AN ANNEX PUBLISHING & PRINTING INC. PUBLICATION • VOLUME 49 • ISSUE 11

Electrical Business

NOVEMBER 2013

Do you comply with rule 12-516 ?

See page 5 for details.

Also in this issue…

- Measurements for motors and drives
- Sudden death for cheque-processing machines
- CEC and inverter point of connection

Intro to wind project maintenance

PM # 40065710

IPEX NEW PRODUCTS FROM IPEX ELECTRICAL SYSTEMS

Universal F Series Double Gang Boxes and Covers

Scepter® F Series double gang boxes, weather-proof covers and cover plates have been redesigned for universal compatibility with any industry standard double gang box or cover. CSA approved, the new universal boxes and covers are easy to use, have more internal wiring space and include reducer bushings to accommodate various sizes of conduit. All the weatherproof covers have been designed to ensure a watertight seal using a new foam gasket, with an adhesive layer for ease of installation.

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Simple yet innovative, the new Round Floor Box Stand is designed to raise the Round Floor Box off the concrete form allowing the ENT or conduit to enter the Box in a flat and straight path. Installed together, the Floor Box and Stand accommodates the different rebar and post-tensioned cable heights and slab depths found from job-site to job-site.

Sold as a kit, IPEX Electrical offers the Round Floor Box and Stand conveniently packaged together as one complete product offering.

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The new 2" SceptaCon is ideally suited for street lighting and traffic signal cables where installation requires a smaller diameter pipe than your typical electrical raceway. Now contractors can install RW cables instead of the more expensive TECK cables required with the use of HDPE pipe.

For more information call Toll Free: 1-866-473-9462 or visit www.ipexelectrical.com

Products manufactured by IPEX Electrical Inc.

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Designed to withstand tough jobsite environments, Kwikon® ENT slab boxes are nonmetallic, nonconductive and noncorroding. All Deep Round Series slab boxes feature our new CORNER MOUNTING TABS. These uniquely positioned corner tabs allow contractors to easily nail Kwikon slab boxes to the slab deck. The angled design guides the nail to be positioned inside the fixture's trim cover, reducing the threat of visible rust bleeding through the finished ceiling.

- Approved for support of ceiling fans up to 35 lbs and luminaries up to 50 lbs
- Corner and traditional mounting tabs offer contractors two options when installing to the slab deck
- Angled design guides the nail into position within the trim cover area
- Ready to install – no assembly required

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IPEX KWIKON Tough Products for Tough Environments®

Products are manufactured by IPEX Electrical Inc.

EPR Kit Adapters make Duct repairs quick & easy!

New Adapters for our EPR Conduit Repair Kits allow contractors to repair a broken section of DB-II duct while leaving the cables inside and restoring the duct to its original form. The pre-cut adapters easily open around existing cabling to make repairs quickly and effectively, reducing end-user downtime and complaints, and saving contractors time, labour and money.

The Perfect Expansion Fitting for Short Runs!

The One Piece Expansion Joint (OPEJ) is designed to accommodate thermal expansion and contraction on shorter runs of PVC Conduit. The efficient design of the One Piece Expansion Joint provides fast trouble-free installation and will ensure the owner receives a secure and appealing installation that will last the life of the system.

"When I think of AD, I think of the best damn independents in the industry."
— Bill Weisberg

"Accumulated tribal wisdom" at AD

"When I think of AD, I think of the best damn independents in the industry," noted CEO Bill Weisberg during his keynote address at last month's North American meeting of Affiliated Distributors' (AD) Electrical Supply Division in Maryland.

This was the first AD North American meeting to include the newly merged member distributors of the former IED (Independent Electrical Distributors) and, in a classy move, Weisberg took a moment to formally welcome former these new Affiliates, and all Canadian delegates to boot.

Change is not easy, so it was heartening to see so many new Affiliates embracing the AD family. "We grow despite consolidation," noted Weisberg.

During his keynote, Weisberg discussed some of AD's strategic initiatives, including globalization, human resources, succession and eContent, but he spent a good deal of time speaking about AD's guiding principles, which he refers to "accumulated tribal wisdom":

EBMag editor Anthony Capkun with Affiliated Distributors CEO Bill Weisberg.

Stephen Kleynhans accepts the Canadian Affiliate of the Year, Performance award for O'Neil Electric Supply Ltd.

1) AD respects the private, independent ownership of its members.
2) AD respects its suppliers. "We want fairness. We respect you as partners," said Weisberg.
3) AD picks its partners wisely.
4) Nobody is more important than everybody.

I, for one, cannot wait to see what the coming months and years will bring with the organization and, if rumours are true, the North American meeting is coming to Canada in 2015... what will we see then?

On the cover and page 20

An introduction to wind project electrical maintenance considerations

Maintaining the electrical equipment on a wind farm is critical to the safe and reliable operation of the power plant. Equipment that does not operate properly will pose a hazard to personnel and make production unreliable. (STOCK PHOTO)

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DEPARTMENTS

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WARNING: Counterfeit UL Mark on emergency lighting inverters

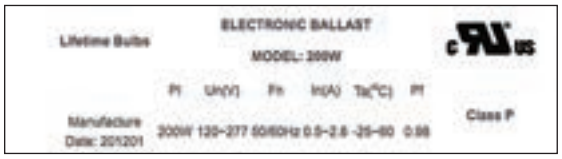


IMAGE COURTESY UL.

UL (www.ul.com) has issued a notification to the public that certain emergency lighting inverters bear counterfeit UL Marks for Canada and the United States. The emergency lighting inverters have not been evaluated by UL to any Standards for Safety and it is unknown if the emergency lighting inverters comply with any safety requirements.

The affected models have been identified as Defender 1, PLC, Mini, Defender 3, Eternalight Mini, Defender Plus, and are manufactured by Digital Signal Power Manufacturer Emergency (DSPM, www.dspmanufacturing.com) of Ontario, Calif.

Light up their lives with Schneider's EV initiative: Charge the World

Global energy management specialist Schneider Electric (www.scheider-electric.com) revealed its "Charge the World-Change the World" initiative: for every EVlink electric vehicle home charging station sold in North America, Schneider will donate a solar-powered, battery-operated LED lamp to a family without access to electricity.

The lamps are donated through Schneider's BipBop program (bit.ly/1a2KPJq), says the company, which aims to provide energy access to "the 1.3 billion people in the world with no access to electricity..." through skills training and technology, and funds to support economic initiatives around energy.

"Through this program, our EVlink team is connecting EV drivers living a charged lifestyle with people around the world living without access to electricity, empowering them with a new efficient light source for their homes," said Mike Calise, director, electric vehicles, partner business, Schneider Electric.

In addition, Schneider Electric's EVlink team has created a video about the initiative and, for every 100 views, the company will donate another light to a family (up to 100,000 views through December 2013). Each person who shares the video online will be entered to win an EVlink home charging station. Visit bit.ly/18xNonQ to watch the video.

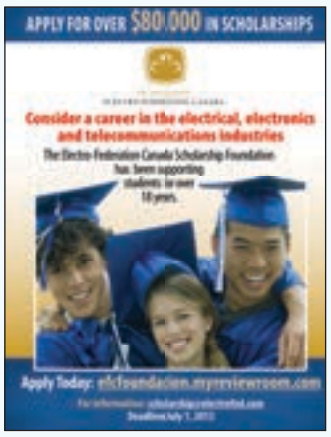
Over $80K doled out to 2013 EFC Foundation Scholarship recipients

Electro-Federation Canada (EFC, www.electrofed.com) has just announced the 2013 EFC Foundation Scholarship recipients. Congratulations!

In total, 35 scholarships were available, supported by organizations in the electrical and consumer electronics sectors, to assist Canadian university and college students achieve their career objectives. Specifically, the scholarship program encourages Canadian youth to pursue a career in the electrical, electronics and telecom industries. To date, EFC says it has invested over $600,000 in post-secondary technical training and education.

2013 SCHOLARSHIP RECIPIENTS:

- **Affiliated Distributors Electrical Industry Scholarship ($3500):** Taylor Reinhart, Fanshawe College
- **Burndy Canada Inc. Academic Achievement Award ($3500):** Matthew Crocker, University of Fraser Valley
- **Cooper Industries Scholarship Award ($3500):** Bilal Manji, Queen's University
- **Eaton Award of Academic Excellence ($3500):** Waheed Zaman, University of Calgary
- **GE Canada Community Leadership Award ($3500):** Nicole Kai, University of Waterloo
- **Gerrie Electrical Memorial Scholarship Awards (2 x $1750):** Muhammad Raza,



Wilfred Laurier University; Cindy Chen, McMaster University

- **Graybar Canada Award of Excellence Scholarship ($3500):** Pascale Mailie, University of Sherbrook
- **Hoffman Enclosures Scholarship Award ($3500):** Kevin Zhou, University of Western Ontario
- **HPS Outstanding Electrical Scholar Award ($3500):** David Drake, McMaster University
- **Hubbell Canada LP Sustainability Leadership Award ($3500):** Katelin Spence, University of New Brunswick
- **I-Gard Corp. Student Merit Award ($3500):** Cory McGraw, Durham College
- **Osram Sylvania Scholastic Achievement Award ($3500):** Greg Bridges, Carlton University
- **Philips Lighting Continuing Education Award ($3500):** Josh Cherum, University of Toronto
- **RABC Future Leader in Radiocommunications Award ($3500):** Lahib Haque, University of Ontario Institute of Technology
- **Schneider Electric Student Merit Award ($5000):** Justin Huskic, University of Calgary
- **Siemens Canada Academic Achievement Awards (2 x $3500):** Mihai Balan, Durham College; Austin Cousineau, University of Waterloo
- **Standard Recognition of Excellence Award ($3500):** Justin Lank, University of Prince Edward Island
- **Thomas & Betts Scholarship Award ($3500):** Raha Darvishi, University of British Columbia
- **Wesco Student Achievement Award ($3500):** Sukhmani Brar, University of Alberta
- **EFC Foundation University Scholarships (4 x $1000):** Veronica Riehl, Queen's University; Paul Lakner, Saint Mary's University; Houtan Emad, University of Victoria; Christian Jegues, University of Manitoba
- **EFC Foundation College Scholarships (4 x $1000):** Aaron Moore, NBCC Moncton; Lisa Wright, Holland College; Tianna Kassian, Lakeland College; Bryan Jarvis, Durham College
- **CEMRA Academic Leadership Award ($2500):** Jonah Tremblay, University of New Brunswick
- **Bob Dyer/OEL Apprentice Scholarship (5 x $500):** Josh Campbell, Fanshawe College; David Thomson, Mohawk College; Daniel Barna, Durham College; Richard Carrigan, Durham College; Perry Blanchard, Fanshawe College

The 2014 EFC Scholarship Program will commence January 2014, so stay tuned!

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Editor
Anthony Capkun - acapkun@annexweb.com
Group Publisher
John MacPherson - jmacpherson@annexweb.com
Account Manager
Scott Hoy - shoy@annexweb.com
Associate Editor
Alyssa Dalton - adalton@annexweb.com
Art Director
Svetlana Avrutin - savrutin@annexweb.com
Production Manager
Kathryn Nyenhuis - knyenhuis@annexweb.com
Subscriber Customer Service Representative
Marie Weiler - mweiler@annexweb.com
President
Mike Fredericks - mfredericks@annexweb.com

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e-mail: mweiler@annexweb.com
Tel: 1-866-790-6070 • Fax: 1-877-624-1940
Mail: P.O. Box 530, Simcoe, ON N3Y 4N5

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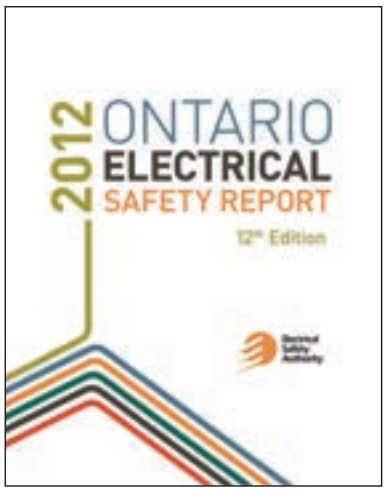
Canada

Overhead powerline contact still a major killer of Ontarians



Despite a 38% decrease in electrical fatalities in the last five years, Ontarians continue to be injured and killed in electrical safety incidents notes Electrical Safety Authority (ESA, www.esasafe.com) in its latest Ontario Electrical Safety Report, with more than 70% of all incidents occurring in four areas:

- Contact with overhead powerlines
- Electrical workers
- The misuse of electrical products
- Electrical fires caused by old or faulty electrical wiring.

"While it appears that Ontarians are slowly getting the message about electrical safety, far too many people are still injured and killed every year, despite knowing the risks," said ESA chief public safety officer Scott Saint. "People recognize the hazards, but they think they can beat the odds."

There has been a decline over the past few years in rates of electrical-related injuries and fatalities, yet incidents continue to occur in the same areas as before. Risk perception (rather than an unexpected event, for example) drives much of that risk, insists ESA.

Powerline contact continues to be an area of concern, accounting for almost half of all electrical-related fatalities in the past 10 years. While most members of the public know that a downed powerline is dangerous, consumer surveys indicate the majority fail to consider they may come into contact with a live wire when doing yard work and chores, notes ESA, like trimming trees or cleaning eavestroughs.

Electricians continue to be critically injured on the job when working on energized electrical panels or commercial lighting systems. Research conducted by ESA reveals electrical workers and those who hire them often do not perceive these jobs to be high-risk.

"Electrical workers continue to be injured or killed: in some cases because they do not appreciate or have become complacent about the risk and, in others, because they feel pressured by their customer or employer," continued Saint. "Changing people's misperceptions is critical to our goal of eliminating electrical-related deaths and injuries."


Scott Saint

Yukon geothermal energy exploration project getting under way

A Yukon geothermal energy exploration project is getting under way thanks to $248,940 in partnership funding from Yukon Energy Corp. (www.yukonenergy.ca), Yukon Electrical Company (www.yukonelectrical.com), the Kaska Nation and the Yukon Government, as well as CanNor (Canadian Northern Economic Development Agency, cannor.gc.ca).

CanNor's investment of over $124,000 will support geological exploration within two areas that are thought to potentially have near-surface geothermal resources. The resource potential in the Ross River and Watson Lake regions was first identified in 2011 during clean energy inventory work co-funded by CanNor and the Kaska Nation.

This new project is divided into two phases. Phase 1 involves data collection, mapping and fieldwork to assess historic drill holes for geothermal testing. Once completed, Phase 2 will involve field exploration, including temperature profiling and geophysical surveying.

Changing of the (electrical) guard in the Princess Province

Thanks to Electrical Contractors Association of Alberta (ECAA, www.ecaa.ab.ca) for sending us the Order-in-Council that amends the Electrical Code Regulation to adopt the 2012 Canadian Electrical Code, 22nd edition; the 2012 Code for Electrical Installations for Oil and Gas, 4th edition; and the 2013 Alberta Electrical Utility Code, 4th edition.

All three codes came into force or became law as of October 1, 2013, though educational institutions may use the codes immediately.

Ontario Waterpower Association engages students via ConserveCanada

The Ontario Waterpower Association (OWA, www.owa.ca) says it is "pleased to support the efforts" of ConserveCanada (www.conservecanada.ca) in delivering renewable energy, conservation and environmental education in Ontario elementary schools. ConserveCanada is a not-for-profit whose mission is to "make changes today and to provide the information to make responsible energy and technology decisions tomorrow".

OWA says it has been working on educating elementary school children on waterpower since its inception in 2001. Its bit.ly/1c97Ij7 website hosts a variety of teacher resources specifically for Grade 2 students that provides information on waterpower.

"Educating the leaders of tomorrow on energy and environmental sustainability is extremely important," said Paul Norris, OWA president. "These programs will reach and inspire the next generation of energy entrepreneurs and professionals."

ConserveCanada's free workshop program began visiting Grade 5 classrooms in 2012, reaching 2000 elementary school students and teachers. The 2013/2014 workshop program will expand to Huron, Perth, Bruce, Grey, Wellington, Middlesex, Oxford, Elgin, Chatham-Kent, Essex and Lambton counties. OWA supported the integration of waterpower educational tools for the program and outreach initiatives.

Bombardier fined $140,000 after worker contacts live conductor

Bombardier Transportation Canada Inc. (www.bombardier.com) recently pleaded guilty to failing as an employer to ensure a worker used the protective equipment prescribed by law to keep him safe from electrical injury, and was fined $140,000 plus a 25% victim fine surcharge.

In July 2012, at Bombardier's production facility in Thunder Bay, Ont., a worker was injured after coming into contact with a live electrical conductor. The young worker—who was also a relatively new employee—was checking the electrical current of an electrical conductor in a passenger rail car.

The worker reached into an electrical cabinet to clamp an ammeter to verify whether it had an electrical current, and inadvertently touched a live terminal strip. He was not wearing any rubber gloves nor using any protective equipment, which is required by the Occupational Health & Safety Act. The worker suffered injuries to an arm and hand.

A Ministry of Labour investigation revealed the terminal block was energized and the worker was not provided with any instructions about the use of personal protective equipment.

ABB sells Baldor's genset business to Generac Holdings Inc.

ABB (www.abb.com) is selling all assets of Baldor's generator set business to Generac Holdings Inc. (www.generac.com), a Wisconsin-based producer of generators and other engine-powered products. The sale is expected to close later this year; terms of the transaction were not disclosed.

ABB says it is divesting the genset business because of limited synergies with ABB's core portfolio, and because Generac is in a better position to create additional value from the business. The business was acquired as part of ABB's acquisition of Baldor Electric in 2011, and accounts for about 3% of Baldor's total sales. Baldor's genset business produces a line of portable, standby, prime power and peak-shaving generators from 3kW to 2500kW in LP, natural gas or diesel.

"The divestment is in line with our strategy to continuously optimize our portfolio and to focus our efforts on driving profitable growth in our core automation and power businesses," said ABB CEO, Ulrich Spiesshofer. "Overall, the fit between ABB and Baldor is excellent, as we are seeing from the value that has already been created."

Baldor CEO, Ronald Tucker, added the transaction would benefit both firms' employees and customers. "This sale will allow Baldor to focus on industrial electric motors and mechanical power transmission products in line with ABB's core portfolio, while enabling the generator-set business to become part of a company solely focused on the manufacturing, distribution and sales of these types of products."

New Brunswick investing $50,000 in Helmets to Hardhats Canada

The Government of New Brunswick is investing $50,000 in Helmets to Hardhats Canada (www.helmetstohardhats.ca), a national not-for-profit organization providing apprenticeship training to current or former members of the Armed Forces or Reserves who are seeking a civilian career.

"This program will help veterans, especially our younger veterans, make the transition from military service to good jobs in the skilled trades, where we need more workers," said Brian Macdonald, legislative secretary to the premier for intergovernmental affairs and military affairs. "The west-to-east pipeline, oil and gas development—as well as mining—are going to grow our economy. We will need skilled workers to continue building New Brunswick. Our veterans should be part of that prosperity."

The program is an opportunity for members of the military—as well as unions, contractors, owners and associations within Canada's building, construction and maintenance industries—to match employment needs with potential employment openings.

"The building trades unions are proud to partner with the New Brunswick government to provide training and jobs for our veterans," said Andrew Dawson, president of the New Brunswick carpenters' union. "The construction unions recognize the valuable contribution that members of the Canadian Forces have made to our country, as well as their outstanding qualities and experience that can transfer into a successful career in the skilled trades."

Join NRC's "critical mass of expertise" for bioenergy systems

The production of energy from biomass is opening up new markets for the Canadian forestry, agricultural and municipal solid waste sectors, says NRC (National Research Council of Canada, www.nrc-cnrc.gc.ca) and, to help industry capitalize on these market opportunities, it launched its Bioenergy Systems for Viable Stationary Applications research program (bit.ly/GGydis).

"This will accelerate deployment in markets where bioenergy is cost-competitive, such as remote communities and industry reliant on expensive diesel fuel, and cities facing high municipal solid waste diversion costs," said Andy Reynolds, general manager of the Energy, Mining and Environment portfolio at NRC.

The NRC bioenergy program will channel a "critical mass of expertise" into projects that aim to optimize biofuel production and upgrading, and resolve biofuel-power plant compatibility issues, thereby lowering the capital and operating costs for bioenergy systems and components.

Co-investment of industry and other stakeholders along the value chain, including utilities, will ensure the program delivers integrated solutions to end-users within relevant deployment timelines, insists NRC. This will bring estimated economic benefits of over $800 million in targeted stationary markets over the next decade, adds the council, expanding export opportunities for Canadian companies while keeping energy costs affordable for consumers. EB

Dave Smith

Write, follow and audit your procedures

Provincial and federal safety regulations all contain some form of general duty clause that identifies the employer as responsible for maintaining a safe workplace. When an injury occurs, the employer is automatically guilty of violating this clause.

There are also specific duty clauses: for instance, when a worker is injured in an arc flash accident, and the jurisdiction has a regulation stating "protect workers from arc flash", then the specific duty clause has also been violated. Health and safety infractions also usually violate clauses 219.1 and 217.1 of the Canadian Criminal Code.

To satisfy the requirements of these regulations, organizations have a variety of administrative tools they adopt as barriers to accidents, including policies, standards, programs, procedures, practices, hazard assessments, forms and other control documents.

A *procedure* is a clear list of steps for performing a task that, when followed, enable a worker to accomplish the task in a safe and efficient manner. When it is a task that has been performed for some time, the procedure is merely a capture of the steps that are already being performed. Where there have been different ways of accomplishing the task, a choice must be made as to which one will be adopted as the standard for that procedure. It does not mean a different set of steps is always unsafe but, when you follow the steps that have been prescribed, you will definitely be safe.

When a worker decides to follow an alternate set of steps, and a serious injury occurs, then he could be in an indefensible situation. If the supervisor knew this was happening, however, then he and the organization are in an indefensible situation. The way you win a court case is to never go to court in the first place; you must ensure your actions are bulletproof and legally defensible in all situations.

I regularly see organizations with dozens or even hundreds of procedures that are never referenced, and haven't been reviewed for what may be years. This is a poor situation for everyone, and misses a great opportunity to improve safety, quality, productivity and cost control while improving team building and morale.

Reviewing a procedure prior to a task they do regularly is usually unnecessary for experienced workers because they have mastered the task. Most maintenance workers receive a work order without the procedure, and it is highly unlikely they will print the procedure when they feel they know the task or feel rushed. Two problems are created when the maintenance worker has a helper: first, the helper learns an unaccredited set of steps and, worse, they learn they can deviate from procedure.

Fatal accident investigators will always check to see whether:

- you had a procedure in place
- the authorized procedure was being followed
- your workers were trained in the procedure, and demonstrated proficiency
- the training was being refreshed regularly
- a progressive discipline system was employed for anyone not following procedure

I advise my clients to have their teams review a portion of a procedure at every regular safety meeting. Take 10 minutes in a daily meeting (they do not need to complete the entire procedure; one page can be enough, as it is the process that is critical), 20 minutes when it is a weekly meeting, and 30 or more during a monthly meeting.

For implementation, we recommend transferring ownership to the work team by enlisting the newest person on the team to take the initiative of starting with the first step of the first procedure.

The newest person is usually quite willing to step up and show themselves as enthusiastic. With the new person leading, his teammates are more than willing to jump in and provide feedback and advice. For subsequent meetings, delegate the process to the next most-junior person; this way each person carries the ball one day before handing it off to another. You will soon go through your entire team this way; then you start the cycle again. When you get through all of your procedures, start the process again.

With this process, a team can review several hundred pages of procedures in a year. You will be fulfilling your legislated responsibilities with due diligence, and your teams will become experts in reviewing and, eventually, writing procedures. The larger outcome to this regular review—besides an audit of your procedures—is an active and focused discussion on safety every day. And that's a good thing.

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.

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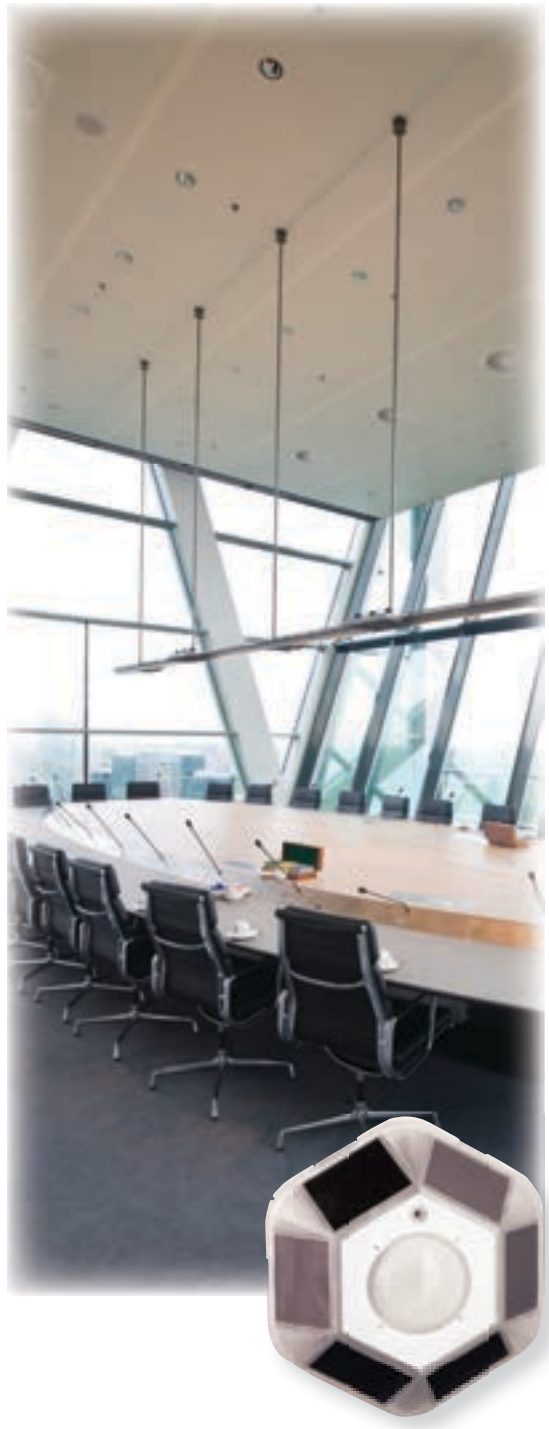

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CANADA'S BEST MANAGED COMPANIES

Holy disparate opinions on THIS one!

The following Comments were published online at EBMag.com under the news item we posted "Marynowycz convicted and fined yet again for illegal electrical work" (tinyurl.com/ldhj729).

#1 Big deal: got fined a total of $3110. I paid more in licences and fees operating above-board in the last two years, and he is probably very busy. Who's the dummy: the legal guys or the hundreds that run under the radar like this guy. — Richard

#2 So, did he do the work wrong? — Anonymous

#3 Fines should be much stiffer, and there should be jail time, too! Electricity can kill, unlike a coat of paint or a sheet of gypsum. — Gil

#4 How about a fine for the general who hired him? — Scott

#5 What needs to happen is that the fines need to exceed the costs of obtaining proper licensing and permits. I'm sure the industry would be for lower fees. If this guy is doing otherwise good and code-compliant work, the authority should work with him to facilitate his becoming properly licensed. I know of licensed guys that I wouldn't allow to fix a flashlight, and guys that are good but somehow fall through the cracks when qualifying for licences. — Brent

#6 ESA is a for-profit organization and should not have authority of any kind on licensing. — Chuck

#7 I live and work outside of Ontario, with interprovincial red seal accreditation, electrical contractor's licence for the metropolis where most of our work is carried out, and registered electrical contractor for the rest of the province. The municipal license is all about revenue stream and very little to do with "safety, protection and control", which is the real spirit and intent of the Canadian Electrical Code.
Question: is the Master License in Ontario, and additional contractor's license, mostly about additional revenue for the Crown?
I am all for health & safety for employees, clients and all [but] I am fundamentally opposed to using safety as a pretense for creating another Crown revenue stream or special interest protectionism. Sometimes the Crown makes more than the contractor that actually did the work... what's up with that? — Bob

#8 What a bunch of B.S. Alberta has the same crap. Masters license? What a joke. Cash Grab License is what it is. Club for big contractors to push out little guys, is what it is. Canada: the land of the stupid! — dienekes

#9 [In response to #2, "So, did he do the work wrong?"] Some unlicensed electricians do a neater and better job than the crap I've seen done by a licensed electrician. Screw the authorities. There are too many of them grabbing money from the same pot. Not all unlicensed electricians are bad like the electrical authority portrays them. — Steve

#10 In Alberta, anyone can own and operate an electrical contracting business as long as there is a person with an Electrical Master's license in its employ. The standard of obtaining the Masters is 80%. It eliminates electricians who can't read a code book from going into business. It also eliminates fly-by-night outfits [...] The Masters in Alberta is administered by the government, no longer the contractor's association. — Hans

#12 [In response to #2, "So, did he do the work wrong?"] Who cares? The main offense was his refusal to pay up!
Think the ESA is bad? Have a look at what the TSSA perpetuates! With a license, they should provide a mask and a gun; elevator service can cost $400/hour and you can't have an elevator unless you have a service contract with a licensed technical service. Even if it is decommissioned and thrown on a scrap pile, it is illegal to tamper with it.
Beware of any organization that incorporates the word "safety" in its name. Its status becomes elevated to that of a deity, and you can't argue with God. — Leo

#13 There is a reason why all us electricians have to do an apprenticeship and then a masters to run a business. It is easy to learn the tricks, but takes years to learn the trade; I still learn new things in this trade.
I have been in the trade for 31 years and have seen lots of horror stories of handymen doing electrical work. Nobody should run a business of any sort without the right qualifications. Would you much rather go to an unlicensed dentist?
Sure there are good and bad electricians, just like any trade, but the bad ones don't tend to stay in business too long. I think the fines should be at least what I have to pay every year just to keep up my legal business plus the costs to rectify the bad work. — Ian

#14 I have been in the industry for 25 years and, up until a while ago, I could pull permits and had no issue with paying the fee. Now I have every government-run agency sticking their hands in my pocket. It's ridiculous.
No, I do not have my Masters ticket or contractors' license. All more fees to go into someone else's coffers. Most times on sites I see the ESA inspector show up and he is there for 20 minutes looking for small issues. It's all about the big companies and the payday for ESA.
I also had to add: what about all these HVAC companies doing work? Or the TSSA? Now *there's* a bunch of clowns. They have no clue most of the time; just told what to install. Also how is it that contractors are getting away with using labourers to install underground duct banks and putting together light fixtures? Case in point: the new stadium being built in Hamilton. — Mike

Not quite a photo finish

Can I help you select pictures that show correct PPE in use for your magazine? My jaw dropped when I saw the latest cover picture of a worker not wearing correct PPE. We need to show workers how to properly wear PPE and use all components of the appropriate system. In the case of your September issue cover, the worker is not wearing a balaclava and his ear plugs are not inserted.
The issue of workers not wearing all of their PPE is a serious problem that was identified in an IEEE PPE performance study over the past few years. Until publications like EBMag make a serious effort to demonstrate the proper use of PPE, how will the mass market know any different? People look at your magazine as a resource for information on electrical safety.
In your "Separating the pros from the joes" (From the Editor, page 3), you say electrical safety is the most significant issue. If I was a worker and looked at your magazine, I would think: "This guy doesn't wear a balaclava, so why should I have to?".

— Jim Pollard EB

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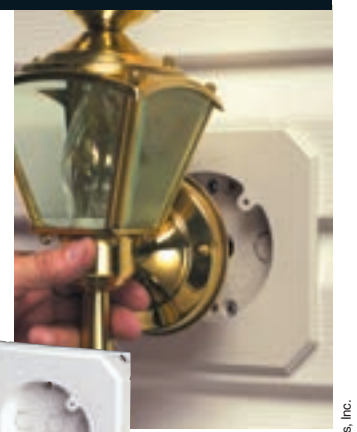

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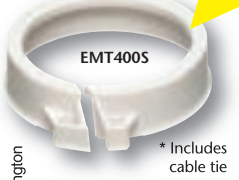

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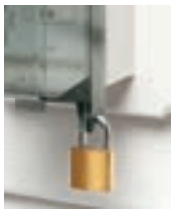

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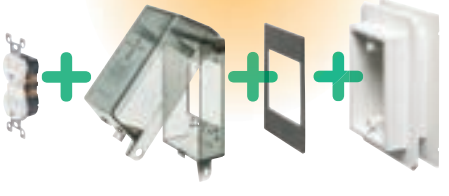

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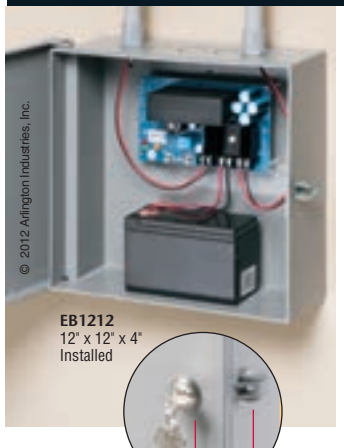

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Electrical maintenance & reliability...
with a healthy dose of electrical safety!
EBMag's Partners in Training

Anthony Capkun

While we're pretty good at attending and covering as many events as we can in our electrical industry, the Electrical Business team has not been as good as it should be in reporting on its own Partners in Training events. A shame, really, because we bring out some of the best subject matter experts and exhibitors to teach you about everything from electrical inspection using airborne ultrasound to maintaining your arc flash personal protective equipment.

We've just wrapped up our 2013 tour, which started this spring in Saskatoon and Dartmouth, and concluded this fall in Sudbury and Toronto (Mississauga). Nowhere else can you attend such high-quality yet completely unbiased, non-partisan education. And, as we look toward finalizing our 2014 tour season, I'd like to review the final event—Toronto—to both tell you what you missed, and to get you excited for next year's lineup.

Partners in Training Toronto edition

With the theme "Electrical Maintenance & Reliability (with a healthy dose of Electrical Safety)", subject matter experts and delegates from across Canada (and at least one from the States) came to the Apollo Convention Centre in Mississauga for a jam-packed day of sessions that provided solid, take-away advice about electrical maintenance, reliability and safety.

As MC of the event, I congratulated delegates on their attendance; their participation served as testament to their professionalism... to their desire to improve their game, increase uptime, win more work and return home safely. I also congratulated and thanked both our speakers and sponsors/exhibitors for their commitment to the market and our audience, devoting their own time and resources in attending and supporting Partners in Training.

Starting the day was Martin Robinson of IRISS Inc. with his session "Why we must consider performing a complete electrical maintenance program". For over 30 years, Martin has been a pioneer in the field of condition-based maintenance technology, and continues to innovate and pioneer the technological benefits of infrared thermography. He is a member of IEEE, NFPA and is a standing member on the technical committee CSA Z463 guidelines on maintenance of electrical systems.

Martin was followed by Sean Miller of UE Systems, who asked the question, "Does your electrical inspection toolbox include airborne ultrasound?". Not to be confused with the ultrasound used in hospitals, airborne ultrasound remains a relatively unknown yet powerful technology for detecting imminent failures in electrical systems. Airborne ultrasound 'listens' to friction and turbulence; in the electrical world, it detects corona, tracking and arcing and, most importantly, it does so at a safe distance without having to open your equipment. As such, hand-held ultrasonic instruments help inspectors by eliminating the need for wearing cumbersome, uncomfortable PPE during a preliminary survey.

Sean reminded delegates that equipment and/or system failure is not when it explodes during a cataclysmic event, but when it fails to meet its minimum performance characteristics.

Terry Becker of ESPS Inc. explained what he calls the 'Electrical Safety Trifecta'. To do everything possible to reduce the risk of worker exposure to the hazards of electrical arc flash and shock, one must adhere to the electrical safety trifecta, explained Terry, which consists of:

1. Approved equipment installed according to the Canadian Electrical Code, Part 1.
2. Effective electrical equipment maintenance according to the soon-to-be available CSA Z463, "Guideline on maintenance of electrical systems".
3. Establishing electrical safe work practices, according to CSA Z462, "Workplace electrical safety".

"Insulation resistance testing", presented by Fluke's Colin Plastow, looked the nuances of this test procedure, and he emphasized the importance of baselining and keeping records. Over time, electrical systems, motors and devices are subjected to normal wear, as well as environmental factors, that can lead to insulation degradation or failure, resulting in loss of production, safety issues or even fires.

Periodic insulation testing is an important component of predictive maintenance and will help prevent such failures. Test result data must be monitored over time, which helps guide your maintenance practices. Colin's session also brought about a spirited discussion over the frequency with which insulation resistance testing is to be performed.

Jim Pollard, an expert in arc-rated personal protective equipment (PPE), presented delegates with more of a hands-on session entitled, "Arc flash PPE management: What's in your kit bag?". Workers using arc flash PPE need to understand how the equipment should be used, which includes pre-use inspection, wearing it properly and how to care for it.

Jim brought examples of arc-rated gear and invited attendees to check them out, and showed them how to inspect, and even how to put on the gear. But how do you select your PPE? Jim had

an easy answer for that: first, you must start with a comprehensive electrical safety program. Once in place, your program defines the PPE you require. There is no sense in purchasing anything until you know exactly what you need, or don't need.

Electrical maintenance and safety programs are an integral part of any corporate maintenance management program; Ken Bannister's session "Meeting the electrical safety plan challenges required by CSA Z462" explored ways in which Z462 can be used to complement and bolster the corporate maintenance approach, while simultaneously easing the pain of implementation and better assuring compliance sustainability.

Ken is a recognized expert, consultant, author and speaker in the field of asset and operations management, and has worked on multi-faceted projects in Europe, Africa, Australia and throughout North and South America in the role of design, project, plant, lubrication and reliability engineer and, for the past 20+ years, as a change management professional. He is also a founding board member and past vice-president of the Plant Engineering Maintenance Association of Canada (PEMAC).

Closing out the day was John Salmon's session on the soon-to-be available CSA Z463 "Guideline on maintenance of electrical systems", which he had a hand in authoring. A Master Electrician, many of you will know John as the former owner of specialty industrial electrical contractor A.R. Milne Electric Ltd., or perhaps from all of his extensive work and participation on numerous codes and standards committees.

In discussing CSA Z463, John noted the guideline has something for everyone involved with electrical equipment: OEMs, owners and those who maintain. He reemphasized that a structured maintenance program saves lives and protects equipment, thereby ensuring and maximizing system reliability. Part of that regimen involves not just training a worker, but ascertaining his qualifications: is he even qualified to do the maintenance.

Most importantly, CSA Z463 is not a How-To document, explained John. It does, for example, explain the process of exercising your breakers, only that they must be exercised to verify performance.

See you next year

As I mentioned at the top, we're finalizing our 2014 schedule; for updates, please regularly visit the recently revamped EBMag.com, and watch for updates in both this magazine and in our biweekly newsletter, E-Line. Want the information even sooner? Then bookmark the website www.partnersintraining.ca, as everything will be uploaded there.

In closing, thanks again to everyone for a great day. And if you're interested in joining Partners in Training as a sponsor/exhibitor or speaker, or if you think we should bring our little roadshow to your neck of the woods, let me know. We look forward to it. EB

Anthony Capkun is the editor of Electrical Business magazine. You can reach him at (905) 713-4391 or acapkun@annexweb.com.

Was bad utility power killing cheque-processing machines?

Patrick J. Lynch, P.Eng.

What do hot cheques, musical chairs, pink slips and electrical power all have in common?

All these seemingly unrelated items have, unfortunately, merged together at a very troubled data processing site to produce one huge, multi-million dollar daily liability. The site was that of one of the largest U.S. bank cheque clearing data processing centres in all of North America.

These bank cheque clearing data processing centres are only given hours to process the received cheques. Severe financial penalties are assessed against the offending data centres for failure to process the cheques within the allotted timeframe (as per their inter-bank cheque-processing agreements).

Each processing centre has high-speed cheque-clearing machines that automatically scan the information on each cheque. They then debit and credit the cheque dollar amount from the respected banks for each cheque transaction. Before the cheques reach these high-speed machines, however, each cheque has to be manually read by a machine operator for the correct dollar amount to be coded and printed onto each cheque.

The cheques were piling up faster than the machine operators could code them. Here was a problem bottleneck!

All of the 40 cheque-coding machines were electrically overheating, automatically resetting themselves every 10 to 15 minutes, then failing again faster than the cheques could be coded. The operators would then grab these unencoded cheques out of their *hot* machines, get up from their chairs with a handful of these *hot* cheques and race over to another, working machine. Within minutes, that machine would also overheat, leading to a footrace between operators to find the next available working machine.

As an outsider peering in through this office glass partition, it appeared these operators were playing a game of musical chairs. The strange thing? Nobody else could hear the music!

Costly penalty fines and imminent pink slips

Several, very large late penalty fines had already been assessed against this banking operation. Facility personnel had been scrambling for answers for almost two months to no avail. The facility operational personnel had been put on notice and were advised to start looking for other employment if the problem was not quickly fixed. Each night, personnel would go home and work on perfecting their resumes. To date, no one the processing centre contacted could find a solution to this massive problem.

The strange thing is all these exact same machines had worked perfectly at the client's other processing sites for the last eight to 10 years. Plugging these same machines into the 120V wall outlets at this site only created overheating and chaos. Believing these machines may have been damaged in transit, the client shipped these failing machines back to their original processing site.

Surprise, surprise... the very same machines now work perfectly again at the original site.

The measured 120V voltage levels and receptacle wiring configuration was correct at this new site, so what could be causing the problems?

The cheque encoding machine manufacturer was contacted, who suggested each machine:

1. have its own dedicated neutral wire (no sharing). The entire site was rewired, and they continued having the overheating problem.
2. be placed on its own dedicated insulated ground circuit (orange receptacle). The entire site was rewired a second time, and they still experienced overheating failures.

Getting to the bottom of it

We were briefed by facility personnel and made to understand the urgency of the situation, and were asked to quickly perform a professional forensic electrical engineering investigation. We had our suspicions as to the underlying problem.

To confirm our suspicions, we brought with us our own small 1000VA ferroresonant isolation transformer: 120V in and 120V out. Within minutes after plugging in, we had five machines up and fully operational, running continuously without overheating and failing. As a short-term fix, the facility personnel frantically ordered additional identical isolation transformers from their supplier.

But these temporary isolation transformers were only masking the real problem. Now with a little breathing space courtesy of the temporary fix, we began the real diagnostic work.

Detailed forensic electrical power system analysis voltage/current waveforms and harmonic frequency spectra data were recorded for the chequing coding machines at both sites.

At the failure site, the current draw from the 120V wall outlets by the machines was double that of the same encoding machines' current draw at the original site (4A versus 2A).

Phase current harmonic frequency components were also considerably higher at the failure site (about 30dB). These results explain why the machines were overheating and shutting down, but why was there such a large electrical current difference between sites? It is still 120V measured at the wall outlets, right?

The elevated phase current harmonic traces and the minor symmetrical voltage ripple on the voltage waveform were the real clues. The

voltage at these wall outlets must be fed from a distorted voltage source. All the wall outlets at both sites, however, are fed from normal utility power.

Is the culprit bad utility power?
Do we call up the electrical utility up and blame them for the supposedly bad power they are delivering and, further, demand they reimburse this data centre for the late cheque processing penalty fines they were continually having to pay?

Our 30-years of experience in conducting electrical forensic investigations tells us the end user is the cause of their own power problems 90% of the time.

Careful examination of the main electrical power schematic for this site revealed there were two main high-voltage feeders to the site with 10MVA, 480V step-down transformers. One 480V transformer basically fed all of the mechanical loads in the building. The other 480V transformer fed office lights, machine receptacles, etc., as well as the site's 3MVA uninterruptible power supply (UPS) system.

Hmm, any clues here?

Based on the harmonic distortion levels measured at the machine receptacles, we had a strong suspicion this large UPS system (that was fed from the same electrical feeder) was the root cause of the voltage harmonic distortion. To confirm our suspicions, the data processing personnel agreed to power their facility from their diesel generators only, temporarily turning off their UPS system.

As we suspected, all voltage and current harmonic distortion immediately disappeared, and the encoding machines returned to drawing nominal nameplate current (2 amps), with no overheating when plugged directly into the wall outlets.

The UPS system was injecting harmonic distortion right back into the utility power system from which it was electrically fed. It was electrically *polluting* this entire site's power system electrical feeder.

Do we have to plug in isolation transformers at every wall outlet that is being used?

We then provided two solutions to the client:

#1 Install additional input harmonic filtering on this UPS system to allow these cheque encoding machines to properly operate (extremely expensive option at this point).

#2 Re-route all the receptacle electrical feeders at this site to the normal utility power side that feeds the mechanical loads within the building (i.e. encoding machines now plugged into the mechanical load side of this building, electrically isolated from the UPS).

The client chose Option #2, and has been humming along problem-free (without the musical chair routine) for the last 10 years.

At the initial electrical design stage for this UPS system, stringent maximum allowable input voltage and current harmonic distortion levels should have been specified, including performing electrical system harmonic modelling. This generally would involve spending about 10% to 15% more to install the correct harmonic filtering on the UPS input side. EB

Patrick J. Lynch, P.Eng., has been the president of Power Line Systems Engineering Inc. since 1986. He graduated Electrical Engineering from the University of Waterloo in 1975, and has successfully directed Power Line's completion of over 1100 complex electrical engineering site disturbance investigations around the globe. Visit www.powerlinesystems.ca.

SO HAPPY TOGETHER:
insulation multimeters and thermal imagers

Measurements for motors and drives

Colin Plastow

Facilities need to get maximum life out of their motors, because they are expensive to replace in terms of both money and labour. Electrical, insulation resistance and thermal measurement are three tests that can troubleshoot motors, drives and associated electrical panels and prolong their operational lifetime. Used together, thermal imagers can detect potential problems, while insulation resistance and electrical tests can determine the cause.

A thermal imager is good for spot checks: to see whether motors and associated panels and controls are operating too hot and, for troubleshooting, to track down the specific failed component. It can also check for phase imbalance, bad connections and abnormal heating on the electrical supply.

When a motor is having problems, check the supply voltage, then use insulation testing to check the starter and control contacts; measure the insulation resistance of the line and load circuits to ground, and winding resistance phase-to-phase and phase-to-ground.

Thermal measurements

A motor's heat signature will tell you a lot about its quality and condition. When a motor is overheating, the windings will rapidly deteriorate. In fact, every increase of 10C on a motor's windings above its designed operating temperature cuts the life of its windings' insulation by 50%, even when the overheating is only temporary.

When a temperature reading in the middle of a motor housing comes up abnormally high, take a thermal image of the motor to find out more precisely where the high temperature is coming from e.g. windings, bearings or coupling (when a coupling is running warm, it is an indicator of misalignment).

Insulation testing combined with regular motor maintenance can help identify degradation before failure, and during installation procedures to verify system safety and performance.

There are three primary causes for abnormal thermal patterns, though most are typically the result of a high-resistance contact surface—either a connection or a switch contact. These will usually appear warmest at the spot of high resistance, cooling off the further away from the spot. Figure 1 shows a classic pattern in the centre phase connection on the line-side of a breaker; note how the conductor cools off at the top of the image.

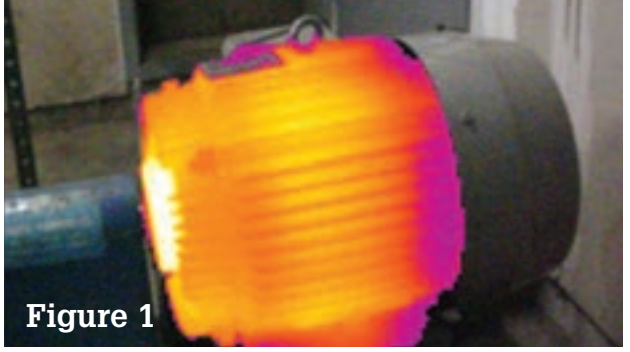
Load imbalances, whether normal or out of specification, appear equally warm throughout the phase or part of the circuit that is undersized/overloaded. Harmonic imbalances create a similar pattern. When the entire conductor is warm, it could be undersized or overloaded; check the rating and the actual load to determine which.

Failed components typically look cooler than similar, normally functioning ones. The most common example is probably a blown fuse. In a motor circuit, this can result in a single-phase condition and, possibly, costly damage to the motor.

Insulation resistance testing

Insulation problems on motors and drives are usually caused by improper installation, environmental contamination, mechanical stress or age. Insulation testing can easily be combined with regular motor maintenance to identify degradation before failure, and during installation procedures to verify system safety and performance. When troubleshooting, insulation resistance testing can be the missing link that enables you to get a motor back into operation the easy way (i.e. by simply replacing a cable).

Insulation testers apply a DC voltage across an insulation system and measure the resulting current (Figure 2). This allows them to calculate and display the resistance of the insulation. Typically, the test verifies high insulation resistance between a conductor and ground, or high insulation resistance between adjacent conductors. Two common examples



If a temperature reading in the middle of a motor housing comes up abnormally high, take a thermal image of the motor and find out more precisely where the high temperature is coming from.

A thermal imager is good for spot checks, to see if motors and associated panels and controls are operating too hot, and for troubleshooting, to track down the specific failed component at fault.

include testing motor windings for insulation from the motor frame and checking phase conductors for resistance from bonded conduit and enclosures.

Insulation multimeters combine the insulation resistance functions above with the other tests needed to investigate motor, drive and electrical trouble, from basic supply measurements to contact temperature. The key difference is that insulation resistance tests are performed on de-energized systems, while electrical (and thermal) tests are almost always performed on live, operating systems.

Electrical and insulation resistance tests on motors

1. Visual inspection

First, look for a reason *not* to energize. Remove power from the motor and starter (or drive) following lockout/tagout procedures, and disengage the motor from the load.

- Conduct a visual, smell and heat inspection, interview the client and check the nameplate. Look for loose connections at the starter and check all fasteners.
- Use a DMM to check the supply voltage, then the voltage starter contacts.

Don't risk a fire from a possibly shorted motor. When the supply is good, then there's a motor problem.

2. Control contacts check

Check the control contacts for quality of contact:

a) Lockout and tagout the disconnect to the starter.
b) Manually engage the starter so the contacts close.
c) Set the insulation tester to the low ohms range.
d) Measure the resistance across each set of contacts.

e) The reading should be nearly zero. When it's higher than 0.1 ohms, that set of contacts needs to be replaced.

3. Resistance of line and load circuits to ground

Measure the insulation resistance of the line and load circuits to ground. However, before doing *any* insulation resistance testing, you must isolate any electronic controls and other devices from the circuit under test. Then:

a) Lockout and tagout the disconnect to the starter.
b) Set the insulation tester to the appropriate test voltage (250V, 500V or 1000V).
c) Identify the resistance between these points:
   - Line side of starter to ground
   - Load side of starter to ground

To pass these tests, the line and load circuits need to show high resistance. As a general rule, AC devices need a minimum 2 megohms to ground and DC devices need 1 megohm to ground to ensure safe operation.

It is important to note that different companies have different threshold minimums for insulation resistance on used equipment, ranging from 1-10 megohms. Resistance on new equipment should test much higher—from 100 to 200 megohms or more.

When the load side resistance values are acceptable, then proceed to the next test; when they are not, start tracing the problem: is the insulation breakdown in the load side of the starter, the cables or the motor?

4. Winding resistance phase-to-phase and phase-to-ground

Take insulation resistance measurements phase-to-ground and resistance measurements phase-to-phase.

GOOD RESULTS

- Balanced comparative low resistance values on all three stator phases
- High resistance values on the phase-to-ground insulation test

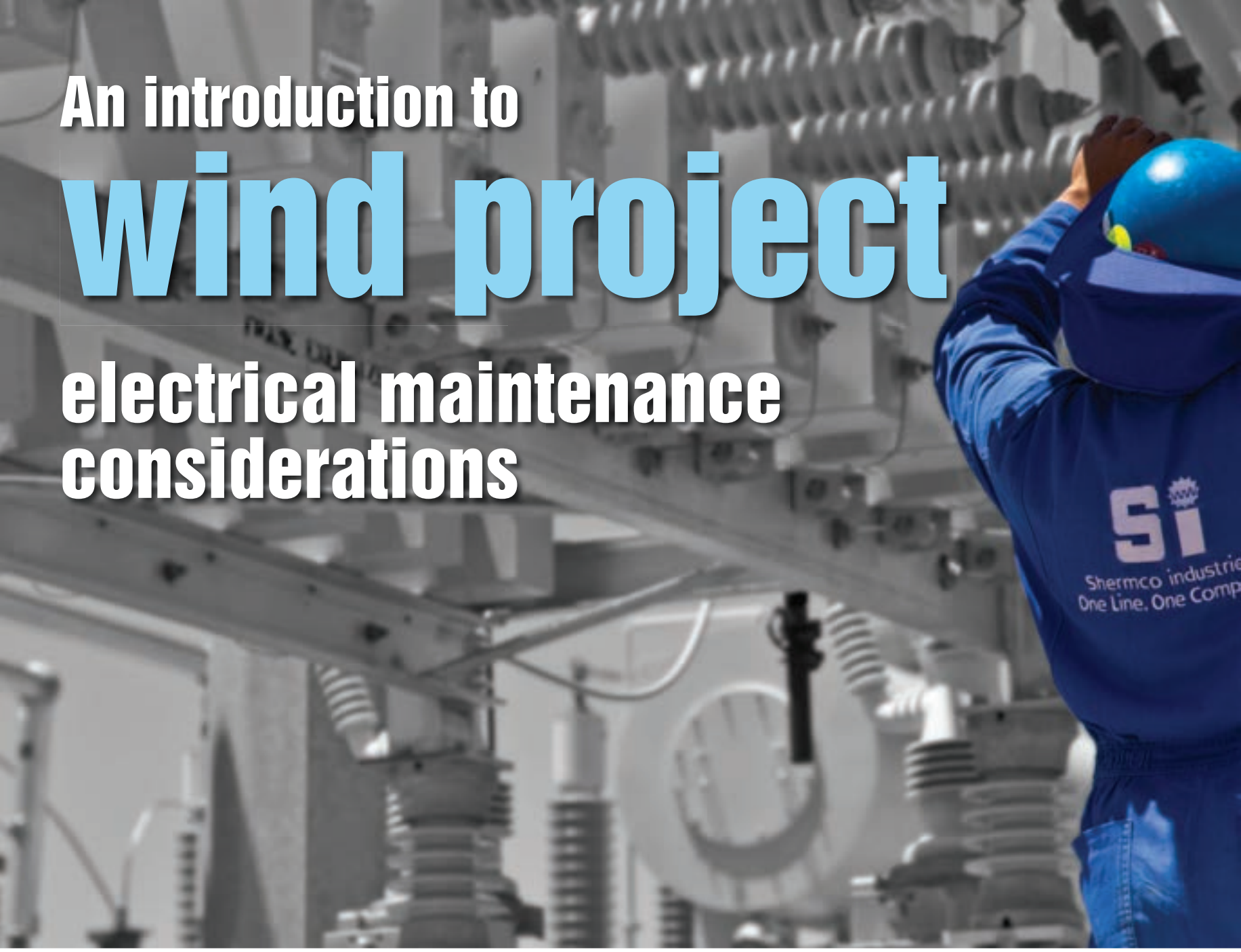
PROBLEMS

- Gross resistance deficiencies, such as a phase-on-phase short.
- Any winding to winding resistance imbalance. When the readings differ by more than a few percent, the motor is probably unsafe to energize. EB

Colin Plastow has been with Fluke Electronics Canada since 1987 in various support and product management positions. Today, as industrial product manager, he brings his expertise in electronic test & measurement to customers in high-tech and industrial markets, and shares his industry knowledge through various seminars and industry publications. You can contact Colin at colin.plastow@fluke.com.

Figure 2

An introduction to wind project electrical maintenance considerations



Kevin Alewine

Wind farms, especially the big utility-scale installations, are just like any other power plant: they need to produce the highest power output at the lowest cost per kWh with the highest level of safety and reliability.

As they are completed and go into production, they experience all of the issues faced by the other generating facilities—namely, consistent, profitable production and a dependable interface with the distribution grid.

To achieve all of these goals, a strong maintenance regime is required, including periodic electrical testing for the wind turbines, collector system and substations.

Since the source energy is free, the entire cost of production is borne by the price of the initial installation and the required operations and maintenance expenses. While these are sometimes in conflict, as will be discussed a little later, the realities of operating costs should be captured in the initial planning for the generating facility.

While there are many pieces of mechanical equipment in wind turbines, as well, most of the focus of this article will centre on just the electrical basics with an eye to helping distributors and service companies understand how they might fit into the supply chain.

Wind farm overview

To begin, a general overview of a typical wind farm, which has two major areas of maintenance planning. The first is the turbines themselves, with the rest of the installation referred to as the balance of plant (BOP). Often, the BOP is maintained by a contractor or specialty high-voltage service company.

The turbines require specialized skills, tools and training. Most wind farms today consist of multiple megawatt-sized turbines: the largest land-based machine in common use is rated at 3MW, and there are still a lot of smaller 1.5MW, 2MW and 2.5MW machines being installed. These large turbines are on towers ranging from 65m to 120m in height, with rotor diameters up to 118 metres. Offshore will be an entirely different situation, with monsters up to 10MW being planned... and even the current 6MW design utilizing a 154-m rotor.

There are also smaller installations—with one to 10 turbines that are community-based, or even single installations near the consumer—referred to as distributed wind since the turbines are mostly connected 'behind the meter', and the power is not normally transmitted to other locations.

In the larger farms, the turbines are connected through an oil-insulated, pad-mount transformer (or, sometimes, an internal dry-type) in strings of up to 10 turbines utilizing direct burial cable, often at 34.5kV. These strings are then collected with others to a connection point utilizing some simple switchgear. These collection points then feed through breakers into the collection substation where the grid connection is made. Pretty simple, but there is a lot of MV wiring and accessories. Some wind farms in North America have over 400 wind turbines with multiple interconnect substations.

The wind turbines themselves fall into two basic categories. The traditional is a gearbox-based drivetrain where the generator actually operates at or near synchronous speed. Utilizing advanced electronics, a double-fed induction generator (DFIG) offers both a wider range of operating speed as well as a higher output for its size than a conventional engine-driven generator.

In this design, the stator of the generator is normally connected directly to the transformer, and the output from the wound rotor is converted and synchronized electronically. Some designs will use a fully converted AC/DC-DC/AC output, which allows a much broader range of operating speed for the generator.

The second type of generator that is becoming popular, called direct drive, is where a large-diameter generator (often 4 to 5 metres in diameter

and built a little like a hydro generator, but on its side) is driven directly by the rotor, normally at 17-20 RPM. The power is also fully converted by electronics at low voltage before attaching to the transformer and the collector system.

This direct drive design has the advantage of lower maintenance costs and generally higher reliability by design, but it is often more expensive initially. It is common in newer versions of both designs to utilize rare-earth, permanent magnets to simplify the excitation supply.

Turbine maintenance basics

General, non-electrical maintenance of the turbines includes managing the gearbox lubrication system, repairing damaged fiberglass blades, as well as cleaning/replacing smaller mechanical components, such as brake pads and, often, hydraulic pitch controls.

The towers themselves are bolted together and to the foundation utilizing hundreds of connections, and these must be checked periodically.

Personnel safety is a major concern and the climb assists, man-lifts and other safety related components must be carefully inspected, repaired or replaced. The gearbox is a major issue, as this is a very strenuous application and the gearboxes are made as small and lightweight as possible. Monitoring vibration as well as the oil condition is critical to maintaining reliability.

So, where/what are the critical elements in maintaining the electrical components of the turbine? First, the DFIG-style generators use a slip ring assembly with carbon brushes to manage the power both to and from the wound rotor. This is a critical maintenance area that must be carefully cleaned of carbon dust to avoid electrical flashover. The brushes are typically changed every six to 12 months. There is also a grounding system of brushes to manage transient voltages on the generator shaft.

Although SCADA (Supervisory Control and Data Acquisition) and other condition-monitoring information will often identify a problem in the making, it is important that the generators be checked periodically for misalignment and lubrication. Secondly, the pitch (angle of the blades) and yaw (direction the rotor is pointing) are powered by gear motors with electronic

controls. These can be high wear items and should be checked regularly.

There is also a control and power slip ring assembly that allows the pitch motors to be located in the rotating hub of the turbine. This can also be a problem area that must be cleaned and maintained properly. There are also hydraulic pump motors in some models for pitch control, braking and gearbox lubrication. These must also be inspected and cleaned regularly. As the pitch and yaw of the turbine must be controlled even when there is no power available from the grid, there are battery banks for temporary control that must be checked and replaced periodically.

Lastly, the power convertors, normally located in the base of the turbine tower, must be cleaned and the filters changed on a regular basis.

What about the collector system and substation?

The collector system is normally considered to begin with the main output transformer at the turbine. It is normally an oil-insulated, pad-mount design located externally and connected to the turbine through a main breaker referred to as the CB-1. The output voltage varies, of course, but a very common value is to boost from 690vac from the turbine to 34.5kV for the collector system.

These transformers can be troublesome (but that will be discussed in the "Oops" section to follow). Periodic testing of the transformers, as well as the wiring, is strongly suggested as part of a predictive maintenance program, and all of the breakers should be operated during a maintenance cycle to assure proper lubrication of the mechanisms. Of course, they should also be tested and repaired during a shutdown to comply with reliability guidelines.

The substations are effectively the same as those in any distribution system. The energy from the collector system is boosted to transmission voltage and connected to the grid with a series of protective devices and controls. This design is somewhat dictated by the appropriate grid reliability agencies with oversight from the North American Electric Reliability Corporation (NERC) and the various interconnection districts.

Maintenance materials and equipment basket

So what is the role for traditional electrical distributors to supply contractor and operators for building and maintaining wind farms? During the construction phase, a full basket of materials and tools are required:

- Transformers: typically 1500VA to 3000VA, 3-phase, oil-insulated pad mounts, various switches and switchgear, junction boxes, etc.
- Substation components, relays, breakers, CTs.
- Cables of all types, from low-voltage wiring and devices to 34.5kW direct burial cables and the related splices, junctions, tees.
- Fiber optic cable and related splices, LAN cables and devices.
- Various electrical accessories: conduit, tools, test instruments, tapes, splices, electronic cleaners, filters.
- Lighting and security systems.
- Replacement motors for pitch and yaw applications, as well as for use in ventilation and hydraulic pumps.
- Fuses, batteries, charging systems, UPS.

So where are the problem areas? As stated above, constructing and maintaining wind farms are the costs affecting the price of the electricity, as the wind is free. Because of this, every effort is made during the design and construction phase to reduce the costs and maximize the forecast profitability of the farm. It is not unusual for both materials and equipment to meet only the minimum standards required, and for the contractors to make the lowest possible offers for various aspects of construction.

It's not that the wind farms are improperly designed, but there is little to no room for errors or electrical stresses. This runs counter to the operations goal of getting maximum output from the facility.

There are also upgrades available to improve the output from existing farms; it is important they do not overload the collection system or its components, so any substantial change should be accompanied by an engineering review, and an upgrade to the collector systems and, possibly, the substation.

Two chronic problems appear in the BOP area. Since these installations are typically built quickly and economically, there have been issues with the quality of the high-voltage splices in the collector system, both terminations and butt splices. Proper grounding of the turbines and the collection systems has also been overlooked in some locations. All of these errors can create faults leading to lost production. Several online and offline tests are available to identify and quantify the damage, but expert personnel are required for locating and repairing these critical faults.

The second chronic problem is with the pad-mounted transformers. Again, these components were possibly specified as standard-duty with little or no headroom for capacity. What has been learned is that the power coming from the turbines is often electronically generated and, although filtered, still might not be as clean as from traditional generators.

Those distortions, along with the high cycle rate of production, probably load the transformers beyond their design capacity. During testing, higher levels than expected of dissolved gasses, especially hydrogen, are common. This condition can create a safety hazard for personnel working on or near the transformer. In addition, the internal tap switch is often used as a disconnect switch, which is not really its purpose.

So what needs to be tested and why?

Again, looking at the two main components of the wind farm—the turbines and the

BOP—a good testing regimen should be developed based on manufacturer's recommendations, consensus standards and agency requirements. For the turbines, basic electrical testing of components is an option, but mere insulation testing (IEEE 43) is really only intended to prove the insulation for safe startup or to continue with more strenuous testing.

However, it is a good idea to check after a turbine has been out of service, especially in humid conditions. Don't forget the auxiliary motors (ventilation, hydraulic, pitch, yaw, etc.) as well as electric devices on man-lifts or hoists. The insulation resistance can also be used for some basic troubleshooting experiments but, when a fault is suspected, it is always best to bring in an expert with additional testing capabilities. There are other electrical systems in the turbine that should be tested, including lightning protection circuits and the electrical cables as required.

Transformers should have oil samples taken on a regular basis and the results trended. When there are concerns, the oil can be serviced or replaced. When any faults are discovered in the collection system, they should be traced, repaired and re-tested. When it appears a chronic problem exists, a cable testing specialist should be called in to test the entire system and recommend repairs. These cable faults, normally at splices or terminations, can become a nagging issue that will haunt production until corrected.

For the switchgear, circuit breakers, relays and the substation in general, there are recommended testing guidelines from the Inter-National Electrical Testing Association (NETA), IEEE and other agencies that provide guidance for testing and test intervals to comply with both good business practice and meet NERC requirements. Local reliability councils might also have requirements.

For additional information, the American Wind Energy Association has developed "Operations and Maintenance Recommended Practices"; while this document does not cover all the details of running a wind project, it is an excellent source for understanding the scope of wind farm maintenance and operations.

Maintaining the electrical (and mechanical, for that matter) equipment on a wind farm is critical to the safe and reliable operation of the power plant. Even when the entire facility has been reviewed and arc flash studies written, equipment that does not operate properly will pose a hazard to personnel and make production unreliable.

Knowing that there are several areas of chronic problems should help assign priorities to the maintenance efforts. Good support from local suppliers and contractors is critical to the ongoing success of the wind farm as is the availability of higher-level expertise for testing and repairs on specialty equipment, such as transformers, generators and substation components. EB

Kevin Alewine, director of renewable energy services for Shermco Industries (www.shermco.com), focuses on strategic planning for the wind energy business sector. He has extensive global experience with the application of electrical materials, systems and processes for both the manufacture and repair of electrical machinery, including wind turbine generators. Kevin is an active member of several IEEE and American Wind Energy Association working groups, and is the current co-chair of AWEA's Operations & Maintenance Working Group responsible for developing and maintaining recommended practices for managing wind energy assets.

Ian J. Houston |

When is negligence really *gross?*

When a person commits a careless act that causes harm to another, provided the act was not planned, it is often considered *negligence* under Canadian law. Over the years, negligence has become the most common area of Canadian tort law, and there is generally considered to be only one standard of negligence in Canada.

However, the term *gross negligence* has increasingly appeared in Canadian commercial contracts, often in limitation of liability and indemnification clauses. An understanding of what this term may mean is important for everyone negotiating such agreements.

For decades in Canada, the only place where the term *gross negligence* appeared was in some highway traffic statutes or in good samaritan legislation. The term was used to establish a higher threshold than ordinary negligence for liability arising from certain designated acts.

The term has found its way into commercial agreements, however, commonly as an exception to, or 'carve-out' from, a limitation of liability provision. In this context, a party is prevented from relying upon a contractual limit when liability in the event damages arise from the party's gross negligence.

A second use of the term is in an indemnification provision. In this context, it often serves to establish a threshold which is higher than ordinary negligence to trigger an obligation to indemnity.

The fact that the term gross negligence is being used in commercial agreements may be an issue, because there is no precise definition for it in Canadian common law jurisdictions. The most cited case on the issue is a 1942 Supreme Court of Canada decision, McCulloch v Murray, in which the court, quite unhelpfully, defined the term as meaning "very great negligence".

Other cases have struggled with arriving at precise definition. Despite the lack of a clear definition, the law is clear that gross negligence differs from ordinary negligence with respect to degree. While the law appears settled there is no requirement of intent to turn ordinary negligence into gross negligence, or a requirement for a finding of *reckless disregard*, it seems that: a) there has to be a marked departure from the standards of reasonable people or, b) when a mishap or failure to take reasonable care will result in a loss of life, serious injury or grave damages, the magnitude of such risks may be found to constitute gross negligence.

> The term gross negligence has increasingly appeared in Canadian commercial contracts, often in limitation of liability and indemnification clauses.

Given that this body of law is somewhat unsettled, it is always advisable that when the term gross negligence is used in a commercial agreement, the parties should take the time to define what they mean by it. In addition, when negotiating the provisions of a commercial agreement that refer to the term, there are few other points to keep in mind:

a) One way to reduce the scope of a gross negligence carve-out from a limit of liability provision is to agree that it only applies to the senior management of a party, while resisting such a qualification broadens the exclusion.
b) A further factor that would narrow the ambit of a gross negligence carve-out is including in the definition an element of intent (despite the fact that, as noted above, the common law definition includes no such element), although the party seeking the gross negligence exclusion will likely resist the inclusion of intent in the definition.
c) Under some contracts, including some standard contract forms, the definitions of *gross negligence* and *willful misconduct* are combined. This practice tends to broaden the definition of gross negligence to include an element of intent and/or the concept of wanton and reckless conduct. Again, depending upon a party's point of view, the broader definition may be more or less desirable.

It is more common than uncommon that parties to a major commercial agreement will need to consider provisions including the term *gross negligence*. Regardless of the point of view of the party, given the somewhat unsettled nature of the law in this area, it is prudent to consider including a definition of *gross negligence* in the agreement when the term is used. As to the nature of this definition, a party's point of view and the context in which it is used will dictate whether a party prefers a broader or a narrower definition. EB

Ian Houston is regional leader of the Construction and Engineering Group in the Toronto office of Borden Ladner Gervais LLP (www.blg.com), and a Fellow of the Canadian College of Construction Lawyers. His practice ranges from providing commercial law advice on contractual and procurement issues, to assisting clients in resolving disputes through litigation or alternative dispute resolution methods. Ian can be reached at ijhouston@blg.com or (416) 367-6111.

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

IN CASE YOU MISSED IT...

PHOTOS • EBMag was invited to visit Franklin Empire's 1st Annual Customer Appreciation Day at its Toronto HQ. Who did we see? Visit bit.ly/19nG37e.

VIDEO • "My goal is to challenge you guys, to help this industry become a sustainable leader in Canada," said Mark Tsou, an EFC university scholarship winner. Visit http://bit.ly/188VVQb.

PHOTOS • Check out the cutting-edge teaching aides at IBEW Local 353's Mississauga, Ont., training facility. Visit bit.ly/19nGyhH.

PARTNERS in Training

EBMag's Partners in Training returns in 2014:
• Edmonton • Winnipeg • Ottawa • Toronto • St. John's
DETAILS coming soon!
Visit www.partnersintraining.ca

EFC e-Tech Marketing Forum
Electro-Federation Canada
November 13, Vaughan, Ont.
Visit www.electrofed.com/newsroom/events

APPrO 2013: 25th Anniversary Canadian Power Conference & Networking Centre
November 19-20, Toronto, Ont.
Visit conference.appro.org

BICSI Canadian Region Meetings
November 21, Ottawa, Ont.
Visit www.bicsi.org

OEN Luncheon Series: Anthony Haines, Toronto Hydro president & CEO
Ontario Energy Network
November 21, Toronto, Ont.
Visit www.ontarioenergynetwork.org

Southwestern Ontario Electrical Products Exhibition
Ontario Electrical League's Essex Chapter and the Windsor Essex county Area Electrical Distributors
November 27, Windsor, Ont.
Visit ibsws.net/oel

EFC Christmas Across Canada
Electro-Federation Canada
• **December 4,** Toronto, Ont.
• **December 5,** Quebec, Que.
• **December 11,** Montreal, Que.
• **December 10,** Halifax, N.S.
Visit www.electrofed.com/newsroom/events

Construct Canada 2013
December 4-6, Toronto, Ont.
Visit www.constructcanada.com

OEN Luncheon Series: Tom Mitchell, OPG president & CEO
Ontario Energy Network
December 9, Toronto, Ont.
Visit www.ontarioenergynetwork.org

Solar Canada 2013
Canadian Solar Industries Ass.(CanSIA)
December 9-10, Toronto, Ont.
Visit www.cansia.ca

2014

OEN Luncheon Series: Bruce Campbell, IESO president and CEO
Ontario Energy Network
January 8, 2014, Toronto, Ont.
Visit www.ontarioenergynetwork.org

BICSI Winter Conference & Exhibition
February 2-6, 2014, Orlando, Fla.
Visit www.bicsi.org

ECAA Annual Convention
Electrical Contractors Association of Alberta
February 15-27, 2014, South America
Visit www.ecaa.ab.ca

Two new switch kits to Standard Products' wireless controls family

Standard Products is offering two types of wireless switch kits to its wireless controls product facility. The two-way kits have a power pack relay and a single switch; and the three-way kits have a power pack relay and two switches. According to the company, the transceiver and the switch(es) are pre-linked and do not require additional programming. The sensor will automatically trigger lights to turn off after the room is vacant and an egress timer expires, thus helping users reduce energy consumption. The units are available for wide angle, hallway and corner mount.

STANDARD PRODUCTS
www.standardpro.com

"More robust user experience" with Universal Lighting's redesigned website

Universal Lighting Technologies Inc.—a manufacturer in the commercial lighting industry—has unveiled a refreshed website at www.unvlt.com. Users will find a new layout and colour scheme; reduced clutter on the homepage; rotator banner; and various points of entry to lead directly to common site destinations, said the company. "Our goal is to provide instant access to specs, product literature, case studies, reference guides and anything else our customers may be looking for in the most straightforward and easy-to-find manner possible," said Susan Phillips, marketing director.

UNIVERSAL LIGHTING TECHNOLOGIES
www.unvlt.com

3M introduces A19 LED lamp for totally enclosed luminaires

3M says its new LED A19 lamp is among the first approved for enclosed fixtures in commercial applications. The LED Advanced Light promises great heat management, energy efficiency and longevity, makes it suitable for difficult-to-reach fixtures, enclosed luminaires and other commercial applications. The light recreates the bright, even glow of an incandescent bulb, says the company, but uses up to 80% less energy; most importantly, it is tested and approved for use in a totally enclosed luminaire. The lamps are available in 3000K or 4000K temperatures, offer instant-On illumination and can be used with a variety of dimmers. They join a family of LED products from 3M that include spot, flood and accent lights.

3M
www.3m.com

GE blends 'reveal' brand with energy-efficient LEDs

GE Lighting has combined two of its technologies—the 'reveal' brand and LEDs—into one bulb. The GE reveal LED bulb delivers the energy efficiency of an LED while promising light that is specially engineered to depict colours and patterns in a home. Reveal lighting technology filters out dull yellow rays and delivers crisp, white light, says GE, making Reds appear redder and Whites whiter. The reveal LED bulb uses 80% less energy than traditional incandescents, says the company, and lasts 13.7 years (based on 3 hr/d operation). The bulbs sport the familiar size and shape of incandescents and offer dimming controls; they are available in 40W and 60W replacements for general purpose use, such as table and floor lamps, as well as the BR-30 indoor floodlight for track and recessed lighting.

GE LIGHTING
www.gelighting.com

Eiko LitespanLED line adds Slim and Direct Panel fixtures

Eiko Canada has introduced a 2 x 2-ft Slim Panel and 2 x 2-ft Direct Panel to its LitespanLED product line, designed to replace 2 x 2-ft fluorescent fixtures. The additions boast energy efficiency, glare-free illumination to simulate natural daylight, and a RoHS compliant design. Both fixtures are suitable for various applications, such as retail, residential, healthcare, and schools.

EIKO
www.eiko.com

EB products

ESPS first with electrical safety eLearning in both official languages

In what it claims is an industry first, ESPS's (Electrical Safety Program Solutions Inc.'s) electrical safety eLearning enables employers to provide immediate, consistent, cost-effective to their entire workforce in BOTH official languages. Both the Electrical and Non-Electrical Worker course options are available in English and French. Accessible online or by LMS license, this eLearning helps employers meet regulatory requirements and provide their workforce with relevant electrical safety training. Developed using 3-D graphics,

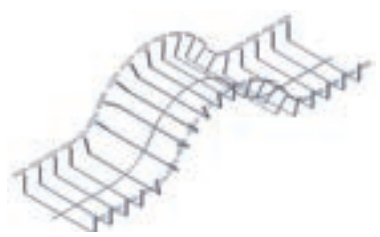
students will learn via simulated electrical hazards within a virtual classroom. Course content includes interactive knowledge checks, which challenges students as they head for the final exam. For more information and/or a free evaluation, email nat.patro@espsi.ca or visit www.arcflash-training.ca.
ESPS
www.esps.ca

Ideal Industries Tuff-Rod poles promise to cut time and hassle of running cables

Tuff-Rod push/pull poles from Ideal Industries claim to simplify the task of running cables above ceilings, down walls, under raised floors, or through hard to access voids and cavities. Described as flexible yet strong, the poles can be used with a variety of cable and wire types, including speaker and telephone wire, twisted pair data cables, fiber, thermostat, coax and general electrical cables. The Tuff-Rods are made of non-conductive fiberglass rods to help protect the installer from electrical shock, and are designed to be threaded together to achieve a maximum length of 30 ft. Three attachment-ends extend the rod's versatility: the J Hook; the Bullet tip; and the Wisp head.
IDEAL INDUSTRIES
www.idealindustries.com

Mega Snake cable tray tackles those crooked runs

When your cable tray installation is not a straight run, consider using Snake Tray's hand-bendable Mega Snake—a pre-configured high-capacity overhead cable tray that comes in straights, turns and Ts to simplify installation. Mega Snake's design can convey thousands of cables for large runs, says the company, adding that Snake Rail—a built-in suspension system—requires no brackets, and allows for random placement of the hanging rod system. Snake Rail interfaces with other-sized Snake Tray trays, as well as patch panels, strain relief and fiber optic pass-over devices. Mega Snake, boasts Snake Tray, is the first large-sized cable tray to be built that nests together for "cost-effective shipping and easy onsite handling".



SNAKE TRAY
www.snaketray.com

Cummins to offer energy-saving hybrid telecom power system

Cummins Power Generation has teamed up with Heliocentris—a player in energy efficiency and clean power solutions—to incorporate the latter's networked energy management technology in a new hybrid power system designed to provide power for cellular base stations and other telecom applications. The Cummins

telecom hybrid power system will employ a diesel genset, storage batteries and networked energy management technology to supply power to cellular sites. Combining gensets that are specifically designed for telecom cellular sites with a hybrid system that cycles storage batteries and can integrate additional power components (e.g. PV modules, wind turbines, fuel cells) ensures a continuing reduction of fuel consumption, and operating and maintenance costs, says Cummins. The resulting hybrid system reduces the operational expense for cell sites by up to 70%, adds the company.
CUMMINS POWER GENERATION
www.cumminspower.com
HELIOCENTRIS
www.heliocentris.com

Hendrix offers kitting solution for spacer cable systems

Hendrix Wire & Cable, a provider of overhead and underground power distribution products, offers a kitting solution for spacer cable systems; with the solution, the components necessary to complete the spacer cable system can be purchased together, assembled at the Hendrix manufacturing plant, then shipped directly to a jobsite or staging area. Since cables are cut to length for the job, scrap and installation time can both be reduced, says Hendrix.

HENDRIX WIRE & CABLE
www.hendrix-wc.com

FSR's Power Coaster table boxes for classrooms and conferences

FSR, manufacturer of audio and video switching, control products, and connectivity boxes, says it has classrooms to conferences covered with its new compact table boxes. FSR's new Power Coaster mini table boxes are suitable for meeting, conference and classroom applications, featuring a decorative cover to help protect and conceal the connectors below and resemble a high-end coaster when closed. Installation is accomplished by drilling a round hole in the table. A variety of connector options are available including Universal AC power receptacles and dual USB charging ports. The decorative covers are available with either black or aluminum anodized finishes for durability.

FSR
www.fsrinc.com

SMA Sunny Tripower TL-US inverter promises high efficiency

SMA has released its Sunny Tripower TL-US to the North American solar market. This 3-phase, transformerless inverter is suitable for decentralized commercial photovoltaic plants, and is available in 12kW, 15kW, 20kW and 24kW models. UL listed for up to 1000vdc, the inverter promises peak efficiency of more than 98%, while its OptiTrac Global Peak maximum power point (MPP) tracking algorithm further maximizes energy production by minimizing the effects of shade. Safety and reliability have been enhanced, says SMA, due to the inverter's all-pole ground fault protection, integrated AFCI, reverse polarity indicator and DC monitoring per MPPT (granular down to four strings).

SMA
www.sma-canada.ca

ADVERTISER INDEX

Nancy Hanna, P.Eng.

Rule 64-114 and inverter point of connection

Section 64 of the code applies to renewable energy systems, but not to solar PV systems (except for Rules specifically referenced by Section 50). Rule 64-114 is one of the referenced rules in Section 50, so it's applicable to all renewable energy systems.

Rule 64-114 starts by setting a general requirement to connect the output of a utility inverter to the supply side of the main service disconnecting means, except as permitted by Subrule (2), which permits the output circuit of a utility interactive inverter to be connected on the load side of the service disconnecting means of other source(s) at any distribution equipment, with the conditions outlined under Subrule (3).

So, basically, where the distribution equipment is fed simultaneously from the utility and one or more utility-interactive inverters, all the conditions outlined in Rule 64-114(3) need to be satisfied to have the output circuit of those inverters connected on the load side of the service box. Otherwise, the connection must be made on the supply side of the disconnecting means as required by Subrule (1). So what are the conditions specified by Subrule (3)?

- Items (a) and (b)(i) are simple, requiring a dedicated branch circuit for each inverter and a warning notice indicating the equipment is fed from more than one source.
- Items (b)(ii) and (iii) are very important, but we have to read (c) and (d) first to understand their importance.
- Items (c) and (d) permit that the sum of the ampere ratings of the overcurrent devices of source circuits feeding distribution equipment to exceed the busbar or conductor rating by a maximum of 125% in dwelling units (120% in buildings other than dwelling units).

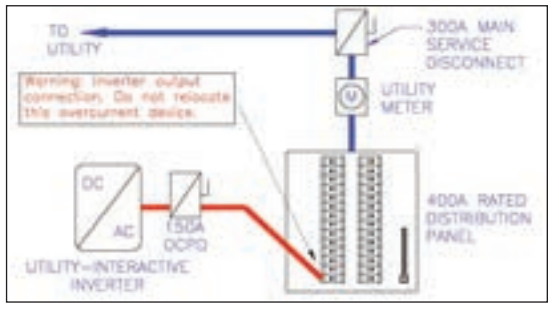
Where the distribution equipment busbar is rated less than the sum of the ampere ratings of all overcurrent protection devices (OCPD) supplying it as permitted by (c) and (d), item (b)(ii) requires the point of utility interactive inverter(s) output circuit to be at the opposite end from the main input feeder connection to the distribution equipment bus (Diagram 1). Also, item (b)(iii) requires a warning label to be posted beside the OCPD to prevent relocating the renewable system connection. These requirements ensure no point in the bus is loaded beyond its ampacity rating.

Where the sum of the ampere ratings of all OCPDs supplying the bus is equal to or less than the bus rating, (b)(ii) and (iii) are not applicable, and there are no restrictions on the location of inverter OCPD on the panelboard bus (Diagram 2).

Where the utility interactive inverter(s) output circuit exceeds limits (125% in dwelling units and 120% in buildings other than dwelling units) permitted in Rule 64-114(3)(c) and (d), the conditions in (3) are not satisfied, hence it shall be connected on the supply side (Diagram 3). EB

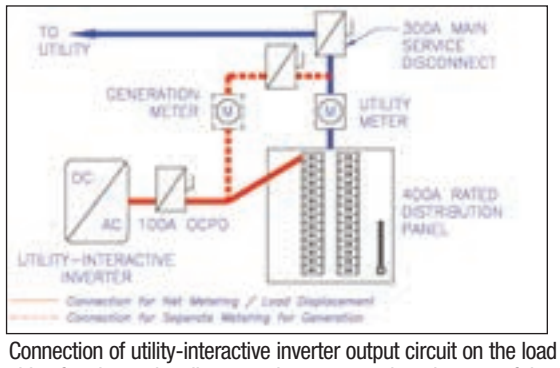
Nancy Hanna, P.Eng., is the engineering manager for Codes & Standards Department at ESA. Contact her at nancy.hanna@electricalsafety.on.ca. Always consult your AHJ for more specific interpretations.

DIAGRAM 1



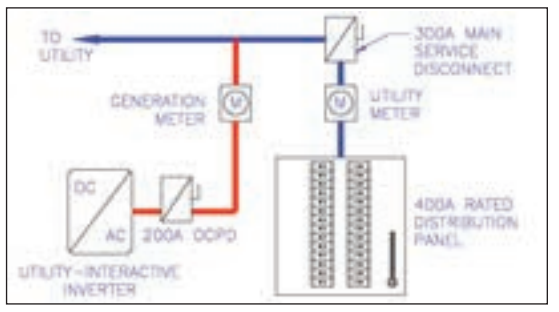
Connection of utility-interactive inverter output circuit on the load side of main service disconnecting means, when the sum of the OCPD supplying the bus is greater than the bus rating and within the limits permitted by Rules 64-114(3)(c) & (d).

DIAGRAM 2



Connection of utility-interactive inverter output circuit on the load side of main service disconnecting means, when the sum of the OCPD supplying the bus is equal to or less than the bus rating.

DIAGRAM 3



Connection of utility-interactive inverter output circuit on the supply side of main service disconnecting means in accordance with 64-114(1), when inverter output OCPD rating exceeds limits permitted in Rule 64-114(3).

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 December'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

What is the maximum continuous load permitted on a service switch if marked for continuous operation at 80% and is supplied by multi-conductor cable?

a) 100% **b)** 80% **c)** 85% **d)** 70%

Question 2

For general power and lighting circuits, the maximum rating of overcurrent protection for No. 10AWG copper conductor is:

a) 15A **b)** 20A **c)** 25A **d)** 30A

Question 3

Where receptacles of type 5-20R are installed on recreational vehicle lots, the CEC requires them to be protected by GFCI of Class A type.

a) True **b)** False

Answers: EBMag October 2013

Q-1: Portable electric lamps shall not be used within a hazardous area during operation of finishing process.

a) True. Ref. Rule 20-406 (4).

Q-2: Overhead consumer's service conductors shall not be less than [____] copper wire.

b) #10 AWG. Ref. Rule 6-302 (4).

Q-3: Where the insulation on a conductor has a flame-tested covering, the covering shall be removed sufficiently at terminals and splices to prevent creepage of current over it.

a) True. Ref. Rule 12-104.

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