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Electrical Business

MARCH 2012

Transformers: where would we be without them?

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We should be teaching and learning good safety habits for everything we do, including electrical.

How do we keep *that worker* safe?

I recently returned from the IEEE Industry Applications Society's Electrical Safety Workshop in Daytona Beach, and what a collection of electrical safety talent! While all the presentations were very good, one in particular sticks out in my mind.

The session "Lessons Learned from the Development of a Global Electrical Safety Program" related the recent example of a European company's efforts to develop a global electrical safety program tailored to the wind industry.

To get top management buy-in, the presenters first had to distill the complexity of a comprehensive global electrical safety program into the two most basic safe work practices: lockout before work, and test before touch. This is especially important since countries outside of North America commonly seem to lack any formal lockout/tagout program.

Second, because of the complexity of the program, it had to be managed with a layered approach. Third, and most importantly, an awareness campaign highlighted real electrical injuries within the company; this helped garner management support, as most managers are simply not privy to injury reports and the associated costs.

To hear of the trials and tribulations the speakers went through was simply amazing, especially when trying to establish electrically safe work practices in some countries where, and I quote, "shoes are optional". Yet they persevered, boiling all their arguments down to one simple thing: how do we keep *that worker* safe?

A very good summation was put forward by Thomas Domitrovich and Anna Floyd, who explained that electrical safety is just part and parcel of an overall health & safety plan. We should be teaching and learning good safety habits for everything we do, including electrical. For example, what's the point of wearing the correct FR clothing if you don't know how to use a ladder safely?

Do you let your workers take PPE home for the weekend for a project they're working on? Why not, asked Floyd? If the PPE will help ensure they come in to work Monday morning in one piece, haven't you just saved yourself a whole lot of headache?

Some forward-thinking companies have started doing just this.

The next IEEE IAS Electrical Safety Workshop is scheduled for March 11-15, 2013, in Dallas, Texas. Electrical Business will be there, and I highly encourage you to attend as well. EB

On the cover and page 12

Transformers: where would we be without them?

We all have a good idea what a transformer is—what it does, how it works, how to make the hookups. But, as is the case with a lot of electrical equipment, there is definitely more than meets the eye.

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Sheraton Toronto Airport hotel fined $70,000 after worker suffers burns

Sheraton Toronto Airport Hotel and Conference Centre, of Etobicoke, Ont., was fined $70,000 for a violation of the Occupational Health and Safety Act (OHSA) after a worker was injured. On May 1, 2010, a maintenance worker was changing a fuse in a 600-volt electric panel. When the worker attempted to pull out the fuse with metal pliers, there was an explosion and the worker suffered first, second and third degree burns. The hotel pleaded guilty to failing to ensure that the worker did not use a tool capable of conducting electricity near the electric panel.

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Canada

CCAB BPA WORLDWIDE BUSINESS

NEMA supports DoE proposal to increase the energy conservation standards for distribution transformers

Upon initial review, NEMA (National Electrical Manufacturers Association, www.nema.org) says it supports the U.S. Department of Energy's (DoE) proposed rule to increase the energy conservation standards for distribution transformers.

"We're pleased that DoE has proposed amended standards that take into account manufacturers' recommendations for higher efficiency levels which are technologically feasible and economically justified," said NEMA president and CEO Evan R. Gaddis. "Saving energy and preserving well-paying manufacturing jobs are two ways to boost our economy."

Throughout the fall of 2011, DoE hosted a negotiated rulemaking, where stakeholders gathered to discuss the justification for higher energy efficiency standards for all three classes of regulated distribution transformers: low voltage dry-type; medium voltage dry-type; and medium-voltage liquid-immersed. Under current energy conservation standards, NEMA insists distribution transformers are already the most energy-efficient product that DoE regulates at 97% to 99% efficiency, but NEMA members believed there was an opportunity to increase energy conservation without unduly burdening the sectors that supply materials for transformers, the manufacturers, and consumers of transformers.

NEMA and its member companies are united behind a recommendation made to DoE that would spur "significant, long-term energy savings" in distribution transformers. The proposed rule would lower electrical losses more.

NEMA says its manufacturers agree that moving to standards higher than what DoE has proposed would likely have the following the negative consequences:

- It would limit the availability of supply of certain materials necessary to meet the standards.
- In effect, it would require the use of a single technology, amorphous material, which is much more expensive than its alternatives and currently available in the U.S. only through a single supplier. This raises real questions about both the availability of this material and how quickly its price could be raised.
- If required to utilize amorphous material, small manufacturers would be forced to make major capital investments or risk much higher input costs, either of which could put some of these companies in jeopardy of closing their doors permanently.
- Since transformer customers give great weight to the first cost of the products they buy, more expensive transformers would have the perverse consequence of further encouraging the refurbishment of older, less efficient transformers instead of the purchase of new, higher-efficiency units. This situation would hinder, not promote, energy savings.

DoE held a public meeting on the notice of proposed rulemaking (NOPR) February 23. There will also be a public comment period on NOPR before the rule is finalized by October 2012.

PowerStream cautions customers on supposed power-saving device offers

PowerStream (www.powerstream.ca), a municipally owned electricity distribution company in Ontario, is cautioning its customers to be aware of telemarketers claiming to have a new power-saving device that can help them significantly reduce their electricity consumption.

In recent weeks, electricity customers throughout PowerStream's service territory have been receiving telephone calls from sales staff representing companies claiming to have such a device, are using high-pressure selling tactics and may, in some cases, imply that they are in the possession of customer consumption data.

PowerStream does not endorse any of these companies and has been made aware of similar claims and tactics used in other provinces, including British Columbia and Alberta. Furthermore, PowerStream's individual customer account information, including electricity consumption, is protected under provincial and federal privacy laws.

Customers who have been contacted by telemarketers about these devices are advised to be cautious.

PowerStream says the Better Business Bureau has included "power-saving scams" as one of the "Top Ten Scams for 2012". Individuals who would like to file a complaint can visit the website of the Better Business Bureau serving Mid-Western and Central Ontario at www.mwco.bbb.org or call (800) 459-8875. Misleading advertising can also be reported through the federal government's Competition Bureau website at competitionbureau.gc.ca.

Call for Papers - IEEE IAS Electrical Safety Workshop 2013

The next IEEE Industry Applications Society Electrical Safety Workshop (bit.ly/yqHLHF) is scheduled for March 11-15, 2013, in Dallas, Texas, and while that may seem like a long way away, paper proposals are due May 1, 2012! The IEEE IAS ESW is requesting technical paper proposals for presentation in a workshop forum or with a poster.

The IEEE IAS Electrical Safety Workshop provides a forum for changing and advancing the electrical safety culture to enable sustainable improvement in eliminating electrical incidents, injuries and fatalities. The workshop's aim to Change the Electrical Safety Culture targets two areas:

1) advancing the application of state-of-the-art knowledge and practices, and
2) stimulating innovation in creating the next-generation of safe work practices, technology and managing systems.

Visit bit.ly/zhCtPY for the proposal form.

Horizon Utilities surpasses One Million Hours without a lost-time injur y!
Horizon Utilities Corp. (www.horizonutilities.com), the utility that distributes electricity to homes and businesses in Hamilton and St. Catharines, Ont., recently achieved a "significant safety milestone for the second time since 2010": one million hours worked without a lost-time injury. Well done!

"Our number one priority in delivering a reliable supply of electricity to our customers is to ensure the safety of our employees, contractors and everyone in the communities we serve," said Max Cananzi, president and CEO of Horizon.

"I am proud of our employees' ongoing success in safety," added Cananzi. "We will continue to strengthen our safety practices and performance with the implementation of a best-in-class health and safety management system: Canadian Standards Association [CSA] Z1000 (www.shop.csa.ca). Our goal remains the same as it has always been—zero injuries. Working safely means that our employees go home safely to their families each and every day. Nothing is more important than that."

Horizon says its safety record has benefited from the strong support of the IBEW (www.ibew1st.org) and the company's Joint Health and Safety Committees.

"We take a team approach to safety. However, everyone also takes individual responsibility for their own safety and for that of their colleagues through an uncompromising and focused approach to health and safety," said Cananzi.

Horizon Utilities extends its commitment to safety beyond the work environment into the communities it serves. In 2011, the company provided electrical safety training for 11,500 elementary school students attending 52 schools in Hamilton and St. Catharines. During these sessions, children from Kindergarten to Grade 7 learn about the hazards posed by outlets, appliances, substations, transformers, hydro poles and overhead electrical wires.

Ideal Supply shows off team spirit at Listowel Cyclones hockey game
In the past, Ideal Supply (www.idealsupply.com) has sponsored different events and organizations, one being the Listowel Jr. B Cyclones, of Listowel, Ont. As part of this sponsorship, Ideal Supply was invited to show their "team spirit" at one of the home games. But instead of handing out thunder sticks or foam fingers, the company teamed up with the local North Perth Community Hospice group (www.northperthcommunityhospice.org) to help out with its Teddy Bear Toss.

On February 5, all spectators received free admission to the game paid for by Ideal Supply, with the intention that instead of having to pay to get into the game, attendees were to bring a stuffed toy.

It seemed to have worked – the hometown Cyclones reportedly had one of its largest crowds of the season, while the hospice collected more teddy bears than any other year .

Say Hello the NEW Westinghouse Electric Canada
Westinghouse Electric Company LLC (www.westinghouse.com) has announced the formation of Westinghouse Electric Canada Inc. to "better serve its Canadian customers, strengthen its ties with Canadian suppliers, and align itself more appropriately with the regulations and requirements in Canada to meet growing business opportunities". The headquarters will be located in Toronto, Ont.

"The formation of an official Canadian entity is consistent with our strategy to increase business in the country," said Jim Ferland, Westinghouse president, Americas. "Our Canadian customers have increasingly turned to us for nuclear power plant services, and upgrades to automation and controls [...] with the creation of Westinghouse Canada, we will better provide our worldwide capabilities and experience in a fashion that will meet the specific needs and aspirations of Canada's viable nuclear energy industry."

Westinghouse currently has more than 150 Canadian suppliers providing a range of products and services for the Westinghouse product lines of Fuel, Services, Automation and Nuclear Power Plants. Westinghouse Electric Company LLC is a group company of Toshiba Corp.

Confused by Ontario's FIT program? Check out Ontario Feed-in Tariff Forum

Confused by Ontario's Feed-in-Tariff Program? Wonder no more, and make plans to attend the Ontario Feed-in Tariff Forum (April 3-4, Toronto, Ont.), of which Electrical Business is a proud partner.

The Ontario Feed-in Tariff Forum (bit.ly/vgjkE7) is an annual conference for FIT contract holders, developers, manufacturers, suppliers, service providers and government. This year's event comes on the heels of the FIT program's two-year review process, and offer the industry a first opportunity to network and discuss the outcomes of the review and the next steps for renewable energy in Ontario.

Representatives from the Ontario Power Authority, Ministry of Energy, Ministry of Environment and Ministry of Natural Resources have all confirmed their attendance, says Canadian Clean Energy Conferences (CCEC), the forum organizer.

In addition to key government and policy speakers, over 100 industry leaders in the solar, wind, hydro and bioenergy sectors have been added to the forum's agenda, says CCEC, which breaks out into technology-specific streams on the second day.

The event is expected to attract over 500 renewable energy developers, manufacturers, suppliers and government representatives to discuss the impacts of the FIT review and the direction of renewable energy development and manufacturing in the province.

"The technology streams will allow developers, manufacturers and technology providers to discuss the issues specific to their industry in the context of the FIT program and renewable energy development in Ontario," says Adrienne Baker, director of Canadian Clean Energy Conferences.

The forum has a growing list of industry supporters including Heliene, Siemens, RTONE and Power Advisory LLC, and continues to have cross-industry support with members of CanSIA, CanWEA, APPrO, OSEA, APAO, OWA, CanBIO and FPAC.

GE Lighting confirms 2012 Revolution Tour

Calling last year's Revolution Tour (www.gelightingrevolutiontour.com) a "tremendous success," GE Lighting says it will be continuing to tour North America again this year with a soon-to-come 2012 schedule. Last year, the tour visited 47 cities in Canada and U.S., where individuals could learn about, interact with and experience the company's newest lighting technology. GE Lighting (www.gelighting.com/na) also held a contest with individuals who RSVP'd or attended the 2011 tour for a chance to win a Sony Bloggie Touch camera. Congratulations to Bruno from Quebec – the tour's only Canadian winner!

A-D Electrical Divisions' 2011 year-end results display double-digit growth

Affiliated Distributors (A-D, www.adhq.com) has released its Electrical Divisions' year-end results with Canadian sales having grown 10% to $852 million. A-D Affiliates also set new records for both net distributions and return on remittances, said the company.

"Our commitment to exclusively supporting independent Electrical Distributors of all sizes is definitely yielding some impressive results," said David Oldfather, president, Electrical Divisions (in photo). "In addition to experiencing above market growth during this past year, our Affiliates added over 950 new Distributor employees, made 14 acquisitions, and approved the addition of 38 new Clean Energy Suppliers to the A-D Preferred Supplier list. Our A-D Clean Energy program, along with AD's willingness to pursue new growth opportunities for both our Distributors and Suppliers, should help stimulate additional growth in 2012 and beyond."

"In spite of tremendous market uncertainty and stiff competition, our independent distributors and suppliers battled back from the depths of the 'great recession' to sales levels that now exceed their peak in 2008," added Bill Weisberg, CEO.

ABB to acquire Thomas & Betts for $3.9 billion

ABB (www.abb.com), a global power and automation technology group, and Thomas & Betts Corp. (www.tnb.com), a North American player in low-voltage products, have announced that both companies' boards of directors have agreed to a transaction in which ABB will acquire Thomas & Betts for $72 per share in cash, or about $3.9 billion.

"Thomas & Betts is a well-run company with strong brands and excellent distribution channels in the world's largest low-voltage products market," said Joe Hogan, ABB's CEO. "Because our products are complementary, we'll go to market with one of the broadest offerings in the industry. That creates strong growth opportunities for both ABB and Thomas & Betts, and gives customers and distributors one-stop access to one of the widest ranges of low-voltage products."

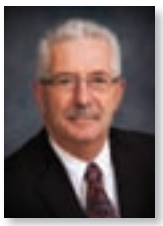
The combination of Thomas & Betts' electrical components and ABB's low-voltage protection, control and measurement products would create a broader low-voltage portfolio that can be distributed through Thomas & Betts' network of more than 6000 distributor locations and wholesalers in North America, says ABB, as well as through its own distribution channels in Europe and Asia. The combined product portfolio and enhanced distribution network will enable ABB to double its addressable market in North America, says the company, to about $24 billion.

"This transaction delivers significant value to our shareholders and will enable Thomas & Betts to accelerate our global growth strategy," said Thomas & Betts chair and CEO Dominic J. Pileggi. "The combination will also enable us to provide our North American customers and distributor network with a broader portfolio of products and will provide long-term opportunities to our employees. This is the right time for this transaction and I believe strongly that ABB is the right partner for our business going forward."

Thomas & Betts, combined with ABB's North American low-voltage products business, will become a new global business unit led out of Memphis, Tenn., under the leadership of Pileggi. The transaction is subject to approval by Thomas & Betts shareholders as well as to customary regulatory approvals, and is expected to close by the middle of 2012. EB


Reg Clark

After close to 40 years of service at **Thomas & Betts** (www.tnb.ca), **Reg Clark**, vice president, Industrial, has retired. Clark started at Thomas & Betts in 1972 as a sales representative for the Atlantic region and, after different promotions, was appointed vice president, Industrial in 1992. He managed Thomas & Betts' industrial business and was actively involved in the electrical industry in Canada throughout his career. "We would like to thank Reg for his exceptional contribution and dedication to Thomas & Betts and wish him a wonderful retirement. He will be missed," said **Nathalie Pilon**, president of Thomas & Betts Canada.


David Tracey

David Tracey will take over as Clark's successor, responsible for overseeing all **Thomas & Betts** sales activities in the industrial market in Canada. During his 29 years of service with Thomas & Betts, Tracey has held many positions in sales and marketing including regional sales manager, Atlantic region. Recently promoted to the position of director, Market Development for Thomas & Betts' industrial business, he will continue to assume these responsibilities until his replacement is named.

Electro-Federation Canada (EFC, www.electrofed.com) and its corporate partners, such as **GE Canada** (www.ge.com/ca), recently awarded over $40,000 in scholarship funds to 26 students across Canada. In recognition of her academic achievement, this year's **GE Canada Community Leadership Award** was given to **Roxanne Olynyk**, a fourth-year University of Regina student studying Accounting/Business Administration. "We are proud to partner with EFC in this initiative that helps young people fulfill their potential and that recognizes and encourages both academic and personal excellence," said **Pat Haughey**, general manager, GE Lighting Canada. The EFC Foundation Scholarship Program was established in 1995 to encourage Canadian students to pursue a career in the electrical, electronics, and telecom industries.

Pat Haughey, general manager, **GE Lighting Canada** (www.gelighting.com/na), has announced the appointment of **Darryl Kalloo** as manager – Lighting Solutions (GELS) and Total Lighting Controls (TLC) in Canada. Effective immediately, Kalloo will be responsible for Canadian sales and market development activities for GE lighting solutions and lighting controls products and will work closely with both the Canadian GELS/TLC agent network and GE Lighting internal sales teams. Formerly national account manager for GE Lighting Canada's OEM and ballast products, he brings to this new position more than 18 years experience in sales and marketing roles in the electrical industry. EB


Darryl Kalloo

Dan Leduc

The name is Bonds... Performance & Labour and Material Payment Bonds

Part One

It may be easiest to think of bonds as forms of guarantee, largely having the same legal characteristics as, say, a personal guarantee you may give to a bank, where the guarantor would be the surety (otherwise known as the bonding company) that, in the case of a performance bond, guarantees the work will be performed on a continuing default by the general contractor; or, in the case of a labour and material payment bond, the surety effectively guarantees payment to those who are unpaid by the bond's principal.

Owner's responsibilities in the bonding process

Because a bond is a form of financial protection against loss in the event that a bonded contractor defaults on his obligations, it is in the owner's best interests to ensure the bond documentation is in order. That is, the bond should be signed, it should be of the correct value, and it should be affixed with the seal of the general contractor.

The owner has an obligation to ensure a bond is valid and enforceable. The owner also has the onus of declaring the contractor in default for it to require the surety company to perform its obligations under the bond.

In the case of Paul D'Aoust Construction Ltd. v Markel Insurance Co. of Canada[1] (an Ottawa decision that made its way to the Supreme Court of Canada), a performance bond had been signed by a broker of the surety and the principal, but the bond was invalid and ineffective because it had not been delivered to the owner. In deciding D'Aoust, Judge Rosenberg explained the starting point in determining validity was in understanding the nature of a bond. He cited the text "Scott and Reynolds on Surety Bonds":

A bond is simply a deed (a deed being a document in writing on paper which is signed, sealed and delivered...) whereby one person undertakes to pay a specified sum of money to another, either immediately or at a future date.[2]

Although the bonding company had intended to honour the bond, Rosenberg explained that, since a deed required delivery to be valid, the lack of validity of a bond was sufficient to make it invalid and to make the examination of the bond itself unnecessary. He stated:

The failure to effect delivery of the bond in this case was fundamental and, therefore, the obligations imposed in the bond never came into effect. There is, therefore, no occasion to look to the actual wording of the bond itself.[3]

He added that "no special form or observance is necessary for the delivery of a deed, and it may be in words or by conduct".[4] However, on the basis of the decision in D'Aoust, it is clear the owner bears the responsibility of satisfying itself that delivery of the bond had been made and that, therefore, the bond has come into effect.

So the owner's obligations are to itself in light of the D'Aoust decision. However, that decision dealt with a performance bond and as we know, performance bonds do not get trades paid.

Although there is little caselaw on this specific point, it can be suggested that an owner could owe a duty of care to a subcontractor to obtain a valid and subsisting labour and material payment bond. It is reasonably foreseeable that the failure to do so could prejudice a subcontractor's ability to recover monies owed to it, and the failure of an owner to obtain a labour and material payment bond could be characterized as negligence on the owner's part.

General contractor's responsibilities in the bonding process

The GC's obligations will generally be contractual in respect of bonds and, typically, bonds are a deliverable required at the outset of most constructions contracts.

As for trying to characterize a general contractor's failure to provide a bond as negligence (usually as a subcontractor looking to the labour and material payment bond for payment), then you are likely dealing with an insolvent general contractor. As such, pursuing the general contractor for negligence is not a real option. EB

Dan Leduc is a partner at Norton Rose LLP and co-c hair of the firm's Canadian Construction Law Practice Group. He is frequently called upon to advise and represent owners, engineers, subcontractors, suppliers and builders in such front-end services as contract review, tender issues and general construction matters, as well as in litigation and arbitration. Dan can be reached at (613) 780-1536 or dan.leduc@nortonrose.com.

Notes

1. [1999] O.J. No. 1837 (C.A.).
2. Ibid. at para. 68, cited from "Scott and Reynolds on Surety Bonds" s. 2.3(a) at 2-14.
3. Ibid. at para. 67.
4. Ibid. at para. 69.

Dave Smith |

Lethal management

It is difficult to be an exceptional manager. It takes experience, training, desire, dedication and human understanding. As a manager, I have too often been lenient when I should have been lethal and, unfortunately, many times lethal when I should have been lenient. I see this in other managers, and it is the lethal that I write about here.

We were doing a high-voltage maintenance course at a mill in Ontario and, as a class project, the electrical supervisor wrote a switching order to take out a set of 13.8 switchgear for an upcoming project. He showed us his switching order with a single-line diagram indicating the grounds he was going to put into place; it was well done, and we said so. He was incredibly happy when he went off to the engineering manager but, 20 minutes later, he came back very disturbed.

On the single-line diagram, the manager had crossed out two of the grounds in big, bold, red marker, saying he did not need them.

The supervisor now had a conflict with his superior and, yes, you can draw the safety card, but what will transpire in three months? This manager, who should have been lenient at that moment in allowing the installation of the extra grounds, was lethal. His previously highly motivated electrical supervisor was now unmotivated and the energized class culture changed immediately as the other students sympathized with their supervisor, with many derogatory comments about the manager and his commitment (or lack thereof) to safety.

If you have ever been to a western Canadian electrical safety conference, chances are you have heard Paul Hebert speak. When Paul, a utility lineman, comes onto the stage, it is easy to see his artificial arm, but the damage done to his remaining limb is not as apparent. He demonstrates this hand at the podium, showing the thumb and remaining fingers, and describes his difficulty navigating through everyday life—even being unable to grasp a normal hamburger.

I won't try to tell you the rest of Paul's story but, when he speaks, he always wears short pants so you can see his two artificial legs.

In September 1989, Paul and a supervisor were working in a remote area repairing downed lines from a major storm. In preparation for the work they were going to do, Paul asked, "Shouldn't we put grounds on this?" and the supervisor replied, "No, we won't be that long".

Several miles away, someone tried to contact them, but they were out of radio range; a decision was made that they must have finished their work and left their locks on. Paul's lock was cut off and the disconnect switch closed while Paul was hanging on a downed high-voltage line.

I won't try to tell you the rest of Paul's story but, when he speaks, he always wears short pants so you can see his two artificial legs. His story is compelling and describes a life no one wants to live.

Being around a two-year old who has mastered the word "No!" makes it pretty clear that we humans seem to be hardwired to argue. I have lost track of the examples students have given to me over the years where one worker made a suggestion that would make a situation safer yet someone else took an immediate and opposite position to argue against it.

This is such a natural human reaction that psychologist Kurt Lewin's Force Field Analysis principle is essential for managers to understand group dynamics and the forces that help or hinder the achievement of goals.

Recent research has proven that the old Heinrich Safety Pyramid concept has proven invalid (bit.ly/qWDtlS). Organizations have reduced the number of close calls and minor accidents yet major accidents continue at the same rate. Paul's life has been immeasurably lessened but the lethal supervisor will also have lived a life of regrets—and his company has been paying every year since.

To prevent this, you need to develop a culture where suggestions that make things safer will be met with discussion and analysis rather than a force field of automatic arguing.

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) available to you. Feel free to use them to support your own safety program and other initiatives.

TRANSFORMERS:
where would we be without them?

David Herres

We all have a good idea what a transformer is—what it does, how it works, how to make the hookups. But as is the case with a lot of electrical equipment, there is definitely more than meets the eye. First, a few words about magnetism.

In a transformer, an electrical current flowing through the primary winding gives rise to a magnetic flux in the silicon steel core. Like electrical energy in a conductor, magnetism in the core of a transformer flows through a circuit. A magnetic circuit resembles an electrical circuit. Both may exhibit a very high flow or a low flow, with high potential.

The *magnetomotive force* (mmf) is analogous to voltage, or *electromotive force* (emf). *Magnetic flux* is equivalent to electric current. *Reluctance*, based on the properties of the magnetic substance, is like resistance in an electric circuit. Electrical units of volt, amp and ohm correspond to magnetic units of *gilbert*, *weber* and *henry*.

It is not possible to build a transformer based on the properties of a permanent magnet, because a moving, dynamic magnetic flux is required to facilitate the transfer of electrical energy from the primary to the secondary winding. For current to flow, the magnetic field has to be moving relative to the conductor.

When current flows through any conductor, a magnetic field appears in the space around the conductor. By winding the conductor in the form of a coil, the magnetic field is intensified. If the coil is formed around a material characterized by significant magnetic permeability, the degree of magnetization of the material in response to the magnetic field is intensified. *Magnetic permeability* is the reciprocal of magnetic reluctance, just as in an electrical circuit conductance is the reciprocal of resistance.

Most materials, including air, have some degree of magnetic permeability. In steel, the permeability is relatively high, so it is widely used as a core in transformers.

To summarize, magnetism and electricity always accompany one another. In reality, they are two facets of a single phenomenon. Because of this fact, many useful devices and types of equipment are possible, including electrical motors, audio equipment, relays and transformers (Photo 1).

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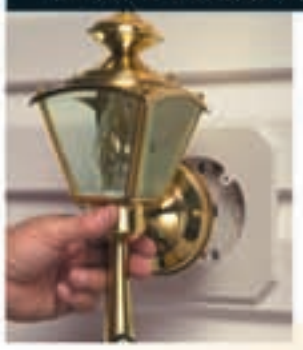

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CATALOG NUMBER	WIRE LENGTH
DWB0805	5'
DWB0812	10'
DWB0815	15'
DWB0820	20'
DWB0830	30'

"Y" w TOGGLES

CATALOG NUMBER	WIRE LENGTH
DWYT0805	5'
DWYT0810	10'
DWY2T0810 (2 PK)	10'
DWYT0815	15'
DWYT0820	20'
DWYT0830	30'

"Y" w HOOKS

CATALOG NUMBER	WIRE LENGTH
DWYH0805	5'
DWYH0810	10'
DWY2H0810 (2 PK)	10'
DWYH0815	15'
DWYH0820	20'
DWYH0830	30'

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Patent pending

PHOTO 1

PHOTO 2

PHOTOS JUDITH HOWCROFT.

In its simplest form

In its simplest form, a transformer consists of two wire coils wound around a common core. When an AC voltage is applied to the primary winding, an AC voltage of the same frequency appears at the secondary. When a load is connected to the secondary, current flows through both windings. The measured voltage at the secondary is related to the applied voltage at the primary in accordance with the number of turns in the two windings.

When both windings have an equal number of turns, input and output voltages are equal. Thus, when the primary winding has 100 turns and the secondary has 200, it is a step-up transformer, and the voltage will be doubled. When the primary has 100 turns but the secondary has 50, it will be a step-down transformer, and the output will be one-half the value of the input.

The Second Law of Thermodynamics states that energy cannot be created where it did not exist in any form. How is this step-up process possible? The answer is that voltage and amperage are two aspects of the total electrical picture. Volts times amps equals watts—the measure of electrical power. Power is the same in the two transformer circuits, except for a small efficiency factor. In a step-up transformer that doubles the voltage, there will be only one-half the current flow in the secondary. A consequence of this is that when you connect a 10-amp load to the secondary of the step-up transformer, the primary will have to draw 20 amps from its supply.

The voltages on both the input and output terminals of the transformer will each divide evenly among the turns.

When there is an output of 100 volts and 100 turns in the secondary winding, each turn will have only one volt of voltage drop. This is why these windings can be lightly insulated; just a thin coat of enamel may suffice but, where layers overlap, heavy paper or similar material is needed so that the windings are not shorted out.

Because voltage drops are evenly divided, it is a simple matter to install taps at various points along the winding to extract desired voltages. Taps can be placed along the primary winding to buck or boost the voltage in desired increments such as 5% and 10%. It is possible to have more than one secondary or a single secondary with several taps so that multiple voltages are available. Also, the secondary may be equipped with a sliding contact to allow for a continuous range of outputs.

Putting transformers to work

Besides stepping up or stepping down voltages, transformers perform other functions. An example is the isolation transformer. Since primary and secondary are coupled by magnetic induction, unwanted electrical parameters can be eliminated. When the primary supply is grounded, this grounding is not passed on to the secondary circuit by means of magnetic coupling. When grounding of the secondary is desired, it must be accomplished by means of a direct connection to the grounded conductor of the primary, or the secondary must be grounded separately.

To be truly effective in critical applications, an isolation transformer must incorporate shielding between the primary and secondary windings. Moreover, measures must be taken to ensure the windings do not exhibit capacitive coupling, especially at high frequencies.

Besides the ground connection, isolation transformers block DC current, noise and interference caused by ground loops. A transformer that is equipped with a Faraday shield will attenuate high-frequency noise.

Patient care areas of healthcare facilities are equipped with isolation transformers to guard against dangerous ground faults that could compromise life-support equipment or pose a threat to vulnerable patients.

Isolation transformers permit rebonding of the electrical system safety ground to the neutral conductor of the transformer secondary. This eliminates neutral-to-ground voltage and noise, which could damage microprocessors in sensitive electronic equipment.

Electronics technicians who are servicing faulty equipment use an isolation transformer to eliminate hazards from nearby grounded objects.

Another common use for transformers is *impedance matching*. This is particularly applicable in communication and data circuits. Maximum power transfer takes place when input and output impedances are the same. When you think about it, the explanation for this phenomenon becomes clear; when output impedance is higher than input impedance, power transfer is limited in accordance with Ohm's Law. When the output impedance is lower than input impedance, power transfer in the circuit is also limited because of excessive voltage drop.

Maximum power transfer occurs when input and output impedances are the same. (Impedance, represented by the letter *Z*, is measured in ohms and is made up of resistance, capacitive and inductive reactances, which are frequency dependent. Like resistance, impedance conforms to Ohm's Law.)

In high-frequency communications and data circuits, digital signals can be reflected in a reverse direction from the intended output, causing packet collision, corruption and errors. This takes place when input and output impedances are not matched.

Transformers may be used to change impedances so that they match. An example is the familiar balun. It converts a balanced signal from a TV antenna (on 300-ohm twin-lead cable) into an unbalanced signal such as carried by 75-ohm RG 6 coaxial cable.

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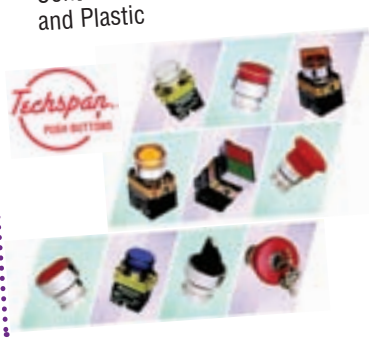

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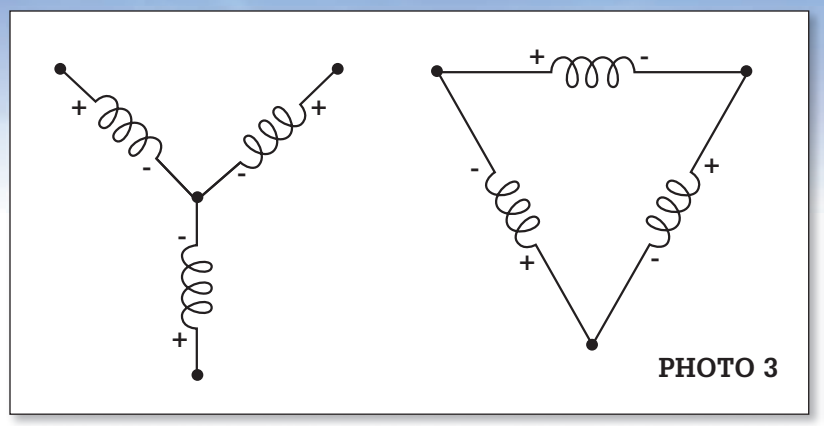


PHOTO 3

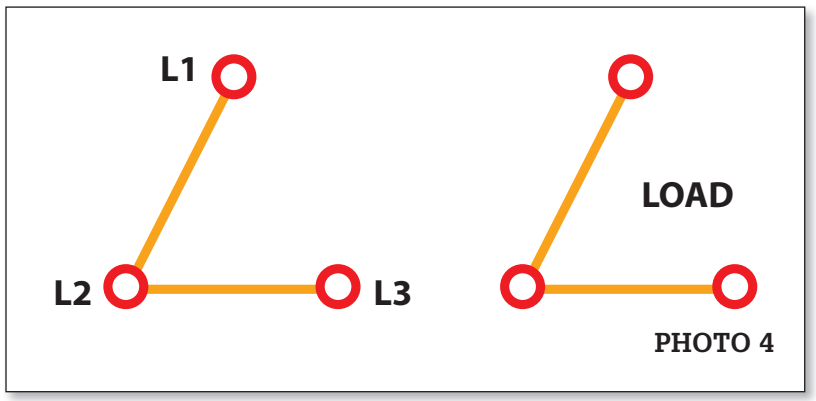


PHOTO 4

Impedance-changing transformers are also used in audio circuits. These transformers are usually mounted on the speakers. Rather than matching impedances, they provide a lower output impedance for improved speaker damping, where maximum power transfer is not an issue. These transformers also eliminate any DC component, which is not desired in speakers.

Power distribution & configurations

When it comes to power distribution networks, transformers perform an essential function (Photo 2). Thomas Edison was committed to the idea of a DC distribution system; it was not that he could not understand AC, but rather because he was driven by the hard economic reality that he did not hold patents to the necessary AC technology.

He visualized an electrical distribution system that would illuminate neighborhoods, ultimately throughout the world. But it was George Westinghouse who implemented the AC system as we know it today. And his associate, the gifted and enigmatic Nikola Tesla, developed and, in 1888, patented three-phase electricity, which powers our modern industrial infrastructure.

Three-phase is a highly efficient method of generating, distributing and using electrical energy. Three separate conductors carry three alternating currents. The waveforms peak at different times. As represented on a circle, they are 120 degrees apart. A neutral wire permits connection of single-phase loads.

The electrical generator converts mechanical power in the form of a rotating shaft into electrical power by means of three coils that rotate with respect to a magnetic field. The windings at the generator, transformer and load may be connected in either a Wye (star) or Delta configuration (Photo 3). Three-phase connections (outside the actual coils but usually inside the generator, transformer or load) are made as shown in the diagram.

For the Wye connection, one end of each coil is connected to a common point, which is generally a grounded neutral. The other end of each of the coils is connected to one of the three circuit conductors. This is considered a three-phase, four-wire, Wye configuration. Three-phase loads such as a motor or welder are connected to the three phase conductors. It is sometimes said that the three voltages are combined, but this is not, strictly speaking, true. The voltages are not combined, but rather exist side-by-side on the three conductor circuits.

The Wye configuration provides the additional option of accessing a single-phase voltage by connecting to any one of the three phase legs and the neutral. This works well for a manufacturing facility that has large three-phase motors and, additionally, many single-phase lighting and receptacle loads.

In its simplest form, a transformer consists of two wire coils wound around a common core. When an AC voltage is applied to the primary winding, an AC voltage of the same frequency appears at the secondary. When a load is connected to the secondary, current flows through both windings.

The other common configuration is the Delta, named after the Greek letter that is an equilateral triangle. One pole of each winding is connected to one pole of another winding as shown in the diagram. One of these windings may have a centre tap that is brought out as a neutral and subsequently grounded. This causes the opposite corner to have a higher voltage with respect to ground than the other two legs.

As shown in the diagrams, the "polarity" of each winding has to be observed. (It is not really a positive or negative polarity in the sense that a DC voltage has polarity. What is important is the orientation of the coils with respect to the magnetic field.)

For a motor load, reversing any two of the three phase connections will reverse the direction of rotation. The connections may be reversed at either end to find the correct rotation by trial and error . However, certain types of shaft-driven pumps can be instantly damaged by running them in the wrong direction.

Transformers may have either a Wye or Delta configuration at the primary and at the secondary. Thus, there are several possibilities:

- Delta-Delta: found in large industrial facilities.
- Delta-Wye: Widely used in commercial and industrial facilities.
- Wye-Wye: Not usually found due to problems with harmonics.

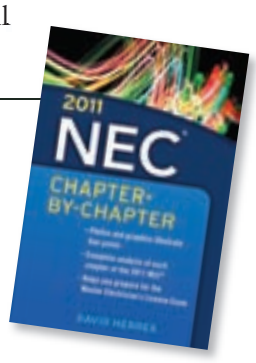
Three-phase transformers with the above connections are available in a full range of sizes, air-cooled or oil-filled, with indoor or outdoor enclosures, and having numerous other parameters and ratings. Manufacturers' catalogues, available in print or online, provide details plus a lot of installation information.

It is possible to create a three-phase transformer bank using separate single-phase transformers. This installation is generally more expensive in material and labour, but it is useful in some ways. Cooling is inherently more effective since the three transformers are spatially separated with free air between them. Also, in case of failure, just one of the transformers may have to be replaced, not the whole installation. However, the Wye and Delta connections are more difficult because they have to be made by the installer outside the three transformers.

An open Delta configuration (Photo 4) may be made with only two single-phase transformers. The available power output is 87% of the rated output of the two transformers.

Great care must be taken in wiring large power distribution transformers because high voltages and available fault current mean an erroneous calculation or faulty connection can spell disaster. However, code-compliance and impeccable workmanship will ensure a safe installation. EB

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



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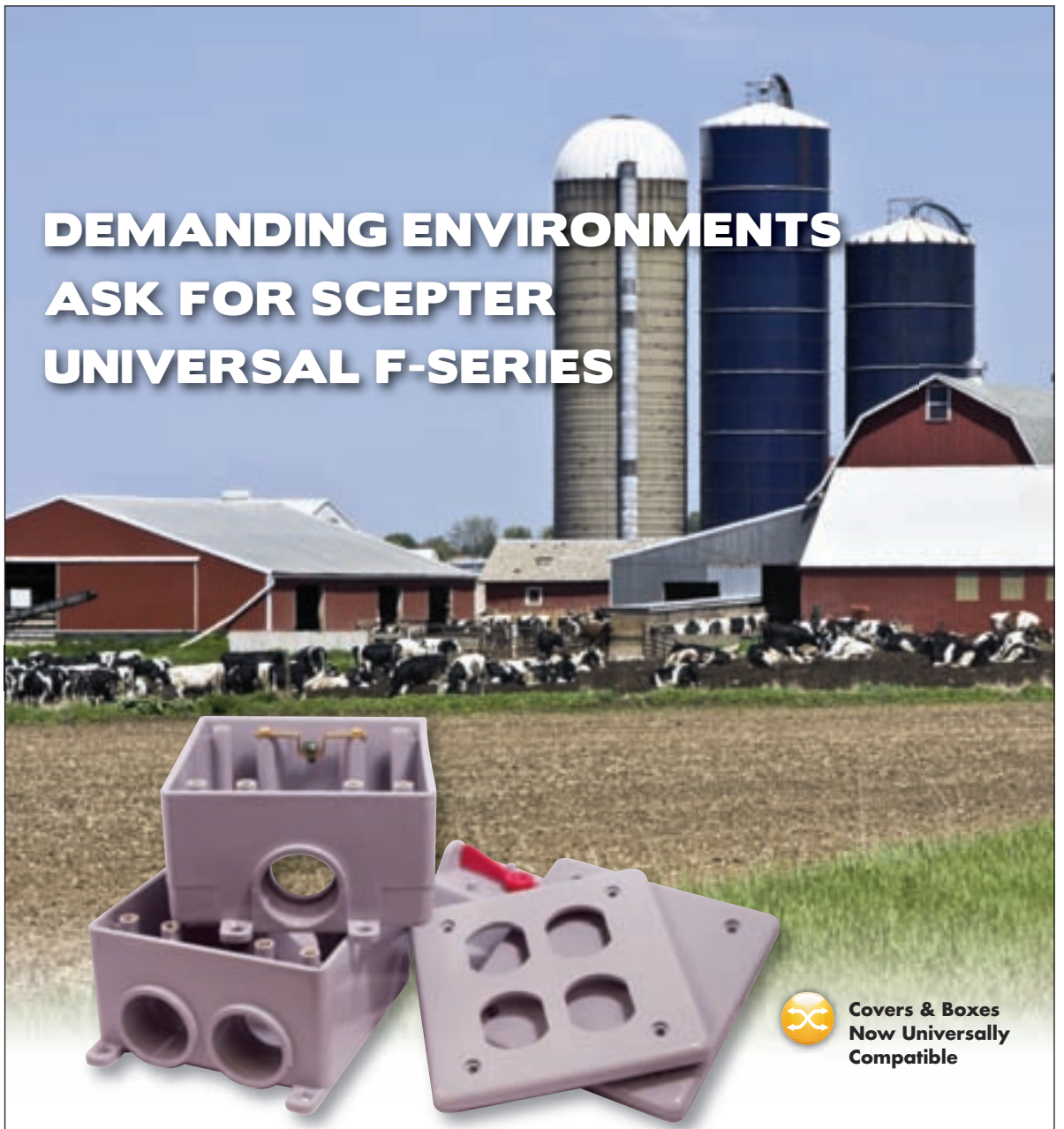

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THE IMPACT OF TIER 4 EMISSION REGULATIONS ON THE POWER GENERATION INDUSTRY

Aniruddha Natekar and Matthew Menzel

In the United States, diesel engine emissions have been regulated for almost 40 years. For most of that time, the regulations governed primarily on-highway engines in trucks and buses but, in 1998, non-road engines were also brought under the scope of the regulations. The Environmental Protection Agency (EPA) defined these non-road engines as those used in mobile equipment, such as farm tractors, construction earthmovers, mobile generator sets on trailers, and other portable industrial engines used in temporary off-road applications.

For a time, stationary engines were exempt from these new emission regulations. A stationary engine was defined as any engine that is permanently installed or located at a site for at least 12 months. This category included standby generator sets, onsite prime and distributed energy power systems, and a wide variety of industrial engines mounted on permanent bases or foundations. In the absence of federal standards, emissions from stationary diesel engines were usually governed by state and local permitting authorities.

But this situation changed with EPA's issuance of the final New Source Performance Standards (NSPS) for compression-ignition (CI) engines in July 2006. When these standards went into effect January 1, 2007, they harmonized regulations for most stationary diesel engine emissions with those for mobile non-road emissions.

Beginning January 1, 2011, these regulations were divided based on application type: stationary emergency; stationary non-emergency; and non-road mobile. Emergency stationary applications only require new installations to comply with pre-2011 emissions limits. Any

power-duty rating (standby, prime or continuous) may be applied to an EPA-defined "emergency stationary application" so long as it is used per EPA's guidelines of an emergency situation, or within the defined testing and maintenance run time requirements. (The ISO rating of a genset is not equivalent to EPA's application type of the same unit.)

Tiers of regulation

The first set of emission regulations, Tier 1, was published in 1996; ever since, EPA has tightened these requirements—a trend that has encouraged technological advancements by engine manufacturers. With each successive tier of regulations, the permitted levels of nitrogen oxides (NOx) and particulate matter (PM)—the two main pollutants from diesel engines—have gone down significantly.

It is worth noting that, to accommodate existing inventory, EPA allows two years from the date of a tier-level change to install an engine certified to comply with the previous tier. For example, gensets with a prime mover rated between 603 hp and 751 hp were allowed to be installed after January 1, 2011, when being used in a stationary emergency application. However, these units may also be installed up until December 31, 2012, in non-emergency applications so long as the engine has a build date prior to January 1, 2011.

Legacy equipment

Legacy equipment, certified to comply with the emissions standard in place for the year it was produced, can continue to be used in some regions with no restrictions. Legacy equipment can also be rebuilt and reused, provided it is rebuilt to the same or a newer emissions standard.

Similarly, remanufactured engines can be used as replacements for retired legacy equipment, provided they meet the same or a newer emissions standard.

On the other hand, remanufactured engines cannot be used to supplement a fleet unless they meet the latest emissions standard (currently Tier 4i), or there is a 1:1 retirement/replacement for engines predating Tier 4i emissions levels (Emissions Replacement Engine Policy).

Moving to Tier 4 interim and Tier 4 final

Currently, Tier 4 is the strictest EPA emissions requirement for off-highway diesel engines. For most of the power range, the final version of Tier 4 is phased in after an interim period (known as Tier 4i or T4i). Such interim requirements are less stringent on one of the main components of diesel exhaust emissions: either NOx or PM.

Since 2008, the Tier 4 requirement has been in effect for engines below 25 mechanical horsepower, while the Tier 4i requirement has been in effect for engines in the 25-48 hp range. For engines greater than 48 hp, Tier 4i is required in 2011 or 2012 (depending on the power range), and Tier 4 final takes effect in 2013-2015, depending on the power range. Note these power ranges are based on the mechanical output of the engine, not the electrical output of the genset.

Emergency power

The Tier 4 initial regulations govern most diesel engines used in power generation, industrial applications, oil & gas applications, mining operations and mobile equipment. However, generators used in EPA-defined emergency stationary applications with an engine rating at greater than 49 hp are exempt from this new standard, and were allowed to stay at 2010 emissions tier levels when the regulations changed in 2011 (for engines of 174 hp and greater) or 2012 (for engines of 49-173 hp).

These generators provide power only in the event of a disruption of the normal power source. Generators used for peak shaving or as the normal source of power, on the other hand, need to comply with the Tier 4 interim or Tier 4 final emissions limits because they do not operate solely when utility power is lost. The specific verbiage from EPA defining what constitutes an emergency situation can be found in the 40 CFR 60 Subpart IIII Section 4219:

> Emergency stationary internal combustion engine means any [...] whose operation is limited to emergency situations and required testing and maintenance. Examples include stationary ICE used to produce power for critical networks or equipment [...] when electric power from the local utility (or the normal power source, if the facility runs on its own power production) is interrupted, or stationary ICE used to pump water in the case of fire or flood, etc. Stationary CI ICE used to supply power to an electric grid or that supply power as part of a financial arrangement with another entity are not considered to be emergency engines.

We should note that the duty rating of a generator (standby, prime or continuous) does not correlate to EPA's emissions certification requirement; the application type itself is the determining factor. The purpose of the duty rating is to indicate the generator's capability as defined by ISO 8528. Any power duty rating may be applied to an EPA-defined "emergency stationary application" so long as it is only used per EPA's guidelines of an emergency situation, or within the defined testing and maintenance run time requirements.

The most common example of an application classified as emergency stationary would include gensets used to produce power for critical networks or equipment when electric power from the normal power source is interrupted. A prime- or continuous power-rated genset may be used in this application and be EPA-compliant at the previous Tier level when the application only requires the unit to run in an emergency stationary capacity.

Alternatively, the most common examples of applications that do not fall under the emergency stationary guidelines would be utility peak shaving operations and gensets used to provide normal power to a facility. Under EPA's guidelines, these would be classified as stationary non-emergency and would need to meet Tier 4i emissions limits.

Emission regulation in non-attainment areas

EPA sets National Ambient Air Quality Standards (NAAQS) for several pollutants, including NOx and PM. For those areas of the States exceeding NAAQS levels (which are referred to as non-attainment areas), EPA requires that states come up with plans that identify needed actions to improve air quality in those areas. While EPA-designated non-attainment areas represent a fraction of the land area of the country, they are typically heavily populated areas.

Thus, certain states and localities might impose additional emissions standards for diesel-powered gensets, primarily for NOx and PM. Generator set applications in these non-attainment areas may be required to comply with the most stringent emissions regulations, which could necessitate the use of the Best Available Control Technology (BACT). These BACT measures generally include aftertreatment devices like selective catalytic reduction (SCR) and particulate traps for reduction in emission levels.

Certified versus verified solutions

The method to prove compliance with a local regulatory authority could also differ from what EPA requires. While EPA requires that the engine manufacturer prove compliance through a certification process, the local authority requiring compliance with an emissions level more stringent than EPA's may require only a site certification or a verification process. It is advisable to work with your local regulator or power generation equipment provider to better understand what is required to prove compliance.

Solving the emissions seesaw

PM and NOx—two significant constituents of diesel engine emissions—have often been considered as two sides of a seesaw. On the one hand, high temperatures and excess oxygen are conducive to the formation of NOx. So lowering the in-cylinder temperatures and oxygen content reduces NOx; however, this also increases the production of soot (PM) thanks to lower fuel conversion efficiency. Decreasing both these constituents

at the same time has challenged engine manufacturers to develop innovative and alternative solutions.

In-cylinder solutions

To meet Tier 4 emission levels, all existing technologies can be classified as either in-cylinder or aftertreatment approaches. In-cylinder technology can include:

1. New combustion bowl geometry for optimum combustion.
2. Multiple fuel-injection capabilities that provide more combustion control and better part load performance in terms of emissions and fuel consumption, without sacrificing power.
3. Advanced fuel-injection systems, such as modular common rail fuel injection, that provide improved stability, cold start and transient response, while maintaining power densities.
4. Solenoid-controlled electronic injectors, which add precision to the delivery of fuel.
5. New engine control modules with improved sensors that control engine operating parameters more precisely and are critical to maximizing power output.
6. High-durability ferrous cast ductile (FCD) pistons, which are stronger than aluminum, especially when operating at higher temperatures. They help deliver optimal power output.
7. Charge air cooling to reduce the temperature of the turbocharged air before it enters the combustion chamber.
8. Cooled exhaust gas recirculation (EGR), which recycles a part of the exhaust to lower combustion chamber temperatures and to reduce emissions at part loads. Intercooling further aids in lowering in-cylinder temperatures.
9. Variable geometry turbocharger, which gives precise control of airflow at all engine speeds and loads, and which provides the necessary pressure differential to drive EGR.
10. 'Miller Cycle' engine design using variable valve actuation (VVA), which allows for late intake valve closing, thereby reducing the effective compression ratio and resulting in lower compression temperatures and, therefore, lower NOx.

Aftertreatment technologies

Such in-cylinder techniques can only do so much, however, because of the mechanical limits of current engines. A close look at EPA's emission schedule also reveals that, as the engine power increases, the allowed emission levels are actually reduced. This calls for something beyond in-cylinder technological advancements. Welcome to the world of aftertreatment.

Depending on the requirement, some or all of the following strategies can be used:

1. DOC, or a diesel oxidation catalyst; a flow-through device where exhaust gases are brought in contact with materials that oxidize unburned hydrocarbons and reduce emissions.
2. DPF, or diesel particulate filter; a device designed to physically capture particulate matter from the exhaust stream.
3. SCR, or selective catalytic reduction unit; includes a 'reducer' that is added to exhaust flow to create the reactions in a catalytic chamber.

Concerns with aftertreatment technology

Other than the obvious downside of additional costs, aftertreatments come with some concerns that need to be carefully addressed. Cooling the exhaust gas before recirculating it, for example, is an effective method for reducing in-cylinder temperatures, but the cooling system then has to deal with an additional cooling circuit and up to 25% higher heat rejections.

In addition, aftertreatment solutions can raise concerns about packaging and space limitations, as well as about thermal management and substance-level constraints like the handling and storage of urea (a material used in SCR technologies) as well as sulphur tolerance. (Diesel fuel with lower amounts of sulphur is less stable than higher-sulphur diesel fuel, and more susceptible to microorganisms growing in the fuel tank.)

In addition, some aftertreatment devices can add a significant amount of backpressure, requiring precise, duty cycle-based control of temperatures and dosing frequency for regeneration. Such devices also represent an additional item to be serviced.

Finally, most NOx aftertreatment devices reduce emissions when operating at high temperatures, but such temperatures may not even be reached by an emergency standby generator that is lightly loaded.

Conclusion

Spurred by the Environmental Protection Agency's Tier 4 emission regulations, the industry has developed cleaner and greener energy solutions. Tier 4 mandates a significant reduction in both NOx and PM levels, which may require complex emission abatement strategies on the engines—especially when your particular application requires a generator set meeting or exceeding Tier 4 regulations. Work with your power generation equipment supplier to acquire the right genset for your application. EB

Aniruddha Natekar and Matthew Menzel are a sales application engineer and senior application engineer, respectively, with Cummins Power Generation (www.cumminspower.com). Aniruddha provides technical recommendations on installations and engineering support to customers, assists the sales force with technical training, and supports technical seminars. Matthew's primary focus is on assisting clients and distributors with technical guidance on application-specific issues concerning standard commercial products and unique projects. This article is based on their paper "The Impact of Tier 4 Emission Regulations on the Power Generation Industry".

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ECAA 50th Anniversary Gala
Electrical Contractors Association of Alberta
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EFC Electrical Council Conference
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IAEI Spring Meeting
Canadian Section, hosted by Prairie Chapter of Int'l Association of Electrical Inspectors
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Application load requirements and duty cycle key to the right motor

Jim Bryan

When it's time to replace an existing motor or to buy a new one, two important considerations are the *application load requirements* and *duty cycle*. Choosing a larger motor than is required increases initial costs and wastes energy because the motor never operates at full load. An undersized motor, however—or one that is a poor match for the application duty cycle—may routinely exceed its rated operating temperature, causing it to fail prematurely.

Why operating temperature matters

A widely accepted '10-Degree Rule' states that motor insulation life is reduced by half for each 10ºC increase in winding temperature. When a motor is started at ambient temperature, the winding temperature increases until it equals the motor's ability to dissipate heat. Once the winding temperature stabilizes, it only varies when the ambient temperature changes.

When a motor has a service factor greater than 1.0, it is possible to run it at a load equal to the rated horsepower times the service factor without exceeding the thermal limits of the insulation system. It is not good practice, however, to operate continually in the service factor range, since this increases the operating temperature and, therefore, reduces the service life of the motor.

Sizing the motor appropriately based on rated temperature rise and torque load requirements will help assure long motor life while keeping initial cost and ongoing power bills as low as possible.

To size a motor properly for varying repetitive-duty, first determine the duration and horsepower load for each interval.

Duty cycles

Most motors run continuously with little variation in load. These continuous-duty motors are designed to operate non-stop at the full nameplate horsepower rating without damaging the insulation system or reducing motor life. This duty classification includes most general purpose motors, many of which are used in continuous-duty applications such as fans and blowers.

In other applications, motors are not loaded consistently throughout the duty cycle, or they are energized intermittently. Some motors start and stop frequently, while others have alternating light and heavy loads. When a motor operates at less than full load for certain periods, it may be possible to size it smaller than the maximum horsepower level than would normally be required. In that case, the lower initial capital investment would be an obvious advantage.

An intermittent-duty cycle is one where the motor is subject to periods of load and no load and/or rest. Motors designed for such applications can run continuously for only a short time and must be allowed to stop and cool off before restarting. Examples include motors for garage door openers, compressors, garbage disposers and some pumps. These motors are sized based on the horsepower requirements of the load.

Heating may be a concern when the motor has an intermittent-duty cycle. When a motor is started several times in succession without sufficient time to cool down, the rotor temperature may increase dramatically—enough to melt the rotor or damage the stator winding. Heating is not as significant when the duty cycle consists of periods of load and no load, because cooling airflow from the internal or external fan is present as long as the rotor is turning. Typical time ratings for intermittent-duty motors include 5, 15, 30 or 60 minutes.

Load variations

For applications with a repetitive-duty cycle, the load varies at specific intervals. Usually, intervals of equal duration are repeated throughout the duty cycle of the machine. The actual loads can vary widely, however, from almost no load to more than full load. An injection-moulding machine is an example of a repetitive-duty cycle application.

To estimate the possible heating effect of varying loads on the motor, calculate the root-mean-square (RMS) value of the horsepower (load) for one cycle. The RMS horsepower is the square root of the sums of the horsepower squared, multiplied by the time per horsepower, divided by the sum of all the time intervals. Use the following equation to determine the RMS load on the motor:

$$HP_{RMS} = \sqrt{\frac{(t_1 \times hp_1^2) + (t_2 \times hp_2^2) + \ldots + (t_i \times hp_i^2)}{t_1 + t_2 + \ldots + t_i}}$$

$$HP_{RMS} = \sqrt{\frac{(t_1 \times hp_1^2) + (t_2 \times hp_2^2) + \ldots + (t_i \times hp_i^2)}{t_1 + t_2 + \ldots + t_i}}$$

where
hpi = load in horsepower for each part of the cycle
ti = time in seconds that the motor is subject to load hpi

As long as the RMS horsepower does not exceed the full load horsepower of the motor used in the application, the motor should not overheat. Of course, this is only true as long as there is adequate ventilation during the entire cycle. (To keep it simple, the effect of acceleration time on a self-ventilated motor has been ignored.)

Example

To size a motor properly for varying repetitive-duty, first determine the duration and horsepower load for each interval. It is helpful to graph the required horsepower versus time (Figure 1) and to list each time and horsepower (Table 1).

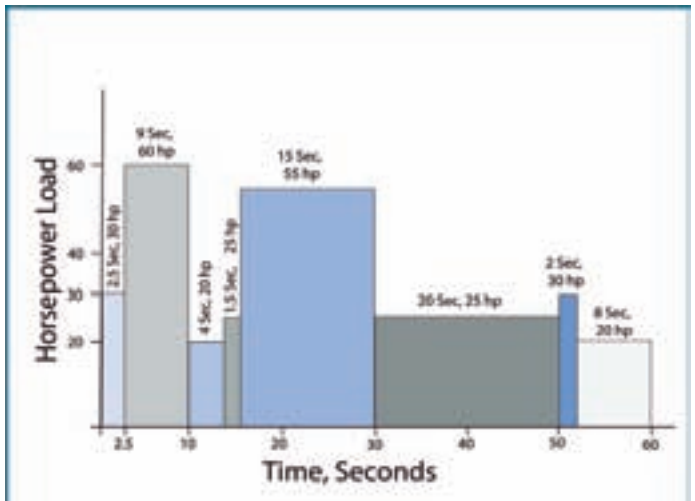

FIGURE 1

TABLE 1
Necessary data for RMS horsepower calculations

Part	Time (s)	Load hp	hp^2	hp^2 x t
1	2.5	30	900	2250
2	7	60	3600	25200
3	4	20	400	1600
4	1.5	25	625	937.5
5	15	55	3025	45375
6	20	25	625	12500
7	2	30	900	1800
8	8	20	400	3200

Using the RMS horsepower for this example gives the following result:

$$HP_{RMS} = \sqrt{\frac{(t_1 \times hp_1^2) + (t_2 \times hp_2^2) + \ldots + (t_i \times hp_i^2)}{t_1 + t_2 + \ldots + t_i}}$$

$$HP_{RMS} = \sqrt{\frac{(2.5 \times 900) + (7 \times 3600) + (4 \times 400) + (1.5 \times 625) + (15 \times 3025) + (20 \times 625) + (2 \times 900) + (8 \times 400)}{2.5 + 7 + 4 + 1.5 + 15 + 20 + 2 + 8}}$$

$$HP_{RMS} = \sqrt{\frac{(2250) + (25200) + (1600) + (937.5) + (45375) + (12500) + (1800) + (3200)}{60}}$$

$$HP_{RMS} = \sqrt{\frac{92862.5}{60}} = 39.3\ hp$$

In this case, the RMS horsepower is 39.3. To allow for voltage variations and to provide a little extra margin of safety, the motor for this application could be sized at 40 hp with a 1.15 service factor, or at 50 hp with a 1.0 service factor. Neither motor would overheat in this application.

To ensure the motor can actually deliver the maximum required torque, its breakdown torque (BDT) must be higher than the highest horsepower load torque throughout the duty cycle. When the motor cannot deliver this torque, it may stall. Be sure to consider seasonal variations in load requirement when sizing any motor for an application, but especially when considering the use of an undersized motor.

For the above example, a 40-hp, 4-pole, Design B motor would have a minimum breakdown torque of 200% of the full load torque (according to NEMA MG-1 requirements). To determine the percent breakdown torque needed for the peak horsepower, use this equation:

$$\%BDT = \frac{\text{Maximum required hp}}{\text{Rated motor hp}} \times 100$$

$$\%BDT = \frac{60}{40} \times 100 = 150\%$$

Since the maximum required horsepower is only 150% of the full load torque, the 40-hp motor could be used in this application.

Keep in mind, though, that analysis of this kind only works for applications with relatively short duty cycles. Any complete cycle that is longer than about 5 minutes will require a more involved study of the load and duty cycle. However, there are many applications with much shorter repetitive load cycles where the RMS horsepower can be used to size the motor.

Conclusion

To sum up, it always pays to analyze the duty cycle requirements of the application when buying a new motor or replacing an existing one. Sizing the motor appropriately based on rated temperature rise and torque load requirements will help assure long motor life while keeping initial cost and ongoing power bills as low as possible. EB

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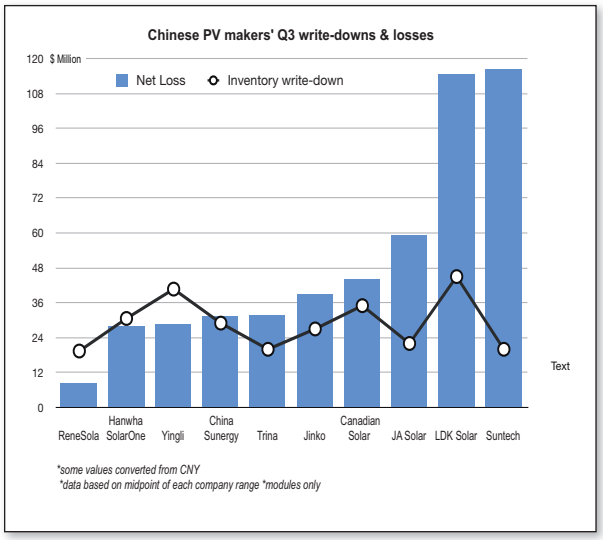
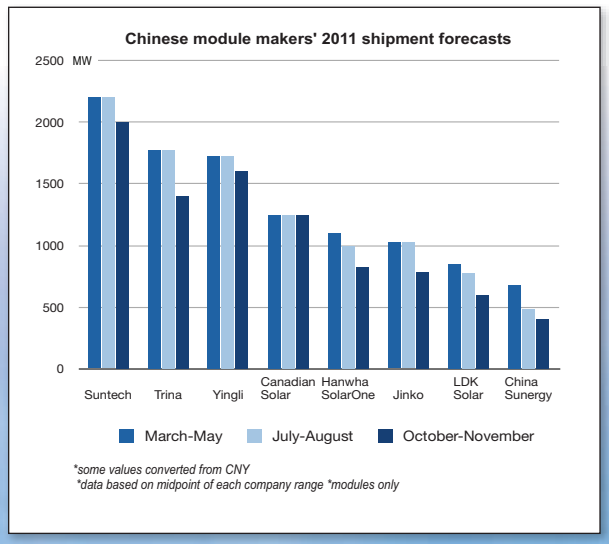
The bigger they are, the harder they fall

PV module bankability alert

Austin Brentley





In today's photovoltaic market, many so-called "heavyweight solar panel manufacturers" continue to take massive losses selling overstocked inventories. Increasingly, project developers and financiers recognize they may have been blinded by Fortune 500 fervour when choosing PV suppliers in the past.

Module warranties backed by name recognition and inflated balance sheets may have led to one of the biggest false senses of security the manufacturing sector has pitched since the Big 3 auto debauchery of 2008. However, whereas the auto industry successfully preserved its warranties with one phone call to Uncle Sam faster than you could say "Chapter 11", solar power plant investors may likely be left holding the "defective parts" bag all by themselves.

2012: The 3rd silicon revolution and a changing of the guard

Savvy industry speculators forecast that 2012 will be the year that redefines the term "bankability", especially once the first of the Big 8 corporate solar dominoes begins to fall.

Over the past year, the Top 8 solar manufacturers have reported record losses during what appeared to be a game of follow-the-leader with an unsophisticated "build it and they will come" attitude.

In Q1 2011, they had announced sales projections totalling 106 GW. In preparation, the Big 8 simultaneously ramped up production, operating at maximum capacity with further contract commitments to outside OEMs in hopes of feeding their wishful appetites.

By Q3, nearly a billion dollars in losses later, it was evident their projections were exceedingly ambiguous, as storage facilities choked, module prices plummeted, and serious misjudgments became harder to hide.

The end result?

There's going to be a major shift in procurement methods this year. Expect a changing of the guard as big name solar corporations find their own power cut off. In addition, financiers will begin tightening their belts while using a little more common sense when choosing bankable supply partners.

Most of the PV giants currently lined up on the plank share much in common. Aside from all being publicly traded, they are "predominately" in the solar sector, meaning they have all of their eggs in one big proverbial PV basket (not too comforting in today's market).

Finding bankability in today's solar minefield

When identifying a bankable panel, balance sheets should definitely be a contributing factor, but don't stop there: look for suppliers who are diversified in other sectors. Other multi-billion dollar, publicly traded corporate PV manufacturers are well-represented in other sectors, including electronics, real estate, spirits... even entertainment. While these players may appear to take a PV back seat to the Big 8, they certainly have comparable market caps and, most importantly, balance sheets that actually "balance".

Manufacturers without all of their egos in one basket are more capable of weathering supply and demand storms and more likely to stand behind their warranty commitments for the lifetime of your project.

Look for manufacturers who are vertically integrated. Some companies own and

operate their own poly silicon mines, often supplying many of the other module producers with silicon chucks, ingots and wafers. In some cases, they even dictate global silicon spot prices. Fully integrated PV companies who control their own supply chains are less likely to get caught with their pants down when competing on a global scale or simply trying to keep up with the herd.

Only choose module manufacturers who offer third-party warranty insurance policies as added protection to their billion-dollar balance sheets. Depending on the size of the order placed, this should only add pennies per watt to any utility-scale order.

This can be hard to find, but the days for corporate arrogance is over. Consumers should insist this security option be added, and manufacturers should be willing to meet their client's needs while saving you the "Trust me" speech. Additionally, fail-safe warranties can be extended to cover project downtime in the event of a system failure. As any insurance salesman will tell you, it's better to have it and not need it than to need it and not have it.

Arrogance got us here; ignorance will keep us here

Don't wear blinders and ignore the many solar opportunities that exist beyond obvious solar name recognition. There is a whole world out there, teeming with multi-billion dollar corporations with competitively priced—even superior-quality—products. In many cases, these lesser-known solar players actually ghost manufacturer products for well-established conglomerates. You might be pleasantly surprised at what you find, especially given how easy due diligence becomes when confirming specs, references and publicly listed filings.

Finally, look for module suppliers who put their money where there mouths are. When their finance departments are willing (and, more importantly, able) to finance the debt portion of your project in-house, take this as a sign of stability and longevity. Remember, a company in economic trouble is less likely to reach into its own pocket to help finance someone else's project.

The renewable energy market is one of the fastest growing sectors of the 21st century. With rapid growth comes rapid change, complete with its own set of risks. As the sector finds itself, and as the solar pricing floor becomes established, so too will the industry's new rising stars and their long-lasting partnerships. EB

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Preparing your business FOR SALE is like rehearsing FOR A PLAY

IGOR BULGARIN / SHUTTERSTOCK.COM

Mark Borkowski

When entering the centre stage spotlight, both a business owner and a star performer must know their roles, the script and the story, as well as the other major players and the roles *they* play. The goal of both is to achieve a certain response for their portrayal of the story from their own specific audience. Whether it is rave reviews for the actor or offers to buy the business for the owner, an experienced director is key to making the presentation a success.

Meantime, you'll often find a professional mergers and acquisitions advisory firm directing and orchestrating the backstage activity for the successful sale of a company.

The business owner's role in a sale

Before dressing up the company for its debut, get ready to share its best features as well as its blemishes, as both will become visible under the due diligence spotlight. As in the classic tale "The Emperor's New Clothes", it doesn't take a rocket scientist to see what the cloth is really made of. Buyers don't like surprises; neither do business brokers or other members of the professional team involved in the sale process. Problems uncovered late impugn your integrity and threaten the price... and the deal. The more issues brought to the table and worked out in advance, the better chance of a smooth closing.

Your role as the owner is to be the source of information necessary to accurately assess the firm. Addressing the following issues will help maximize the value of the business, provide transparency to prospective buyers, and minimize the amount of time consumed in the sale process. This information will be the foundation of the script that will tell the story to your audience... the marketplace of buyers.

- Why is the business on the market? This is not only important from the buyer's perspective, but an owner must have a sincere motivation to facilitate a smooth process.
- Are accounting procedures in place and easy to follow?
- Are profit & loss and balance sheets well-prepared and clean?
- Are the facilities and equipment in good working condition? "Curb appeal" makes an impression. When someone walks into a business establishment, they're looking at everything. An orderly and organized facility gives a good feel for how the business is run.
- Is intellectual property (if applicable) well-documented and up-to-date?
- Is there an appropriate lease in place and is it transferable?
- Are customer contracts secure and transferable?
- Are there employee contracts? Are they well-documented?
- Are operating procedures documented and in use?
- Are there outstanding legal or financial aspects that may hinder the sale?
- How is the business positioned in relation to the competition?
- What distinguishes the business from others in the same field?
- What services or products are offered that are unique?
- What niche is served?
- Are there areas for future growth?
- What makes the company's customer service superior?

The story

Once information-gathering is complete and data analyzed, a price range will be determined and a company profile formulated. This is the story about your business. It will be the marketing tool that articulates and presents the message about your company to the audience of buyers.

My conversation with myself

The script is made up of the individual pieces that tell the story. The following are individual

items that will be pieced together by the prospective buyer to substantiate the story and justify the asking price.

- Financial statements. An accurate financial statement not only adds to a buyer's comfort level, it will more likely result in a higher sales price. A potential buyer is typically looking for a predictable cash flow from the business. Three, four or five years of professionally prepared financial statements and tax returns will show them that.
- Trends in accounts receivable and payables. When selling a business, you want to show that you have good customers who pay on time. Owners need to be on the ball and contacting slow-paying clients. This shows better credit management, follow-up and attention to detail. Seasonality of cash flow and concentration of the customer base are also underlying themes of the story.
- Make sure patents, trademarks and other property rights are properly registered. Review contracts for third-party consents needed to facilitate a transfer. An example would be a construction-subcontracting firm that has a contract with a homebuilder to provide doors and windows for an additional number of houses. That contract needs to be reviewed to see whether it can be transferred or whether it requires the consent of the homebuilder.
- Well-organized and updated collateral materials such as employee handbooks, policy manuals, mission statements or an online internet presence add value in the eyes of the purchaser. Other collateral, such as brochures, press releases, advertisements and marketing campaigns (such as mail out or email programs) add credence to the story.
- A list of furniture, fixtures and equipment, along with applicable service records, shows the buyer the company is well-maintained. Remove excluded items prior to the sale, or list items excluded from the deal separately.
- Being prepared for the questions the buyers will ask will facilitate a smooth process for all involved.

Who are the other players in my conversation?

The team that a business owner puts together to assist in the structuring of the business sale will play key roles in the transaction. Depending on the size and complexity of the business, the usual team may consist of the firm's accountant, attorney and business broker. To ensure a smooth process, it is recommended that all team members be experienced in business transfer transactions.

The successful follow through

Proper rehearsal and having the necessary props in place for presenting a business to the targeted audience is key for attaining the desired outcome—the successful sale of the business in a timely manner. That's the payoff for a well-executed performance... the whole reason for the show. EB

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Ensuring electrical circuit protection without nuisance tripping

Colin Plastow

Whether commercial, institutional, municipal or industrial, sooner or later, nearly every facility will experience some type of overcurrent situation. Unless they are dealt with promptly, even modest overcurrent levels can cause system components to overheat and damage insulation, conductors and equipment. When it's large enough, an overcurrent condition can destroy insulation and melt conductors. Fault current and short circuits can also produce fires, explosions, and arc flash and blast, which could cause injury or death to personnel.

Electricity is distributed at a higher voltage than most facilities can use. Transformers step transmission-level voltage down to medium voltage. When a facility uses medium-voltage for equipment such as large motors, power is distributed through medium-voltage switchgear. However, for the lion's share of non-residential uses, secondary substation transformers step incoming voltage down to low voltage. Although IEEE defines low-voltage systems as those that operate below 1000V, most industrial applications are rated at 600V or lower.

Depending on the type of facility, low-voltage switchgear distributes power through feeders to branch circuits. These branch circuits can include motor control centres and drives, load centres and even associated equipment, such as metering modules, capacitors and harmonic filtering.

Some larger facilities may need provisions for ensuring that mission-critical applications have a reliable supply of electricity. Facilities may have secondary utility feeds, onsite power generation, or backup generators—usually operating through an automatic transfer switch.

Equipment in many facilities—especially industrial—requires 600V or 480V to operate. For lighting and control panelboards, voltage is stepped down further and converted from three-phase to single-phase power. There are quite a few three-phase step-down transformer combinations. However, the most common configuration for industrial use is Delta-Wye. A three-phase transformer with its secondary connected in a Wye configuration (208 Y/120V) produces 208V from phase-to-phase (A to B, B to C, or A to C) and 120V from any phase to neutral.

Overloads and short circuits

When current exceeds the ampere rating of conductors, equipment or electrical devices, an overcurrent situation exists. Facilities need devices that protect circuits and equipment from overcurrent.

Overcurrent includes both short circuits and overloads. During a short circuit, electrical current bypasses the load, taking the path of least resistance. Faulty wiring, improper equipment connections and insulation breakdown can cause short

circuits. Fault current magnitude can range from fractions of an amp to more than 200kA, and is determined by system impedance (AC resistance).

During fault-free conditions, the connected load determines the normal circuit current magnitude. An overload condition exists when the normal circuit current is exceeded, and a short circuit is not present. An overload—when allowed to persist—could cause damage to wiring or equipment. Temporary overloads can be harmless; sustained overloads can cause damage.

Momentarily pushing equipment past its limits can cause temporary overloads. For example, were a box to become lodged as it turned a corner on a conveyor, the conveyor motor may draw more current than normal. Were the box to dislodge quickly, or if someone repositions it, the overload is temporary. Temporary overloads are frequent. They're typically harmless and should be allowed to subside. Overcurrent protection devices should not open the circuit, allowing loads to stabilize.

Continually overloading electrically driven mechanical equipment, failed bearings or equipment malfunctions can cause sustained overloads. Installing equipment or lighting circuits that increase power demand beyond planned capacity can also cause sustained overloads.

Protection from too much current

The most common overcurrent protective devices are fuses and circuit breakers. With fuses, a separate disconnect must be used. Fuses are designed to open in overcurrent situations only. When using circuit breakers, a separate disconnect is not required because circuit breakers can be opened and closed manually.

Some people assume that a fuse will open as soon as the current flowing through it exceeds its rated value. However, a typical fuse has an inverse time-current characteristic. In other words, the higher the current, the faster the fuse will open. The time-current characteristic of a fuse cannot be adjusted.

The time-current characteristic of some circuit breakers can be adjusted. For example, most low-voltage power circuit breakers have adjustable trip functions. The tripping time delay can be short to long, depending on the trip unit adjustment. It's important that circuit breaker trip units are set based on a coordination study performed by the designer of the facility's electrical system or a qualified electrical engineer.

Coordinating protective devices

A coordination study involves properly selecting protective devices based on their short circuit ratings and appropriate settings where applicable. Not only does a properly coordinated system protect cables and electrical equipment from damage, it also isolates and interrupts fault currents while ensuring that electrical power is provided to unaffected branches of the electrical system. Good protective device coordination provides the optimum balance between selectivity and system protection.

Selective coordination effectively isolates a circuit with an overload or fault from the rest of the

electrical system, thereby minimizing downtime due to nuisance tripping. Only the upstream overcurrent protection device nearest to the fault opens. When a system is not selectively coordinated, it is possible for a single circuit with a fault to shut down part or all of a facility.

During the coordination study, the electrical engineer examines the time-current curve for each protection device in each branch of a facility's electrical system. For breakers, the engineer "overlays" the time-current curves to ensure that the curves do not overlap at any possible fault current. For fuses, coordination is achieved as long as the electrical system designer maintains ratios recommended by the fuse manufacturer, and those maintaining the facility do not substitute a different fuse class, type or rating.

Proper coordination depends on a good coordination study. And a good coordination study depends on a facility having accurate electrical documentation.

Using a clamp meter to avoid nuisance tripping of the circuit protector

The clamp meter is an important and common tool found in the toolboxes of electricians and technicians alike. A clamp meter is an electrical tester that combines a voltmeter with a current meter.

Since motors make up 40% or more of the electrical load in most plants, it is not surprising that plant electrical personnel spend a considerable amount of their time either installing or troubleshooting them. Regardless of the job at hand, it is useful—and often necessary—to know the value of the starting or in-rush current. This can help identify where a starting problem is located—either in the motor or somewhere in the starting circuit. This measurement may also be recorded in a preventive maintenance log.

While new, high-efficiency motors consume less electricity than their older, less efficient counterparts, they are much more likely to trip the circuit protector when started. The trips are caused by the initial start-up current, which can be several times greater than their operating or steady-state current.

Although short lived, this surge can create problems. The most annoying consequence of inrush current is appropriately called a "nuisance trip" of the circuit protector. When the protector is not designed to handle the amount of in-rush current present, the device can trip upon energizing the circuit or during circuit operation.

With technological advances in electrical equipment and circuits come more challenges for electricians and technicians. These advances not only require more capability in today's test equipment, but more skills on the part of the people who use them. An electrician who has a good grounding in the fundamentals of test equipment use will be better prepared for today's testing and troubleshooting challenges.

For electricians who deal with motors in their work, the ability to capture the amount of current drawn by a motor during its start-up can tell a lot about a motor's condition and loading. EB

Colin Plastow is industrial product manager for Fluke Electronics Canada and can be reached at colin.plastow@fluke.com.

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Standard Products claims its electronic sign ballasts consume 25-40% less energy than magnetic ballasts and feature instant start parallel wiring, ensuring that if one lamp fails, the remaining lamps will continue operating, keeping the sign lit. The line is made up of five models that operate one to six T12HO or T8HO lamps for different length configurations. Not only do these ballasts operate both lamp types, but all models have a 120-277V input voltage range. The ballasts are cUL listed.
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www.standardpro.com

Fulham 5-Tap HID high pressure sodium and metal halide ballasts

Fulham has augmented its line of 4-tap magnetic HID ballasts with new 5-tap magnetic HID high pressure sodium and metal halide ballasts of 120V, 208V, 240V, 277V and 480V. All ballasts include a high temperature rated capacitor, an ignitor (where applicable) and mounting brackets (hardware). Fulham describes the new ballasts as featuring precision wound, vacuum impregnation coils for quiet operation and long life.
FULHAM
www.fulhamcanada.ca

Toshiba PAR38 and MR16 LED lamps

Toshiba International claims its new PAR38 and MR16 lamps offer higher lumen output while still providing huge energy savings when compared to similar lumen halogen bulbs. The PAR38 1100 Series replaces 90 to 110W halogen lamps and offers outputs of up to 1170 lumens and uses up to 75% less energy, while the MR16 450 Series, a replacement for 35W halogen lamps, offers up to 475 lumens and uses up to 80% less energy.
TOSHIBA INTERNATIONAL
www.toshiba.com/tic

Lumenpulse 2012 product catalogue now available

Lumenpulse is showcasing its entire product line through its new 2012 product catalogue. Designed with ease of use in mind, Lumenpulse says the 500-page hardback volume enables lighting designers, architects and electrical engineers to select luminaires that will bring their ideas to life. Graphical indexes, quick-lookup specification tables, graphical representations of mounting options, accessories and wiring diagrams are included for each product.
LUMENPULSE
www.lumenpulse.com

Leviton redesigns website to include "Leviton 101"

Leviton boasts that its redesigned website offers an enhanced user experience for both professionals and consumers. "The new www.leviton.com is the smart choice, serving as a complete resource," it says. The redesign features "Leviton 101", an educational platform that connects visitors with training videos and information from Leviton experts, as well as with other site visitors for collaborative DIY discussions. Users will also be greeted with a cleaner interface, a rotating carousel of images, and an updated navigation menu.
LEVITON
www.leviton.com

Steinel RHB 300 wireless occupancy sensor provides 360° coverage

Steinel's new RHB 300 wireless occupancy sensor uses passive infrared technology to sense occupancy in high bay installations. The sensor mounts directly to a high bay fixture, and can perform at mounting heights as high as 45 feet. Three pyroelectric sensors are used in the product to provide 360° coverage. The company stresses that by achieving the right coverage, users can maximize energy savings by monitoring locations with fewer sensors, while still achieving proper detection.
STEINEL
www.steinel.net

EB products

Ideal SLK Disconnect Fuse Kit for streetlights and electric car chargers

To help protect against exposed electrical systems in the event a streetlight gets knocked down, Ideal Industries has introduced the SLK Disconnect Fuse Kit, a waterproof breakaway safety device that de-energizes roadway lights, streetlights, parking lot lights and electrical vehicle charging stations. The kit also aims to protect service personnel who are performing maintenance. The fuse stays on the de-energized load side when separated, which helps to protect those nearby as well. The kit is listed to UL's ECIS category for special purpose connectors.
IDEAL INDUSTRIES
www.idealindustries.com

Milwaukee 2603-20/22 drill/driver and 2604-20/22 hammer drill/driver

Milwaukee's new M18 Fuel ½" drill/driver (2603-20/22) and M18 Fuel ½" hammer drill/driver (2604-20/22) are slated to launch in March – delivering up to 10 times longer life, 25% more power and 50% more run-time, describes the company. Both 18V drills offer up to 725 in-lb of torque, 0-550 / 0-1850 rpm and weigh no more than 5 lbs. They also both include Milwaukee's Powerstate brushless motor, Red-Lithium battery pack and Red-Link Plus intelligence.
MILWAUKEE ELECTRIC TOOL
www.milwaukeetool.com

Hammond HN4_SS stainless steel two door cabinets

Hammond Manufacturing describes its new HN4_SS series of stainless steel two door cabinets as robust units ideal for various process and water-related industries. Designed to house electrical, electronic, hydraulic or pneumatic controls and instruments installed in harsh industrial environments, the HN4_SS range is available in 12 different sizes, ranging from 24" H x 42" W x 8" D to 42" x 60" x 12". The three-point door closing mechanism can be secured with a padlock to prevent unauthorized entry, and can be mounted on walls or equipment.
HAMMOND MANUFACTURING
www.hammondmfg.com

NEMA ANSI C84.1-2011 for 60Hz electric power systems

The National Electrical Manufacturers Association (NEMA) has published ANSI C84.1 Electric Power Systems and Equipment – Voltage Ratings (60 Hertz), a standard which establishes nominal voltage ratings and operating tolerances for 60Hz electric power systems above 100 volts. It includes preferred voltage ratings up to and including 1200 kV maximum system voltage, as defined in the standard.
NEMA
www.nema.org

Appleton FSQC interlocked receptacle

Appleton's expanded Powertite line of plugs, connectors and receptacles features the new FSQC interlocked receptacle for refineries, chemical plants, water treatment facilities, and pharmaceutical production, among other sites. According to the company, the compact footprint of the unit is suitable for applications where space is restricted and is ideal as a drop-in replacement for existing competitor FSQC receptacles. The receptacle comes with a durable epoxy powder coat finish to provide superior corrosion resistance, it adds.
APPLETON
www.appletonelec.com

Infinite Solar launches online solar training courses

Infinite Solar Inc., a provider of renewable energy training, is launching Infinite Solar Online, internet-based solar training programs that expand its traditional curricula to an online format. Designed to complement each other, the online courses can be followed by one of the hands-on workshops to put theory into practice, it explains. Online course instructors will be available to answer questions along the way, with email, live chat, office hours, and video chats. A course glossary, internet resources and case studies are included in the online classroom.
INFINITE SOLAR
www.solarschoolpa.com

Expanded Sew-Eurodrive X Series covers lower power range

Sew-Eurodrive has expanded its X Series industrial gear units to cover the lower power category by offering a torque range of 6.8 to 45 kNm (5000 to 33,000 ft-lb), resulting in a total torque range of 6.8 to 475 kNm (5000 to 350,000 ft-lb) for the product line.

According to the company, the series' finely graduated size and high power density results in savings in terms of both weight and cost. Product applications include motor adapters and mounting flanges, backstops and cooling systems, as well as sealing systems for the most varied environmental conditions.
SEW-EURODRIVE
www.sew-eurodrive.ca

Arlington 8161PM pole-mount box

Arlington has released the non-metallic 8161PM pole-mount box for face down installations of security cameras and electrical accessories on a rigid pole or pipe. The one-piece product attaches to a round non-metallic or metallic rigid pipe with hose clamps, and holds cameras and other electrical accessories up to 50 lbs. It is also available with ground clip for Canadian orders.
ARLINGTON INDUSTRIES
www.aifittings.com

Cooper Crouse-Hinds develops new hot dipped galvanized products

Cooper Crouse-Hinds says its new hot dipped galvanized products, meant for use with rigid/IMC conduit, offer corrosion protection against water, road salt and other harsh environmental conditions. The product offering includes conduit bodies and covers, mogul bodies and covers, conduit straps, clamps and couplings, hubs, XJG & XD expansion & deflection joints, cast boxes, and covers. According to the company, the hot dip galvanized process produces a much thicker, durable coating which prevents corrosion of the protected product and results in a reduced need for replacement or general maintenance.
COOPER CROUSE-HINDS
www.crouse-hinds.com

T3 Innovation Coax Clarifier

The new Coax Clarifier layout/fault finder by T3 Innovation is now available. Designed to help field technicians qualify and quantify 'dark' coax systems, the tool features a backlit LCD to show loss levels on each coax cable run and displays a bar graph of quality for each. Users will also be able to measure cable lengths, measure signal quality and wiremap with the tool.
T3 INNOVATION
www.t3innovation.com

Bridgeport Magnetics PhazeSaver PS15000

Bridgeport Magnetics Group has developed the PhazeSaver Model PS15000, a transportable 15,000VA transformer to restore 240VAC power from a single phase 120VAC and a good neutral source. It can also provide 120V power from a service without a neutral but with two good phases. The PhazeSaver works with both overhead 120VAC/240VAC and underground 120VAC/208VAC systems, and restores power when partial service is lost until permanent repairs can be completed. Two units in parallel allow loads up to 30KVA. All electrical connections are enclosed and secured behind a hinged door with tamper proof key lock.
BRIDGEPORT MAGNETICS GROUP
www.bridgeportmagnetics.com

CommScope offers GroundSmart Copper Clad Steel

CommScope has developed a copper-alternative grounding wire designed to deter copper theft and lower maintenance costs for telecoms and data applications. The GroundSmart Copper Clad Steel solution has been intended for use in subsurface grounding grids, as well as inside and outside plant bonding applications. According to the company, the solution makes it less susceptible to theft by increasing the resistance to cutting and drastically decreasing the scrap value. It can be jacketed with a polyethylene coating and printed to disguise and distinguish the wire from solid copper alternatives.
COMMSCOPE
www.commscope.com

Britech Snow-Mat ice and snow mats

Britech has introduced Snow-Mat ice and snow mats, designed to be installed quickly and easily under concrete, asphalt or interlocking bricks, it says. The mats consist of twin conductor heating cables bound to a fiberglass mat, and are available from 24 to 122 sf. Users could also create the custom layout shape by cutting the mat backing between the heating elements.
BRITECH
www.britech.ca

CWS-01 Wire/Cable Stripper from Macoy Tools

The compact, heavy-duty CWS-01 Wire/Cable Stripper distributed by Macoy Tools features a 3/4 hp, 110V/60Hz single-phase motor (220V/50Hz single-phase upon request) and can accommodate wires from 14 AWG to 3 inches. Weighing about 90 lb, the Canadian-made CWS-01 is direct-gear driven with single-blade operation. The blade itself is made of 4140 steel and hardened to 57 Rockwell, meaning each blade should last for thousands of feet of wire. The unit strips both solid and stranded wire at a rate of 120 ft/min, and can be bench-mounted.
MACOY TOOLS
www.macoy.ca

Schletter AluGrid solar mounting system

Schletter has introduced its AluGrid solar mounting system, which it describes as ideal for quick installation of high concentrations of modules. According to the company, AluGrid uses fewer components resulting in lower costs and installation time. The system was designed for flat-roof applications with module tilts at a fixed 15°; each system includes complete structural analysis including ballast calculations and project drawings.
SCHLETTER
www.schletter.ca

ADVERTISER INDEX

CEC 2012 Rule 10-812

Kris Paszkowiak, P.Eng.

Just released, the 22nd edition of the Canadian Electrical Code (CEC 2012) has over 180 changes and revisions. Section 10, Grounding and bonding, is one section among many that will impact electrical trade wiring practices. For example, Table 17 specifying the minimum size of the system grounding conductor has been deleted.

The new Rule 10-812, Grounding conductor size for alternating-current systems, requires the grounding conductor connecting the service equipment to the grounding electrode not be smaller than No. 6 AWG for all service sizes. The previous version of the code based on Table 17 required a minimum No. 8 AWG for a 100-ampere service and at least a 2/0 AWG copper grounding conductor for any service over 800 amperes.

The reasoning being that, under normal operating conditions, the No. 6 AWG grounding conductor is not intended to carry any substantial current.

Under a single line-to-ground fault condition it is the neutral conductor of the electrical distribution system that provides the low impedance path for the fault current. The impedance of the ground is generally much higher than the impedance of the neutral conductor. So long as the equipment bonding conductor and neutral conductor are properly connected at the service panel, the circuit protective devices (such as a fuse or a circuit breaker) should operate as required.

A properly installed neutral conductor meets the requirements of Rule 10-204, Grounding connections for alternating current systems. The neutral must be grounded at the transformer and at each individual service where the system is grounded at any point. The neutral conductor must be run to each individual service and have a minimum size as specified for bonding conductors in Table 16.

Other significant CEC changes include a major rewrite of Section 50, Solar photovoltaic systems. There are new or expanded Rules for voltage ratings of photovoltaic circuits, voltage drop, photovoltaic DC arc fault circuit protection, wiring methods and photovoltaic system grounding.

Also, major changes occur in Section 4 dealing with increased ampacities for wire and cables. The CEC ampacities are being harmonized with similar requirements previously defined in the National Electrical Code, which is the standard for electrical installations and equipment in the United States.

Section 64 defines rules for renewable energy systems such as fuel cells, small and large wind systems, micro-hydropower systems, hydrokinetic power systems and inverters.

There are also new receptacle requirements for single dwellings. Rule 26-714 (c) requires that one receptacle must be provided in a garage for each cord-connected garage door opener.

New Rule 27-704 requires receptacles protected by Class A-type ground fault circuit interrupters and dedicated for maintenance of equipment located on rooftops.

Rule 62-116 (3) requires new 100% demand factor for electric thermal storage heating systems, duct heaters or electric furnaces.

More than ever, the safety of electrical systems depends on the electrical trade workers being up-to-speed on the numerous changes and revisions introduced in the new code. There are significant changes affecting consumers, equipment manufacturers and electrical contractors. Relentless updating is the only way to limit risk and eliminate electrical shock, fire and explosion hazards. EB

Kris Paszkowiak is principal of CodeSafety Associates, a consulting firm serving the needs of the electrical industry. He holds a Master Electrician licence and has served numerous organizations over the years, including the Canadian Advisory Council on Electrical Safety, Committee on CE Code Part I and UL Electrical Council. E-mail CodeSafety Associates at kris.paszkowiak@codesafety.ca.

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

Tackle The Code Conundrum... if you dare

Answers to this month's questions in April'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

Where a separate bonding conductor is run with single conductor cables, it need not follow the same route as the cables.

a) True **b)** False

Question 2

Sheath currents are not a concern for single conductor cables installed underground where the ampere rating of the circuit is less than 425 amps.

a) True **b)** False

Question 3

Where non-metallic sheathed cable runs along metal studs, it shall be located so as to be effectively protected from mechanical injury both during and after installation.

a) True **b)** False

Answers to Code Conundrum EBMag February 2012

Q-1: For single dwelling units, the CEC requires minimum ____ duplex receptacle(s) to be installed in a two-car garage with a cord-connected central vacuum and a garbage disposal unit installed.

c) Three. Rule 26-710, 26-714.

Q-2: The maximum rating for overcurrent protection for exposed wiring permanent outdoor lighting is:

c) 30A m. Rule 30-1120(1).

Q-3: A Class I location is:

a) An area that has flammable vapours. Rule 18-004.

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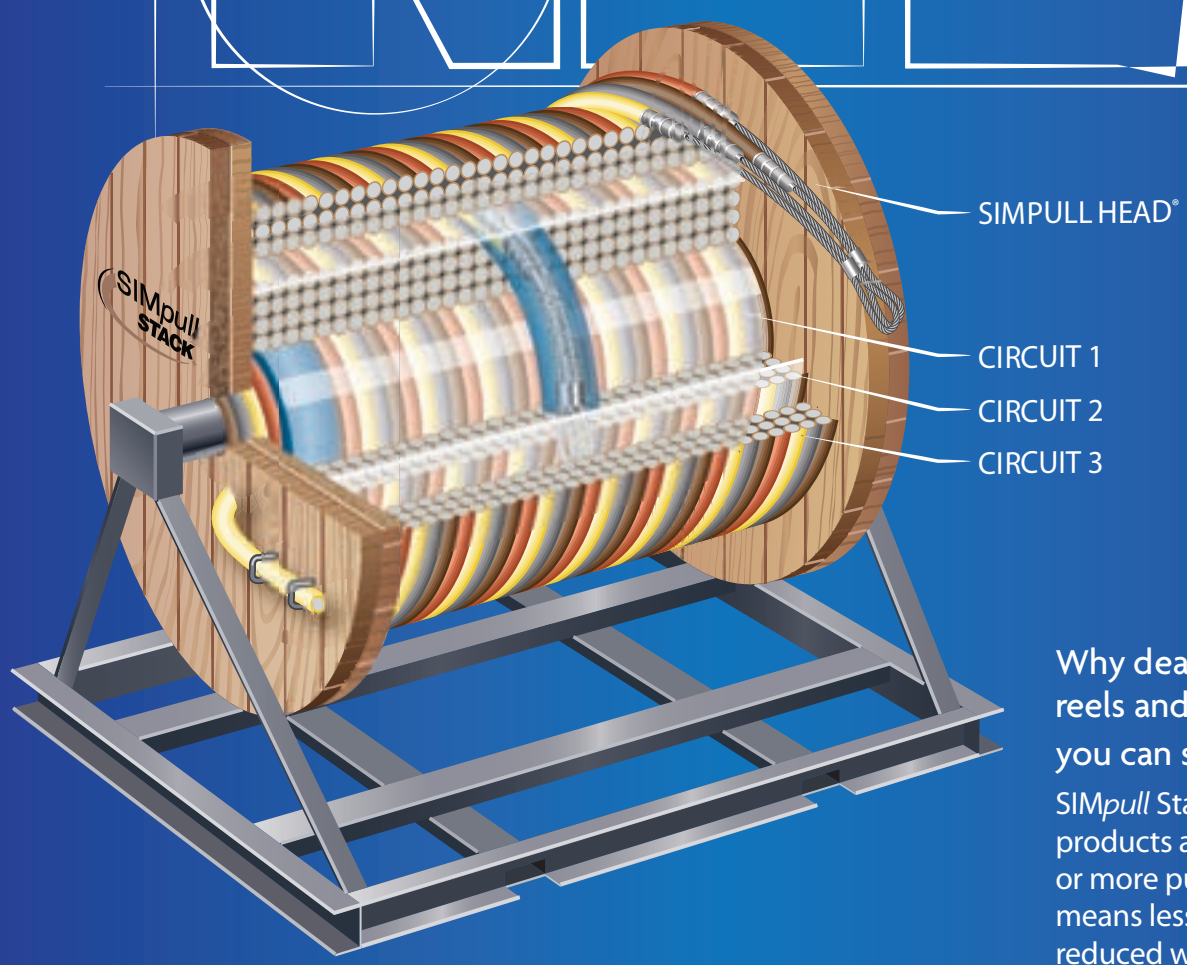

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