilities cannot automatically be assumed.

Indeed, along with the rapid growth in the number of UPS suppliers, the industry has seen the distinction between a UPS and a power conditioner become too poorly defined. What does the user of these devices need to know to intelligently and properly protect a system?

Myth versus reality

The best place to start is by highlighting several of the most common misconceptions concerning UPS products:

1. UPS provides total power conditioning.
2. For total power conditioning, an online UPS (as opposed to a standby design) must be used.
3. Standby UPS systems are undesirable because they only become active when power is lost.

Much has been said and written in the battle between different UPS technologies. It is important to recognize that, today, most UPSs are used in applications where the system is powered by a switch-mode power supply. These power supplies make computer systems very tolerant of both voltage variations and short duration (5-20 millisecond) power losses. The fact is systems powered by switch-mode supplies (and that's most systems today) are perfectly compatible with standby UPS designs.

Equally inaccurate is the assumption that, because of its inverter design, an online UPS provides superior power conditioning to a standby UPS. It is true that online UPS systems provide excellent normal-mode protection (between line and neutral). Normal-mode protection, however, is only one part of the power conditioning picture (Figure 1).

The switch-mode supply is a significant improvement in electronic system design for a number of reasons. Not only does it make system more tolerant to voltage variations, but it is also smaller, lighter, more efficient, and quite a bit cheaper to produce.

All these advantages come with a price tag, however. The predecessor to the switch-mode supply was the linear supply. It was characterized by a step-down isolation transformer on the input side. Elimination of the transformer in switch-mode designs accounts for most of the physical and economic advantages (Figure 2). However, it also results in a distinct operation disadvantage; that is, the loss of common-mode (neutral-to-ground) noise immunity for the system.

Modern microprocessor system use electrical ground as a signal reference when making logic transitions, and for the proper exchange of data between systems and peripherals. For reliable operation, ultra-quiet ground reference is a necessity. Common-mode disturbances disrupt this clean signal reference. Such disturbances can only be eliminated with an isolation transformer.

It is important to recognize that a UPS—any UPS—should include an isolation transformer in it output circuit. Without it, the UPS cannot qualify as a power conditioner because it will not be capable of protecting the attached computer system from common-mode noise (Figure 3).

There is a proliferation of UPS systems available in the marketplace that do not contain all the elements necessary to provide complete protection to the sensitive electronic load. This is true for both online as well as standby designs. Examples abound of both types of UPS designs that fail to incorporate an isolation transformer as the final stage of their construction.

A final caveat

An often-overlooked factor when selecting UPS products is the inverter design. The UPS inverter is that part of the UPS that changes DC power from the batteries into AC power for use by an electronic load. A variety of inverter designs exist: these include sine wave, square wave, pseudo wave, rectangular wave and modified sine/square wave.

Electronics normally run on sine wave power. This is the kind generated and delivered by the power company the office or home. Building a sine wave inverter is time-consuming and costly and, as a result, many manufacturers produce systems that do not provide sine wave power when on batteries.

There are many claims concerning the compatibility of non-sine wave designs with switch-mode supplies. It is true that switch mode supplies will run on non-sine wave inverters; however, all non-sine wave inverters generate substantial noise and impulse activity that has been demonstrated to cause observable problems for sensitive systems. Sine wave inverters are far preferable to any other design.

When considering a UPS, here are the real issues:

1 Are you buying a UPS because you need power protection or backup power? When the answer is power protection, a power conditioner that includes a surge diverter, noise filter and an isolation transformer is a better choice. It will do an excellent job of protecting your system at a lower initial cost and while saving the later expense of replacing batteries.

2 When you really need both power protection and backup power, it is highly likely that a standby UPS will be adequate for your application. Make sure, however, that its design includes a surge diverter, powerline filter and isolation transformer. Should you purchase UPS (or already own one) with these elements, it is possible to add a power conditioner to the UPS to complete the power protection solution.

3 When your application requires an online UPS, or when peace of mind is worth the extra money, you must still make sure the unit contains an isolation transformer. Many do not, and you may spend a great deal and still not get the protection you really need. Power conditioners can also be used to improve the performance of online systems.

4 Make the right waveform choice. It is attractive to save money at the purchase stage, but this often results in hidden costs later. Don't economize on UPS inverter design. Use sign wave UPS products instead of other less expensive designs. EB

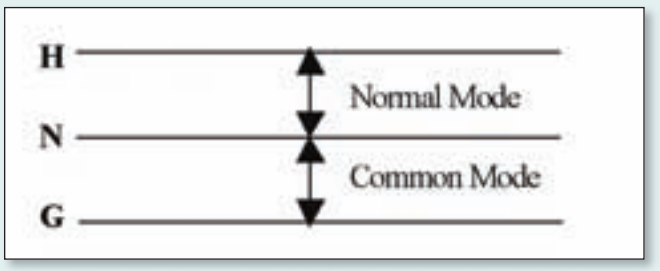

FIGURE 1
Mode of entry

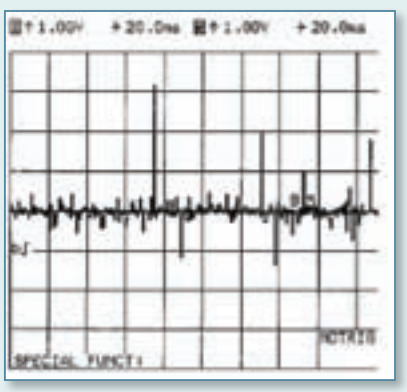

FIGURE 2
UPS Output no isolation

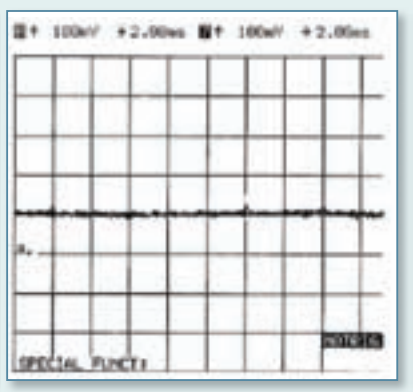

FIGURE 3
UPS Output with isolation

This article based on a white paper submitted by PowerVar (www.powervar.com).

Evaluation of onset to second-degree burn energy in ARC FLASH HAZARD ANALYSIS

Michael Furtak and Lew Silecky

Our interest in determining accurate onset to second-degree burn energy and its significance in computing the arc flash boundary is focused on the prevention of injury to the skin of a human who might be exposed to an arc flash.

During the last two decades, different formulas have been proposed to calculate incident energy at an assumed working distance, and the arc flash boundary to determine arc-rated personal protective equipment (PPE) for qualified electrical workers.

Among others, IEEE P1584 "Guide for Performing Arc-Flash Hazard Calculations" and formulas provided in Annex D of NFPA 70E "Standard for Electrical Safety in the Workplace", and CSA Z462 "Workplace Electrical Safety Standard" are the most often used in the industry to perform arc flash hazard analysis. The formulas are based on incident energy testing performed and calculations conducted for a selected range of prospective fault currents, system voltages, physical configurations, etc.

Use of incident energy as a measure of burn severity in arc flash boundary calculations

IEEE P1584 was developed by having incident energy testing performed based on methodology described in ASTM F1959 "Standard Test Method for Determining the Arc Thermal Performance Value of Materials for Clothing". The incident energy to which a worker's face and chest could be exposed at working distance during an electrical arc event was selected as a measure for determining hazard risk category and calculating the arc flash boundary.

The incident energy of 1.2 cal/cm^2 (5 J/cm^2) for bare skin was selected in solving the equation for the arc flash boundary in IEEE P1584. Also, NFPA 70E states: "a second-degree burn is possible by an exposure of unprotected skin to an electric arc flash above the incident energy level of 1.2 cal/cm^2 (5 J/cm^2)", and assumes 1.2 cal/cm^2 as a threshold incident energy level for a second-degree burn for systems 50 volts and greater. The IEEE 1584 Guide states: "the incident energy that will cause a just-curable burn or a second-degree burn is 1.2 cal/cm^2 (5 J/cm^2)".

To better understand these units, IEEE P1584 refers to an example of a butane lighter:

If a butane lighter is held 1-cm away from a person's finger for one second, and the finger is in the blue flame, a square centimetre area of the finger will be exposed to about 5.0 J/cm^2 or 1.2 cal/cm^2.

However, IEEE P1584 equations 5.8 and 5.9 for determining the arc flash boundary can also be solved with other incident energy levels as well, such as the rating of proposed PPE. The important point to note here is that threshold incident energy level for a second-degree burn or onset to second-degree burn energy on bare skin is considered constant value equal to 1.2 cal/ cm^2 (5 J/ cm^2) in IEEE P1584.

Flash fire burn experimentations and observations

Much of the research that led to equations to predict skin burns was started during or immediately after World War II. To protect people from fires, atomic bomb blasts and other thermal threats, it was first necessary to understand the effects of thermal trauma on the skin (e.g. work done by Alice M. Stoll, J.B. Perkins, H.E. Pease, H.D. Kingsley and Wordie H. Parr).

Tests were performed on a large number of anaesthetized pigs and rats exposed directly to fire. Some tests were also performed on human volunteers on the fronts of the thorax and forearms. A variety of studies on thermal effects have been performed and thermal thresholds were identified for different degree burns. We will focus on second-degree burn, as this is the kind of burn used to determine the arc flash boundary in engineering arc flash analysis studies.

Alice Stoll pursued the basic concept that burn injury is ultimately related to skin tissue temperature elevation for a sufficient time. Stoll and associates performed experimental research to determine the time it takes for second-degree burn damage to occur for a given heat flux exposure. Stoll showed that, regardless of the mode of heat application, the temperature rise and, therefore, the tolerance time is related to heat absorbed by the skin. Results of this study are represented in Figure 1 (Line A), along with other studies.

TABLE 1

A	B	C	D	E	F	G	H	I
Available 3 phase SC Current	Arcing Current	Arc Duration	Incident Energy @ 20inches	Onset to second degree burn	AFB	Heat Flux	Onset to second degree burn evaluated from Equation 2	AFB
kA	kA	sec	Eb, cal/cm^2	Eb, cal/cm^2	inches	cal/cm^2/sec	Eb, cal/cm^2	inches
1	0.94	1	2.1	1.2	29	2.1	1.2	29
10	7.84	0.1	2.1	1.2	29	21	0.6	47
100	65.2	0.01	2.1	1.2	29	210	0.3	74

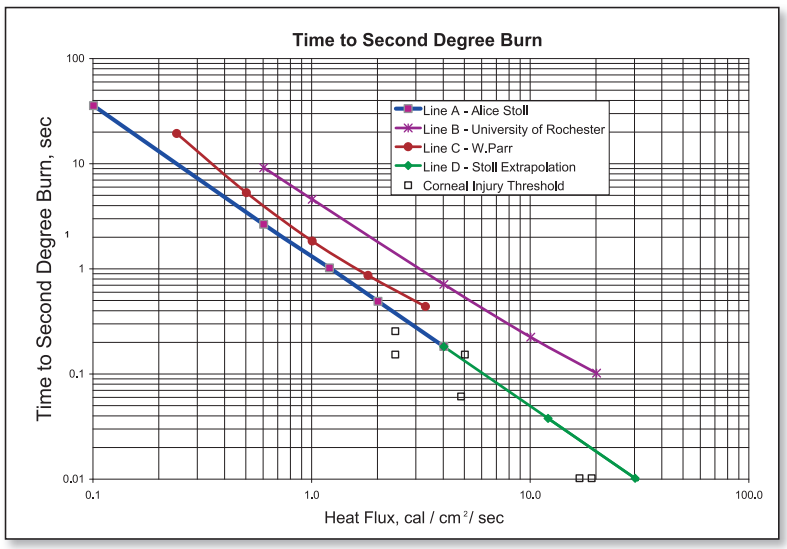

FIGURE 1
Stoll criterion time to second-degree burn for various incident heat fluxes on bare human skin.

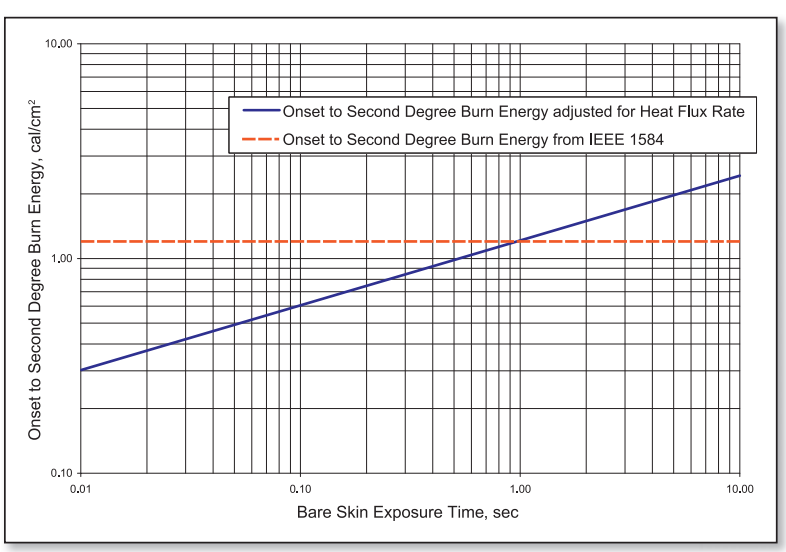

FIGURE 2
Threshold incident energy for a second-degree burn versus exposure time.

Stoll found that the results from her experiments could be predicted using Henriques' burn integral. Henriques and Moritz were the first to describe skin damage as a chemical rate process and show that first order Arrhenius rate equation could be used to determine the rate of tissue damage.

In 1952, Perkins, Pease and Kingsley of the University of Rochester investigated the relation of intensity of applied thermal energy to the severity of flash fire burns. Comparing results of this study with those of Alice Stoll shows that a larger amount of energy is required to induce second-degree burn. (See Figure 1, Line B).

Figure 1 (Line C) shows second-degree burn threshold as reported by Wordie H. Parr. The results were obtained by exposing skin to laser radiation and determining the dose-response relationship for producing different grades of burns. Figure 1 shows the Parr curve lies between those proposed by Stoll and those by the University of Rochester.

The explanation for these second-degree burn threshold differences could be interpreted by the fact that thermal injury depends on energy absorbed per unit volume or mass to produce a critical temperature elevation. Skin reflectance and penetration greatly influence this absorption. Also, heat conduction in tissue is far more efficient for smaller than for larger irradiated areas, and exposure to higher levels of irradiance would be possible before injury occurred. Indeed, with extensive irradiation, injury would occur at far lower level of irradiance.

After reviewing these three studies, it was concluded that the curve presented by Stoll is most suitable for evaluating the type of burn hazard expected with arc flash. Stoll's study is a good choice because it is more conservative than the other two studies and, therefore, minimizes cases where the burn severity for a specific thermal flux exceeds the associated degree of burn, and is less open to criticism.

Figure 1 also includes an arrangement of onset to corneal injury thresholds from CO2 laser radiation (See square markers on Figure 1). The data follows the trend similar to that observed by Stoll and others. The range of scatter in the data is thought to be mainly due to the use of different corneal image sizes.

Stoll's results can be theoretically extended to include heat flux rates over 40cal/cm^2/sec experimentally observed, and are represented by Figure 1 (Line D). The observed and extrapolated data lines A and D can be expressed analytically as:

$$t = 1.3 \cdot H^{-1.43}$$

WHERE
t = time to second-degree burn in seconds
H = heat flux in cal/cm^2/sec

Using Equation 1, the projected time to second-degree burn at a heat flux rate of 2 cal/cm^2/sec is about 0.5 seconds. During this time interval, the skin would be exposed to a total of 1 cal/cm^2 incident energy (2 cal/cm^2/sec x 0.5 sec = 1 cal/cm^2). At 30 cal/cm^2/sec flux, the time to second-degree burn is equal to 0.01 seconds, resulting in only 0.3 cal/cm^2 incident energy exposure, yet inducing the same burn severity as the former, less intense and longer=lasting exposure.

Discussion and conclusion

Our understanding of the burn mechanism is neither perfect nor complete, but it is sufficient for the practical purposes concerned here. The important point from Figure 1 and Equation 1 is that the degree of burn injury depends not only (and, in fact, not as much) on the total dose of energy received by the skin, but by the rate at which the energy is received.

The concept of the destructiveness of rapid heat liberation is not new, and is widely used in many industrial and military applications. Apart from the total amount of heat released during an arc flash event, it is the high heat flux rate that causes the gaseous products of arc flash to expand and potentially generate high pressures similar to most explosive reactions. This rapid generation of high pressures of the released gas constitutes the explosion. The liberation of heat with insufficient rapidity will not cause an explosion. For example, although a kilogram of coal yields five times as much heat as a kilogram of nitroglycerin, the coal cannot be used as an explosive because of how slowly it yields this heat.

Figure 2 shows onset to second-degree burn energy threshold adjusted for heat flux rate as a function of exposure time. The onset to second-degree burn energy threshold was calculated as a product of heat flux rate and time to second-degree burn as per the Stoll data from Figure 1 (Lines A and D).

Figure 2 demonstrates that the threshold energy for a second-degree burn injury is not a constant but rather a variable. Note that the 1.2 cal/cm^2 onset to second-degree burn energy for bare skin used in IEEE P1584, NFPA 70E and CSA Z462 (dashed line on Figure 2) intersects with the curve produced using the

Stoll data at the 1-sec mark. This observation supports the choice of Stoll's curve that we made for evaluating the type of burn hazard expected with an arc flash.

For exposures lasting less than 1 second, the irradiance required for an injury would significantly increase as the duration of exposure decreased. However, the amount of incident energy required to cause a second-degree burn would decrease. Equation 2 is an analytical expression for the threshold line represented by Figure 2:

$$E_b = 1.2 \cdot t^{0.3}$$

WHERE
t = exposure time in seconds
E_b = threshold incident energy in cal/cm^2 that needs to be released during the exposure time (t) to cause a second-degree burn

Using Equation 2, consider 1kA, 10kA and 100kA faults in 600V grounded switchgear with a 1-in. gap between conductors. Table 1 summarizes arcing current, incident energy and the arc flash boundary (AFB) predicted using IEEE P1584 Empirical Model. We deliberately assigned arc duration to 1 s, 0.1 s and 0.01 s for the 1kA, 10kA and 100kA faults, respectively, which is consistent with the inverse nature of typical protective device time-current characteristics.

Column F lists AFB values calculated using 1.2 cal/cm^2 onset to second-degree burn incident energy recommended by the IEEE P1584 Guide. Column I lists AFB values calculated using onset to second-degree burn energy evaluated from Equation 2 and published in column H.

Note that the amount of incident energy the person would be exposed to remains the same and equal to 2.1 cal/cm^2 in all three instances (Column D). The arc flash boundary also remains the same when incident energy at AFB is assigned 1.2 cal/cm^2 value onset to second-degree burn energy as recommended in IEEE P1584. Therefore, applying the same onset to second-degree burn energy for the above fault scenarios would make them appear to be of same severity. However, the arc flash boundary drastically changes when incident energy at AFB is being evaluated using Equation 2. AFB will now increase with an increase of the available fault current, predicted arcing current and heat flux released by an arc.

Therefore, using onset to second-degree burn energy for bare skin exposure fixed to 1.2 cal/cm^2 in calculating the arc flash boundary for arc durations other than 1 second is, as far as we are concerned, open to dispute and, in our strong opinion, heat flux rate should be factored when estimating skin damage imposed by an arc flash.

Using the 1.2 cal/cm^2 energy for exposure times less than 1 second will result in undervalued arc flash boundaries while resulting in conservative but safe arc flash boundaries for exposure times greater than 1 second.

As per the IEEE 1584 Guide, the equations 5.8 and 5.9 can be used to calculate the arc flash boundaries with boundary energy other than 1.2 cal/cm^2, and we believe the equations should be, in fact, solved for boundary energy computed using Equation 2—especially for cased when arc duration is less than 1 second. EB

Michael Furtak is an application engineer, and Lew Silecky is manager, technical sales & marketing, with Mersen (Canada), formerly Ferraz Shawmut. Visit www.mersen.com.

RED SEAL: *making the grade*

Bryn Snow

You've completed trade school, your apprenticeship is behind you and you're ready to write for your Red Seal Certification (also commonly referred to as Certificate of Qualification, C of Q or your 'ticket'). You pick up your electrical code book and try to match up your practical experience with the legal words of the code. But all of the things you have learned while apprenticing are now lost in a sea of rules, exceptions and provisions. Either you don't know where to look, or the wording of the questions seems confusing.

Electrical students run into many difficulties with the Red Seal exams. Three of the most common problems they face are navigating through the electrical code, visualizing what's described, and managing their time during the exam.

Navigating the code is very complex, and it takes practice to find your way around. Electrical students are familiar with hands-on problems, but seeing them described in words can be confusing. Finally, time management is of the essence; even stellar students can fail in this department.

Navigating the code: where do I go?

Master electrician Marvin Rosenberg has met many struggling students while teaching courses for electricians at George Brown College. He understands why they regularly fail the Red Seal exam. Electricians need to find two things: the definitions of the words and the rules in the code that explain how these devices or systems may be used.

Sue Turner, director of publications for building materials publisher Orderline, says they receive regular phone calls from electrical students wondering where to turn next. Exam practice helps, she says. "Students need to sit down to the type of practice exam they will face for their certificate".

Rosenberg worked with Orderline to develop the Paperless line of C of Q Pre-Exam Workbooks for Domestic and Rural Electricians—as well as Construction and Maintenance Electricians—to help students practice these skills and strategies. The Paperless workbooks cover all applicable electrical code references with related study questions. Once a student has gained experience finding code references with the practice questions, they approach the exam with confidence.

Here's an example of a typical exam question:

A mast installed on a deep well submersible pumping station requires additional support when the mast sticks out into the air above the roofline ___ , and this additional support bracket shall be attached to a guy wire attached to an eyebolt which, in turn, is attached to the ___ .

When you know where term 'mast' is discussed in the electrical code, you can go there and, having read through the definitions, the accepted applications and the exceptions, you will more clearly understand what the exam question means.

Visualizing the problem

Electrical students often struggle to visualize the situation they read about in an exam question. Many learn more easily by taking something apart or putting it together with their hands, or seeing it rather than reading about it.

As a result, Rosenberg's study materials (practice exams, instructional books and self-study materials) include diagrams with his instructional material. He notes: "These students are hands-on learners. They need diagrams to help them understand the questions".

Time management and exam-writing strategies

What about exam-writing strategies? How, for example, do you allot your time on the Red Seal certification exam? Time management can challenge even the best electrical students. Rosenberg has developed exam writing strategies and tells students that it is not only what they know that matters, but whether they answer all the questions. Missed questions cost marks, so Rosenberg offers students tips on how to maximize their scores, even when they aren't sure on every single question.

Study material formats

Electricians are busy professionals needing training products that fit their schedules so, when seeking additional tutoring, look for a provider that offers courses and training products online, via CD or downloadable PDFs. This allows for the flexibility of learning at home. For students that find in-class courses do not offer enough time to review or absorb the material, online courses allow for extended access to the content while PDFs and CDs can be reviewed as often as needed.

Orderline, for example, carries a line of self-assessment tools in CD format for both Construction and Maintenance and Domestic and Rural exams. These tools are filled with sample questions and practice exams, enabling students to test themselves against the clock to better prepare for exam conditions. EB

Visit EBMag.com and click Calendar to see an extensive list of upcoming events.

IN CASE YOU MISSED IT...

GALLERY • ESFi Canada National Electrical Safety Summit 2012. Visit bit.ly/K7695x

VIDEO • EBMag attends Siemens Canada industrial control market launch. Visit bit.ly/Jb71s1

VIDEO • What would you do with over $100,000? Visit bit.ly/K76zc5

GALLERY • EBMag's exclusive tour at Cat's Indiana facility. Visit bit.ly/IkXTR2

VIDEO • Checking out the new Fluke 805. Visit bit.ly/K76t4n

Ridgid Reputation Roadshow 2012
Various Canadian dates/locations, May through August
Visit www.ridgid.com/roadshow

IED Annual General Meeting
Independent Electrical Distributors Limited Partnership II
June 11-14, Victoria, B.C.
Visit www.ied.ca
EB WILL BE THERE!

3rd Canadian Smart Grid Summit
June 12-13, Toronto, Ont.
Visit www.smartgridsummit.ca

ECABC, ECAO and CECA Conference
Canadian Electrical Contractors Association, and Electrical Contractors Associations of British Columbia and Ontario
June 13-17, Whistler, B.C.
Visit www.ceca.org
EB WILL BE THERE!

RETScreen Training Institute
June 19, Toronto, Ont. - 101: *Introduction to Clean Energy Project Analysis*
Other dates available in September, October, November, December
Visit bit.ly/yLxGtt

EASA Show
Electrical Apparatus Service Association
June 24-26, Nashville, Tenn.
Visit www.easa.com

BICSI Canadian Region meetings
Various dates/locations across Canada
Visit www.bicsi.org

SCHOLARSHIP APPLICATION DEADLINE!
Electro-Federation Canada Scholarship Program
July 1 (midnight)
Visit bit.ly/HRgWwy

ECAO IBEW Golf Tournament
Electrical Contractors Association of Ontario & IBEW Construction Council of Ontario
July 17, Milton, Ont.
Email michelle_esposito@ibewcco.org for details or to register

Ontario Energy Industry Sunnybrook Foundation Golf Tournament
Ontario Energy Network (OEN)
July 19, Gormley, Ont.
Visit bit.ly/Jln7HQ

CUEE 2012
Canadian Utilities Equipment & Engineering Show
September 11-12, Toronto, Ont.
Visit www.cuee.ca
EB WILL BE THERE!

IAEI Fall Convention
Canadian Section & Ontario Chapter, Int'l Assoc. of Electrical Inspectors
September 21-23, Toronto, Ont.
Visit www.iaeicdnconvention.org/fall.htm
EB WILL BE THERE!

CAEA Canadian Airports National Electrical Workshop (CANEW)
Canadian Airports Electrical Association
September 24-28, St. John's, N.L
Visit www.canew.ca/canew_2012.htm
EB WILL BE THERE!

Standard Products FlexLED 4" and 6" downlights

Standard Products claims its FlexLED 4" and 6" downlights provide exceptional light output that replicate the look of a traditional downlight but at a fraction of the energy and maintenance costs. Both 4" and 6" are offered in colour temperatures of 2700K and 3000K, and can be retrofit into a recessed downlight or surface mounted directly to a J-box.
STANDARD PRODUCTS
www.standardpro.com

Philips Lighting Controls launches information portal

Philips Lighting Controls has launched a new website dedicated to lighting control solutions. "Electrical contractors, facilities managers, lighting designers, engineers and other lighting professionals now have access to more information than ever," says the company. The Products page provides a high-level overview of the portfolio, while individual product pages have links to data sheets, drawings, installation guides and user manuals. Meantime, the Gallery features businesses around the world using products such as Dynalite, IGBT Dimming, etc.
PHILIPS LIGHTING CONTROLS
www.philipslightingcontrols.com

Lithonia Lighting 100 LPW LED luminaire

Acuity Brands has expanded the Lithonia Lighting VTLED indoor lighting series with new 100+ lumens per watt (LPW) luminaire. The 100+ LPW

luminaire is a new standard offering for VTLED 2' x 4' and 1' x 4' configurations.
New optional features, including 2.5 McAdams ellipses and L80 performance for up to 50,000 hours, are also available for the VTLED and RTLED product lines.
LITHONIA LIGHTING
www.lithonia.com

Ventes Electra Retrolum troffer retrofit solution

While at Le Salon Lumen in April, EBMag met Denis Ricard of Ventes Electra. We learned he has uploaded an installation video to YouTube for Retrolum: a troffer retrofit for 2x4 or 1x4 fixtures that converts them from 4xT12 to 2xT8 or 2xT12 to 1xT8 in, says Ricard, less than four minutes... all while maintaining the same light level.
VENTES ELECTRA
www.venteselectra.com

Halco Lighting 13W ProLED PAR30 lamps

Halco Lighting Technologies has introduced the ProLED PAR30 lamps, featuring a single point light source for improved colour uniformity and optical control, it says. According to Halco, these dimmable 13W lamps are 83% more efficient than 75W Halogen PAR30 over the life of the ProLED lamp. The bulbs are UL rated for damp locations, and are available in 3000K and 5000K with flood and narrow flood beam spreads.
HALCO LIGHTING TECHNOLOGIES
www.halcolighting.com

Holophane Washington PostLite II LED luminaires

Holophane describes its next generation acrylic Washington

PostLite II LED luminaires as delivering increased lumens per watt, improved lighted appearance and reduced uplight and light trespass. According to the company, the new LED optical design replicates HID light levels with asymmetric and symmetric distribution and comfortable, low-glare in multiple lumen packages for design flexibility. Like the original, the new generation is optimized to meet Illuminating Engineering Society (IES) RP8 street lighting recommended practice. The LED system offers a rated life of 50,000 hours.
HOLOPHANE
www.holophane.com

Acuity Brands WSD NGX wall switch sensor now available

Acuity Brands has added the WSD NGX (neutral/ground exchangeable) wall switch sensor to its Sensor Switch line of occupancy sensors. The WSD NGX sensor can use either the neutral conductor required by NEC 2011 for new construction projects, or the ground connection for retrofit applications. The WSD NGX is available in both Passive Infrared (PIR) and Dual Technology (PDT) versions.
ACUITY BRANDS
www.acuitybrands.com

Cat C175-20 diesel genset

EBMag got an exclusive look at Caterpillar's 20-cylinder C175-20 diesel generator set last week at the company's press summit in Lafayette, Ind. According to Cat, the genset provides more power from a smaller footprint – a single 4MW C175-20 represents a 55% reduction in footprint when compared with two 2MW 3516B generator sets and a 28% reduction when compared with a 4MW 3612, making it ideal for data centre and hospital applications.
CATERPILLAR
www.cat.com

New thermal imaging capabilities with FLIR T420 and T440

FLIR Systems unveiled the new T420 and T440 thermal imagers, which include new imaging capabilities to help you find and capture problems more easily and with more vivid thermal images. In addition to thermal resolution at 76,800 pixels (320x240), the T440 features MSX Multi-Spectral Dynamic Imaging, which adds the detail of real-time visible spectrum images captured by the built-in digital camera to thermal spectrum images, providing sharpness, contrast and clarity, boasts FLIR, "previously unavailable in thermal imaging". Other imaging capabilities include scalable picture-in-picture and thermal fusion for easier image identification and added context. To drive home findings, thermographers can also add voice and text comments to images or sketch circles and arrows right on the touchscreen (T440). The T-series' ergonomic rotating optical block swivels vertically up to 120º making it easier to properly aim at targets without compromising your view of the 3.5-in. colour touchscreen.
FLIR SYSTEMS
www.flir.com/ca

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Harnessing the power of AMI

How utilities can make the most of data provided by smart meter installations

Ken Vergara, P.Eng.

The continued expansion of advanced metering infrastructure (AMI) is a key indicator of smart grid growth. Based on a recent report from Zpryme Research and Consulting, the "2012 Smart Grid Executive Survey", more than 52 million smart meters will be installed in the United States alone by the end of 2012. Measuring power usage in near real-time, these meters have changed the nature of utility billing for the foreseeable future, feeding information critical to the invoicing process back to the control room, and providing increasingly accurate data to the revenue office.

The precision is delivered through validation, estimation and editing (VEE) functions, which confirm the accuracy of readings or perform advanced approximations based on historical usage analytics to fill in instances where data is missing. A Meter Data Management (MDM) system is the platform that operates these functions and serves as the central collection point for all the data reported from the AMI.

However, new strategies of integration with other highly advanced smart grid solutions now offer utilities access to a wealth of new business intelligence that goes well beyond supporting accurate customer invoicing. The following discusses how innovations in MDM solutions and systems integration are helping companies make the most of their AMI investment.

Start with data storage and analytics

Consider the amount of data an AMI generates for a utility. Even with just 250,000 meters, with each reading two data values (e.g. kW and kWh) four times an hour, this AMI produces at least 2 million data values an hour, 48 million a day and 17,520 million a year. This is a tremendous amount of data to be managed, organized and stored.

Therefore, a central feature to extracting the most value from the AMI is a single, secure database where the millions of data points being collected from multiple sources can be stored and integrated. The MDM data collection application automatically identifies meters, configures data points and can measure consumption at different time intervals to support time-based variable rates. It also can collect different reading types, such as kWh, kW and power quality.

It is this single, secure database that allows the MDM system to not only produce trends and validate readings by drawing on historical data, but also combine and compare supporting information from across enterprise systems to boost key business operations.

Integration across the enterprise

MDM is not the only enterprise system collecting information and performing critical business functions. The utility geodatabase (GIS), distribution management system (DMS), supervisory control and data acquisition (SCADA) system and outage management system (OMS) all produce information on the operations they control, including management of network outages, power delivery and demand management. The MDM system—with meter modelling components and standardized connectivity—can integrate with these systems to support the identification of network outages, losses, overloading, load forecasting and theft.

Load profiling and planning

While the real-time data reported from enterprise systems gives utilities heightened awareness of the current state of the network, it also helps them plan for the long term. Drawing from the meter-read database, MDM systems create advanced network load projections by leveraging historical data and identifying demand trends over time, as well as during key periods, such as peak load or storm situations. With this information, utilities can manage peak loads and plan for increasing energy demands more effectively, reducing the need to add generation capacity and taking advantage of distributed sources of renewable energy generation. By integrating MDM systems with DMS solutions and weather feeds, utilities can achieve key environmental and business goals while making their existing networks go farther.

Similar benefits can be seen on a smaller scale, by aggregating the data from individual meters to determine the load on transformers and higher-level devices, identifying equipment that should be replaced to optimize asset performance. For example, existing residential infrastructure may become overloaded with the introduction of electric vehicles. MDM can identify where load demand has exceeded rated capacity, allowing the utility to replace devices before a more expensive and disruptive event occurs, such as a blown transformer.

Operational and business network losses

Aggregating meter readings to higher-level devices also supports the important operation of reducing energy loss—both technical loss that comes from damaged or degraded infrastructure, and non-technical loss (namely in the form of theft).

While providing more readings at less cost than meter technicians, the implementation of smart meters also forced utilities to innovate new ways to detect electricity theft and meter tampering with the reduction of in-person inspections.

New MDM systems fill this void with built-in analysis that can compare real-time data to historical trends and alerts to abnormal readings. This analysis can identify patterns likely to suggest theft and tampering, and automatically generate a work report for the revenue department and field teams to investigate.

In addition, the integration of the MDM system with SCADA or distribution

management systems (DMS) allows aggregate comparisons between the energy supply and demand load, helping to identify potential theft or network loss. For example, the MDM system can aggregate usage data from all the meters tied to a specific feeder and compare those figures to the power delivered to that feeder. Aggregated usage figures that are significantly less than the power delivered may represent loss—either technical or non-technical—and signal the utility to investigate the source.

Innovations in MDM solutions and system integration are helping companies make the most of their AMI investment.

Outage management

Beyond long-term forecasting and general day-to-day operations, AMI and enterprise integration benefits the management of real-time events as well, such as power outages. With near real-time readings coming in from meters, MDM systems quickly identify meters that are returning 'last gasp' messages, signifying a potential power outage. An outage management system (OMS) with enhanced processing power and advanced prediction algorithms, integrated with the MDM, will accurately identify the outage event and rapidly determine the scope.

The MDM system can also contribute event notifications from non-meter devices higher on the network. The OMS can prioritize those events and rapidly identify related downstream locations—all to implement faster response and restoration.

The MDM system also helps in verifying outage status and optimizing restoration efficiency by actively pinging meters to determine their power status. This capability helps utilities prevent over-prediction of outages and identify nested outages during restoration, providing specific information to field restoration crews and reducing additional trips into the field.

Data visualization

All of these business enterprises gain tremendous value through the visualization enabled by the integration of the MDM and the GIS database, which provides a clear display of network information, data and AMI deployment. These visualizations can assist controllers by spatially displaying areas of projected concern or opportunity. During power outage situations, controllers are provided with a visual picture of the size and scope of the outage.

The tools described above, available with an advanced MDM solution, help utilities extract the true return on investment from AMI implementation, providing highly valuable intelligence that enables a better understanding of the network and its real-time behaviour. As more utilities realize MDM capabilities beyond simple meter-to-cash functionality, the industry can expect they will integrate MDM across all operational enterprises to help achieve a smarter network grid. EB

Ken Vergara, P.Eng., is the director of sales, Smart Grid Solutions, with Telvent, a Schneider Electric business.

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GE Energy launches Grid IQ Network Communications Platform

Now available is GE's Grid IQ Network Communications Platform, an end-to-end, industrial-grade networking communications platform that supports AMI, SCADA and other mission critical grid automation communication applications. Designed for ruggedized environments, the Network Communications Platform meets customers' expanding needs for a single network that can support multiple grid applications, says GE. The platform also supports utilities' critical needs to simplify operations, lower overall operating and capital expenses, as well as providing the capability to leverage legacy networks and end devices, it adds.
GE ENERGY
www.gedigitalenergy.com

Electrolab "Hearing Conservation: Noise Under Control" DVD

Electrolab Training Systems has released its "Hearing Conservation: Noise Under Control" DVD which aims to help viewers understand the long-term importance of proper hearing protection. According to Electrolab, hearing loss is the most common occupational disease in industrial workplaces accounting for one third of all workplace diseases. This DVD discusses how to recognize high noise hazards, identify actions to take for preventing hearing loss and the importance of wearing proper hearing protection. It is produced by DuPont Sustainable Solutions.
ELECTROLAB TRAINING SYSTEMS
www.electrolab.ca

Milwaukee to release M18 Fuel Drill Driver and Hammer

Milwaukee is set to release the new M18 Fuel Drill Driver and Hammer. The complete M18 Fuel system, featuring a new line of drills that offer breakthrough performance in a smaller and lighter size than its competitors, will be officially available in spring 2012, says Milwaukee. The line of extreme-performance cordless power tools integrates the Powerstate brushless motor,

RedLithium battery technology, and RedLink Plus Intelligence for enhanced durability, run-time and performance, it adds.
MILWAUKEE ELECTRIC TOOL
www.milwaukeetool.com/fuel

Falcon Electric SSGB-1S40-5U 40AH battery bank

Falcon Electric, a manufacturer of online uninterruptible power supplies (UPSs), frequency converters and precision ac regulators, has added a wide-temperature (-30°C to 63°C) battery bank option to its SSG and SSG-RP UPS products. The SSGB-1S40-5U 40AH battery bank consists of eight deep cycle, valve regulated lead-acid, 40 Amp Hour (AH) batteries and two internal one amp chargers. According to the company, the battery bank provides users with over 10 times the battery runtime, compared to Falcon's standard 2U extended battery pack option.
FALCON ELECTRIC
www.falconups.com

SMA Multicluster Box strives for scalable rural electrification

SMA is taking orders for its Multicluster Box, an off-grid AC distribution hub that manages renewable and combustion generation sources for large-scale Sunny Island multi-cluster systems. Now available, the SMA Multicluster Box features a preconfigured design that simplifies the installation of off-grid renewable-energy systems, providing users with superior design flexibility and making rural electrification simple and scalable, describes the company. The unit is designed for systems up to 110 kW, and allows two, three or four three-phase clusters, each consisting of three Sunny Island inverters, to be connected in parallel.
THE SMA GROUP
www.sma-canada.ca

Two Technologies HGP-3 integrated thermal printer

Two Technologies, a manufacturer of ultra-rugged hand-held computers and terminals used in global applications, has introduced the HGP-3 fully integrated thermal printer for its Hydrus and Handgear hand-held computer products. The new IP65 3in.-printer is drop tested to MIL-STD 810G 516.4 Method IV Shock, and is designed for data collection applications that require a receipt or a report to be generated on the spot. Along with offering a one-step paper-loading method, the HGP-3 operates a print speed of 50mm per second at a resolution of 203 dots per inch.
TWO TECHNOLOGIES
www.2t.com

Electrovaya PowerBlock 25-400V lithium ion SuperPolymer battery energy storage system

Electrovaya Inc. says it has made its first delivery of a 25kWh, 400V lithium ion SuperPolymer battery energy storage system—PowerBlock 25-400V—to a Japanese utility through Nippon Kouatsu Electric Co. Ltd. The PB25-400V system will be providing energy storage for a program to investigate distributed energy storage for solar applications. The PowerBlock line of products is designed to cater to the mid-size residential and industrial energy storage market; it is a complete energy storage system, with cells, battery management system and power electronics.
ELECTROVAYA
www.electrovaya.com EB

ADVERTISER INDEX

LES STOCH, P.Eng.

Neutral grounding devices

Neutral grounding devices (resistors) are used to control the ground fault currents and voltages to ground of alternating current systems. Earlier versions of the Canadian Electrical Code restricted the use of neutral grounding devices to systems that supplied only 3-phase loads (no single-phase loads). But the 2006 CEC was revised to change all that—single-phase loads are now permissible... with conditions.

Grounding devices other than resistors (reactors) do exist. However, these devices do not fit in very well with CEC requirements. Harmful transient voltages are likely unless ground-fault reactors are sized to permit fault currents of at least 25% of the available phase-to-phase fault current. This article assumes the use of grounding resistors.

When supply continuity is a requirement by the customer, resistance grounding has a number of advantages over solidly grounded and ungrounded delta systems. When a fault occurs, the ground-fault current is reduced and, therefore:

- mechanical stresses and damage to electrical wiring and equipment are reduced;
- arc flash, arc blast and line dips are reduced;
- line overvoltages are controlled; and
- as with an ungrounded delta system, an electrical system shutdown is not required when only 3-phase loads are supplied. Ungrounded delta systems provide some of the same advantages, since the power supply need not be interrupted during a ground fault. However, the temporary overvoltages occurring during ground faults shorten the insulation life of electrical equipment and wiring.

CEC Rule 10-1102(2) specifies that, for electrical systems up to 5 kV—where only 3-phase loads (no single-phase loading) are supplied—neutral grounding devices must be sized to limit ground fault currents to 10 amperes or less with visual and/or audible alarms. An immediate disconnection of the power supply is not required.

Rule 10-1102(3) specifies that, when single-phase loads are supplied by a system grounded through a neutral grounding device, the system must be automatically de-energized should any of the following occur:

- a ground fault;
- the system neutral is inadvertently grounded; or
- any of the grounding connections become inadvertently disconnected.

Rule 10-1104 requires that neutral grounding devices be approved. The devices must be continuously rated when systems are not de-energized on occurrence of a ground fault. A continuous rating is not required when systems are de-energized during a ground fault, and the neutral grounding devices are adequately protected by coordinated upstream protection. The insulation rating of neutral grounding devices must be at least equal to the system line-to-ground voltage.

Rule 10-1106 also provides some electrical safety requirements for installing neutral grounding devices:

- The devices must be enclosed or guarded, and accessible only to qualified people;
- The devices must be located so as to minimize the possibility of damage by ground faults, and allow effective dissipation of heat; and
- Warning signs must be displayed at equipment locations (e.g. transformers, generators, switchgear and metering equipment) where accidental contact with the system neutral is possible.

Rule 10-1108 provides requirements for colour coding and connecting neutral grounding devices. The ampacities of connections between the system neutral and the grounding device, and between the grounding device and the electrical system ground electrode, must be the greater of #8 AWG and the current rating of the grounding device. The grounding conductor between the neutral grounding device and ground must be copper. When single-phase loads are supplied, the minimum size connections are #12 AWG. EB

Les Stoch is president of L. Stoch & Associates, specialists in quality management/engineering services. He is a member of PEO, OEL and IAEI, and develops and delivers electrical code and technical workshops for Dalhousie University. He also developed the Master Electrician training program and exam (Ontario) for the Electrical Contractor Registration Agency. Visit L. Stoch & Associates online at www.lstoch.ca.

Questions and answers compiled by the Electrical Safety Authority | VISIT WWW.ESASAFE.COM

Tackle The Code Conundrum... if you dare!

Answers to this month's questions in July's Electrical Business.

How did you do with the last quiz? Are you a...

Master Electrician ? (3 of 3)
Journeyman ? (2 of 3)
Apprentice ? (1 of 3)
Plumber ?! (0 of 3)

Question 1

All receptacles of CSA configuration 5-15R and 5-20R installed in childcare facility shall be tamper resistant receptacles, unless rendered inaccessible behind a stationary appliance.

a) True **a)** False

Question 2

Single phase inverters for utility interactive solar photovoltaic systems are permitted to be connected to 3-phase systems, provided they are:

a) designed to provide a balanced 3-phase output
b) in compliance with Rules 84-008 and 84-018
c) in compliance with supply authority requirements
d) all of the above

Question 3

Receptacles required for maintenance of rooftop HVAC equipment shall be:

a) located within 2.5 m of the rooftop electrical equipment
b) located not less than 300 mm above the finished roof
c) of CSA configuration 5-20R
d) all of the above

Answers: EBMag May 2012

Q-1: Overload protection shall not be required for a manually started motor rated at ____ hp or less that is continuously attended while in operation, and that is on a branch circuit having overcurrent protection rated or set at not more than 15 A, or on an individual branch circuit having overcurrent protection as required by Table 29 if it may be readily determined from the starting location that the motor is running.

b) 1 hp, Ref. Rule 28-308.

Q-2: or areas where flammable finishes are regularly sprayed, all space within 6 m horizontally in any direction from dip tanks and their drain boards with the space extending to a height of 1 m above the dip tank and drain board, is considered.

a) Class I, Zone 1, Ref Rule 20-402.

Q-3: For areas where paint finishes are regularly applied by spraying, the spraying equipment for a spray booth shall be interlocked with the spray booth ventilation system so that the spraying equipment is made inoperable when the ventilation system is not in operation.

a) True, Ref. Rule 20-404.

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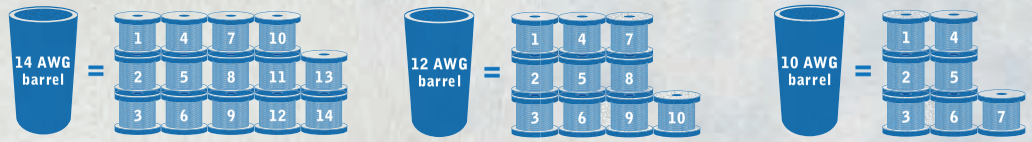

14 AWG barrel replaces 11-14 reels. 12 AWG barrel replaces 7-10 reels. 10 AWG barrel replaces 5-7 reels.

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