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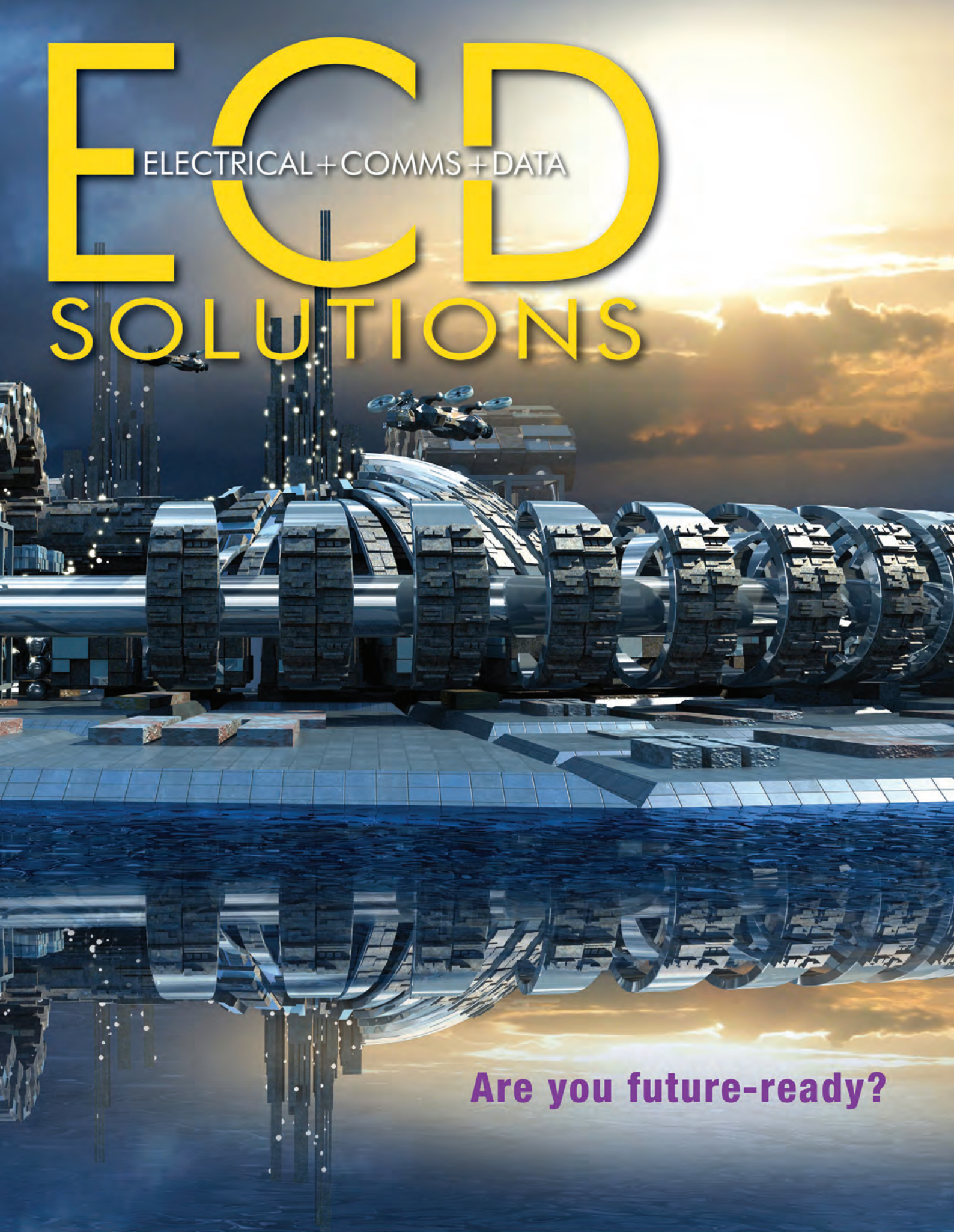

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SEP/OCT 2015 | VOL.14 NO.4

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## FROM THE EDITOR

Digital disruption is affecting all industries, and the electrical, comms and data industry is no exception. The Internet of Things, smart and connected devices, smart grid and cloud computing are changing the way we work and the work we do. Some are embracing the challenges and opportunities that the disruption brings and others are waiting for the changes to affect them. In this issue, telecommunications and IT industry veteran Lawrence McKenna provides detailed insights on digital disruption, what it means, how it will affect the industry and jobs, and how to best prepare for the changes that will transform your industry.

Speaking of change, we relaunched this magazine three years ago and we think now is a good time to take stock and get future-ready. With an aim to improve the magazine to better suit your changing requirements, we've launched a Technology Trends survey. We want to know what's challenging you and where you see the opportunities for growth, how the Internet of Things is impacting your sector and what we can do differently to better supply you with the right information to help your career and your business.

There are only 22 questions and it will take you five minutes to complete the survey. As survey participants, you can enter the draw to win a computer on a stick — the Intel Compute Stickand — and receive the top-line summary of the findings that will help you benchmark yourselves against your peers in the electrical, communications and data sector in Australia. To take the survey, please visit https://goo.gl/KfLGI0.

*Mansi Gandhi - Editor*
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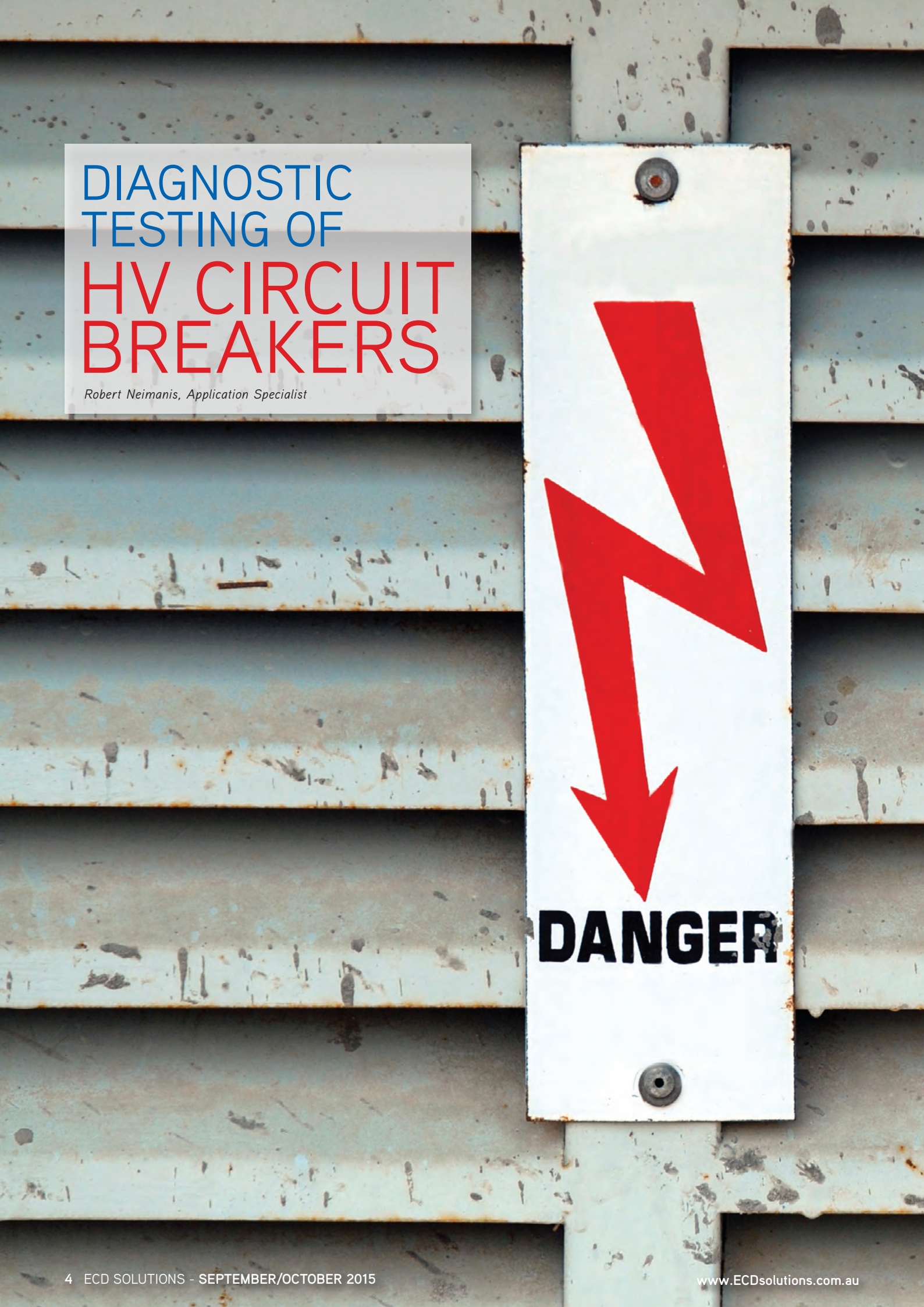
# DIAGNOSTIC TESTING OF HV CIRCUIT BREAKERS

*Robert Neimanis, Application Specialist*



Circuit breakers are not the most prominent items of equipment in a substation. They spend a lot of time doing nothing except waiting in anticipation. There comes a moment, however, when the circuit breaker must perform instantly and flawlessly. How can you test that yours will?

Unfortunately, all electrically operated devices are sooner or later likely to experience some kind of malfunction and, if a circuit breaker does not work as expected, problems can cascade with potentially catastrophic results.

By testing, however, technicians and substation managers can diminish their worries about circuit breaker performance. Circuit breakers provide protection for equipment that's an essential part of the infrastructure and expensive to replace; maintaining the breakers prevents outages, which reduces headaches — and saves money — for utilities and their customers. Additionally, there is a real public service component in ensuring the reliable supply of power, minimising business downtime and customer 'dark' time.

Substation breaker testing is an important task for all power utilities. The proper functioning of a breaker relies on many individual components that must be calibrated and tested at regular intervals. The factors used to determine maintenance intervals differ greatly between power utilities, but they often include time since last test, number of operations or severity of fault current operations. Environmental considerations such as humidity and temperature — whether the breaker is located in a desert or coastal region — also affect the maintenance schedule.

## Types of circuit breakers

Circuit breakers can be classified in many different ways — by voltage, application, insulating medium, etc.

Depending on where the circuit breaker is positioned in a power network, different levels of reliability will be required from it. It is these requirements that usually determine the test schedule for the breaker and the amount of maintenance it will receive. In this two-part article we will look at the most common test methods for breakers as well as at some newer methods that are rapidly growing in popularity.

## Conventional testing methods

The main functions of a circuit breaker are to open the circuit in response to faults and to connect/disconnect objects and parts of the electricity network. The majority of the switching operations of a circuit breaker are normal-load operations.

At first it may appear that there is not much to test in a circuit breaker, but a closer look reveals a complex mechanism that must perform flawlessly in a matter of milliseconds. Measuring those milliseconds — the main contact timing — is one of the key objectives of circuit breaker testing. In addition, measurement of contact movement is almost always included in the circuit breaker maintenance/service plan. Possible tests on circuit breakers are not limited to just these two, however, and we will discuss a number of diverse measuring techniques that help in reliably assessing circuit breaker status.

## First trip test

An effective method to verify the condition of a circuit breaker is to examine its behaviour during the first open operation after it has been idle for long time. For a test of this type, the connections to the circuit breaker and the measurements are carried out while it is still in service. All test connections are made inside the control cabinet.

The major benefit of performing a first trip test is that it checks circuit breaker performance under 'real world' operating conditions. If the circuit breaker has not operated for long period of time, first trip testing will reveal whether its operation has become slower due to problems in the mechanism linkages or coil armatures caused by corrosion or dried grease. With the alternative test methods that have traditionally been used, testing is carried out after the circuit breaker has been taken out of service and has operated at least once.

During a first trip test on a gang-operated circuit breaker (a breaker with a common operating mechanism), one coil current is measured. On an independent pole-operated breaker, however, three coil currents are measured. Analysis of the coil current signatures provides information about the circuit breaker condition. The timing of the auxiliary contacts can also be measured.

The opening time of the circuit breaker can be measured by monitoring the secondary current in the protection CTs, but if this method is used, the arcing time will be included. If there

## Examples of problems that can be revealed by first trip analysis:

| Problem | Revealed by |
|---|---|
| Sticky trip latch components in the mechanism | Trip coil current graph comparison |
| Delay in trip or close initiations | Auxiliary contact timing measurement |
| Issues with voltage supply to circuit breaker | Coil voltage graph |
| Sluggishness in energy delivery by a spring/hydraulic/pneumatic operating mechanism | Speed measurement from motion graph |
| Loose connections in the control wiring | Trip/close coil current graph comparison |

is a parallel primary current path, the opening time can be determined more accurately since arcing is then minimised.

## Main contact timing

Main contact timing is based on these IEC definitions: Opening time — the time interval from when the opening release (the trip coil, for example) is activated to the instant when the arcing contacts have separated at all poles; Closing time — the time interval from when the closing device (the closing coil, for example) is activated to the instant when the arcing contacts touch each other in all poles.

The aim of the main contact timing test is to make sure that the opening and closing times are as specified by the circuit breaker manufacturer. Times outside the manufacturer's specifications, especially when switching short-circuit currents, lead to an increased arcing time. This results in excessive contact wear (in the best-case scenario) and can also cause an equipment emergency, namely melting of the contacts. And, if the contacts melt, the breaker will need to be serviced or replaced.

As well as acceptable opening and closing times for the circuit breaker as a whole, correct synchronisation is imperative, both between phases and, in case of multiple breaks per phase, between contacts in the same phase.

Synchronism within a phase is essential where several contacts are connected in series. Here, the breaker becomes a voltage divider when it opens a circuit. If the time differences between the operations of the contacts are too great, excessive voltage will appear across one of them resulting in flashover, with the possibility of serious damage to the breaking chamber.

The time tolerance for simultaneity between phases is greater for a three-phase power transmission system running at 50 Hz since there is always 3.33 ms between zero crossovers. Nevertheless, even in such systems, the time tolerance is usually specified as less than 2 ms. It should also be noted that breakers that perform synchronised switching must meet more stringent requirements in both of the aforesaid situations.

IEC 62271-100 requires that circuit breaker synchronisation (phase versus phase) is better than 1/4 cycle for closing operations and better than 1/6 cycle for opening operations. Synchronisation between interrupters in the same phase is specified as better than 1/8 cycle.

## Resistor contact timing

The resistor contacts can be of the pre- or post-insertion type. Timing of resistor contacts is performed simultaneously with the main contacts but it is only possible to detect the resistor contacts while the main contact is open. The resistance value is a good parameter for evaluation.

## Auxiliary contact timing

There are no generalised limits for the time relationships between main and auxiliary contacts, but it is still important to understand and check auxiliary contact operation. The purpose of an auxiliary contact is to close and open a circuit. Such a contact might, for example, enable a closing coil when a breaker is about to perform a closing operation and then open the circuit immediately after the operation starts, to guard against coil burnout. Auxiliary contacts are also used for relay protection and signalling purposes.

## Primary injection test

For primary injection testing, a high current is injected on the primary side of the current transformer. The entire chain — current transformer, conductors, connection points, relay protection and sometimes the circuit breakers as well — is covered by the test. During primary injection testing, the system under test must be taken out of service. This type of test is typically conducted as part of the commissioning process.

The only way to verify that a direct-acting, low-voltage circuit breaker operates properly is to inject a high current through it and observe/record its performance.

## Main contact motion

A high-voltage breaker is designed to interrupt short-circuit currents in a controlled manner. This puts great demands on the mechanical performance of the operating mechanism and of all the components in the interrupter chamber. The breaker has to operate at a particular speed in order to build up adequate pressure for the cooling stream of air, oil or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gas (depending on the type of breaker) to extinguish the arc that is generated after the contact separation until the next zero crossing.

It is important to interrupt the current to prevent a re-strike. This is achieved by ensuring that the contacts move sufficiently far apart before the moving contact enters the so-called damping zone. The distance throughout which the breaker's electric arc must be extinguished is usually called the arcing zone. From the motion curve, velocity and acceleration curves can be calculated which reveal even marginal changes that may have taken place in the breaker mechanics. The contact motion is captured by connecting a travel transducer to the moving part of the operating mechanism. The transducer provides an analog voltage related to the movement of the contact. Motion is usually presented as a time versus distance curve.

## Travel

The travel trace indicates the instantaneous position of the circuit breaker contacts during an operation. The trace provides important information such as total travel, over-travel, rebound, under-travel, contact wipe or penetration of moving contact or operating-rod position at the time of close or open, and it also reveals many types of anomalies.

## Speed and acceleration

Speed is calculated between two points on the motion curve. The upper point is defined as a distance in length, degrees or percentage of movement from either the closed or open position, or from the contact-closure or contact-separation point. The time that elapses between these two points ranges from 10 to 20 ms, which corresponds to 1-2 zero-crossovers. The lower point is determined based on the upper point. It can either be a distance below the upper point or a time before the upper point. The most important benefit derived from the instantaneous velocity and acceleration curves is the insight they provide into the forces involved during the operation of a circuit breaker. Average acceleration can also be calculated from the velocity trace.

## Damping

Damping is an important parameter to monitor and test as the stored energy the operating mechanism uses to open and close a circuit breaker is considerable. The powerful mechanical stresses produced during open and close operations can easily damage the breaker and/or reduce its life. The damping of opening operations is usually measured as a second speed, but it can also be measured as the time that elapses between two points just above the breaker's open position.

## Contact resistance measurement

Contact resistance is measured by injecting a known DC current through the main contact system when the circuit breaker is closed. By measuring the voltage drop the resistance can be calculated. The value of the main contact resistance reflects the condition of the conducting parts. This test is often called static resistance measurement (SRM).

The static resistance value provides a reference value for all types of electrical contacts and joints. IEC56 states that this resistance is to be measured using a current between 50 A and the breaker's nominal current. ANSI C 37.09 specifies a minimum test current of 100 A. Other international and national standards set forth similar guidelines in order to eliminate the risk of obtaining erroneously high measurements if the test current is too low. In some cases, heat generated by a high test current disperses any contact grease remnants or other impurities found on contact surfaces (resulting from numerous high-current breaking operations). When the circuit breaker contacts are in poor condition, the values obtained can differ dramatically from those measured at the factory when the breaker was new. ANSI mentions about 200% increase of resistance over the maximum value specified at the factory.

## Dynamic resistance measurement

This test is conducted by injecting DC current through the breaker main contacts and measuring both the voltage drop and current while the breaker is operated. These values are then used to plot the resistance as a function of time. If contact movement is recorded simultaneously, it is possible to determine the resistance at each contact position. This method is used mainly for contact diagnosis, but can also be used for main contact timing.

With DRM, the arcing contact length can be reliably estimated. The only alternative way of finding the length of the arcing contact is to dismantle the circuit breaker. In SF6 breakers the arcing contact is commonly made of tungsten. This contact is burned off and becomes shorter at each interruption of load current. Dynamic resistance measurements clearly reveal this shortening of the arcing contact. To obtain reliable DRM data, a high test current is required as well as test equipment with good voltage measurement resolution.

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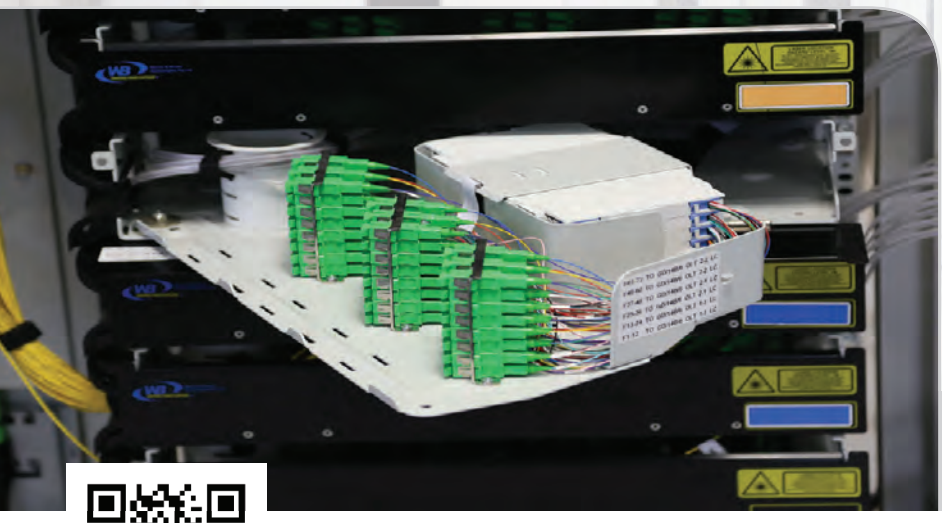

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# MANAGING YOUR BUSINESS FINANCES

Whether you're just starting out, or have been in business for some time, having a good understanding of your current financial position will allow you to plan, expand and grow your business.

## Using financial professionals

Looking after your business finances while running your business can be difficult, so you may like to consider using the services of professionals to make sure your business is in the black.

Financial professionals can help you maintain your books, create and stick to a budget, monitor your cash flow and help you make decisions about opportunities like buying new equipment, expanding your business and leasing or buying a commercial space.

Some of the financial professionals you might consider using include:

- Accountant — Accountants can help with a number of business financial needs including preparing financial statements, managing tax and providing financial and business advice.
- Bookkeeper — Bookkeepers can keep track of day-to-day financial transactions, look after your banking, chase overdue payments, pay wages and prepare some financial statements.
- Business Activity Statement (BAS) agent — BAS agents can help you prepare and lodge your BAS to ensure you get it right the first time. They are registered professionals who are specialists in their field. You can find registered BAS agents on the Tax Practitioners Board (TPB) register.

## Organising your finances

When organising your business finances, there are some things you'll need to consider.

### *A business bank account*

If you operate as a sole trader you aren't legally required to have a separate bank account for your business, you can use your personal account. However, for easy tracking of business income and expenses, you may consider opening a separate account for your business. Have a look at the Australian Taxation Offices (ATO) Separate business and personal expenses information on how to use a single bank account for both your personal and business finances. If your business operates as a partnership, company or trust then you must have a separate business bank account for tax purposes.

### *A bookkeeping system*

There are many manual and electronic bookkeeping products available that could suit your business needs. If you have employed a financial professional, have a chat to them about the products that will best integrate with their systems.

### *Managing your cash flow*

Keep track of the money that is coming in and going out of your business. An easy way to do this is to use a cash flow statement. A cash flow statement will allow you to track your income and plan your expenses, so that you can plan ahead and know you will have the money to pay your bills.

It's also important to send correctly formatted invoices for the goods and services you provide. Make sure to include a clear due date and follow up on payments that fall behind. If your business provides subscriptions or memberships, you may wish to consider setting up an automatic payment system or direct debit to save yourself the hassle of having to chase payments.

### *Find out more*

There are financial templates available to help you get an understanding of the financial position of your business:

- Cash flow statement
- Profit and loss statement
- Balance sheet
- Financial calculators

For more information, go to www.business.gov.au, an online government resource for the Australian business community.

*The Department of Industry and Science*
*www.industry.gov.au*

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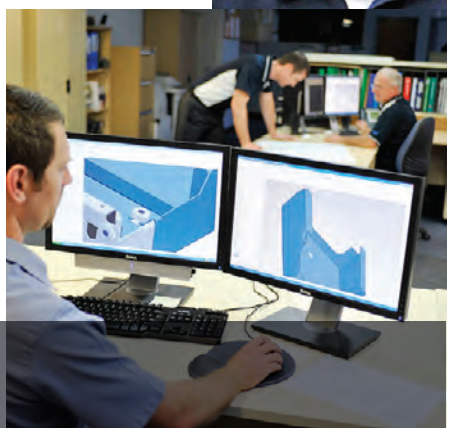

# CONNECTING AUSTRALIA & NEW ZEALAND FOR OVER 30 YEARS

TE Connectivity is the sole manufacturer in Australia & New Zealand providing ITC solutions from Data Centre to Enterprise buildings. KRONE has been designing and manufacturing products in Australia and New Zealand for more than 30 years. Products such as the ever-lasting disconnect module and the locally-made RJ-45 outlets for Australian faceplates.

With local technical expertise and manufacturing we are able to provide custom solutions and tailored products for the Australian and New Zealand market. A country wide network of distributors and a large central warehouse near Sydney, means we can support your projects as needed.

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## NBN INVESTS $40M TO ATTRACT 4500 NEW WORKERS

nbn has committed nearly $40m for training and awareness campaigns to help attract 4500 workers into the industry. With this, the current construction workforce is expected to double to 9000.

"To bring high-speed broadband to Australians faster, our delivery partners will need a bigger pool of trained, skilled workers," said nbn CEO Bill Morrow.

The occupations needed to meet nbn's requirements include telco copper cable jointers, telco linesworkers, cablers, telco technicians and electrical linesworkers.

The intention is to expand the industry's workforce to meet construction and activation requirements. Long-term opportunities will also be created as the network moves into ongoing operations and maintenance.

"To those with telco experience, there are options to use your skills or become a teacher and coach for the next generation of workers," said Morrow.

"To those thinking about what course or career to pursue, our partners are developing options that will include training and real job opportunities on the nbn network over the long term." nbn also aims to attract school leavers and workers rolling off other construction jobs, building a range of training and reskilling programs with tailored career paths.

Flexible career options will be explored by construction partners to attract late-stage career workers looking to balance their hours with lifestyle and family. Roles in coaching and training for new industry entrants will harness their experience and provide valuable expertise to younger workers setting out in the industry.

nbn is signing agreements with a number of training organisations, comprising TAFEs and registered training organisations, with providers in every major rollout region across the country. Further, a national nbn skills register will also be established to help record worker accreditations across the nbn network.

## HILLS AND IPSOTEK DISTRIBUTION DEAL FOR ANZ

Hills has signed a new agreement with video content analytics company Ipsotek to be its exclusive Australian and New Zealand distributor.

"We are delighted to partner up with Ipsotek as their exciting product suite will complement our range of VMS solutions," said Mark Shannon, vendor business manager with Hills.

"Video content analysis (VCA) provides a powerful set of capabilities to allow users to maximise their investment not only in video surveillance, but also allows use in business analytics for marketing and other commercial purposes.

"Ipsotek's VCA adds a dimension to a surveillance system that turns heads and provides a level of intelligence we have only heard about. Well now it is here," he added.

The partnership was successfully received at the recent Security Exhibition & Conference 2015 in Melbourne.

"We are delighted to have the opportunity to work with Hills in Australia and New Zealand," said Bill Flind, chief executive of Ipsotek.

"They are the market leaders in the region and have the experience and commitment to deliver and support our advanced video analytic solutions in all of the key vertical market areas.

"The positive response from end users at the recent security show was extremely encouraging, and we are already working closely together in several key government and commercial projects," he said.

## $30M INTERNET OF EVERYTHING INNOVATION CENTRE IN WA

Cisco, in association with foundation partners Curtin University and Woodside Energy, has established The Cisco Internet of Everything Innovation Centre (CIIC) — an industry and research collaboration centre.


With over 80 researchers and links to advanced facilities and a global industry network, the centre will bring together start-ups, industry experts, developers and researchers in an open environment to create groundbreaking and innovative solutions that foster growth, provide jobs and help build sustainable economies.

Cisco and the foundation partners Curtin University and Woodside Energy have committed approximately $30 million to establish and develop the Perth Centre and help position Western Australia as a global collaborator in research and innovation.

Cisco defines the Internet of Everything (IoE) as "bringing together people, process, data and things to make networked connections more relevant and valuable than ever before, turning information into actions that create new capabilities, richer experiences and unprecedented economic opportunity for businesses, individuals and countries".

The CIIC's mission, therefore, is to create a state-of-the-art connected community in Western Australia focused on leveraging cloud, analytics, cybersecurity and IoE network platforms. It will interconnect with the second node in Sydney, to enable work to be undertaken on both west and east coasts. The centre provides collaboration and co-working space, a demonstration area and an experimental lab facility, and is open to students, researchers, industry operators and technology service providers. It facilitates and showcases state-of-the-art research and technology demonstration projects and delivers targeted research solutions to industry problems.

## Industrial UPS

Eaton has launched the 9EHD range of high-efficiency 'heavy duty' uninterruptible power supplies (UPSs), developed to perform reliably in industrial environments.

Available in three-phase input/output ratings from 10-200 kVA and single-phase outputs up to 100 kVA, the range combines a compact footprint with the ability to operate continuously in ambient temperatures of up to 50°C. Its modular construction enables service repairs to be made in less than 90 min.

With a transformer-free design and sensing and control circuitry, 98% efficiency can be achieved while still providing maximum load protection. Advanced Battery Management technology counters the effects of high ambient temperature, extending battery life by up to 50% to lower the total cost of ownership (TCO) and enhance safety by reducing the possibility of thermal runaway.

For extremely critical applications requiring parallel redundancy, Eaton's patented Hot Sync technology enables load sharing between parallel systems without the need for a dedicated communication line, eliminating a potential single point of failure and increasing power availability.

A large graphical LCD panel shows UPS status and allows access to measurements, controls and settings. As standard, the units have integral USB and RS232 ports as well as two Eaton Mini-Slots that can accommodate optional connectivity cards, including types for use with Ethernet and Modbus networks.

***Eaton Industries Pty Ltd***
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## Multifunction copper tester

The Greenlee Communications Sidekick Plus is a multifunction copper tester designed to help technicians diagnose and troubleshoot problems with twisted pair cable. The product uses digital technology for an easy-to-use multifunction test set for today's telecom engineer.

The device features: time domain reflectometer (TDR), resistive fault locate (RFL), stress test, volt-ohm meter (VOM), loop current tests, longitudinal balance, transmission and noise tests, open meter, load coil detection, 1 GΩ insulation resistance test and a long battery life.

Advanced versions of the product come with wideband spectrum analysis tests and an option for VDSL/ADSL sync and service tests with bonded/vectoring VDSL.

The device's standard features include: ground resistance test, resistance, circuit loss, tracing tone generator and reference tone.

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## Server rack

The APC NetShelter SV enclosure by Schneider Electric is an adaptable server rack designed to maintain good airflow for IT infrastructure. This helps ensure better efficiency by providing additional availability for servers and networking switches within the enclosure.

Its perforated front and rear doors provide ample ventilation for rackmount equipment. The product keeps cables neat and organised, while a range of accessories supports vertical, horizontal, front and rear cable routing. Large cable access slots in the roof provide for access for overhead cable egress, while the bottom design allows for unobstructed cable access through a raised floor. An intelligent PDU can also be integrated into the rack by attaching it to the back to make it easier to install servers and switches.

Accessories are available to also help optimise server installations.

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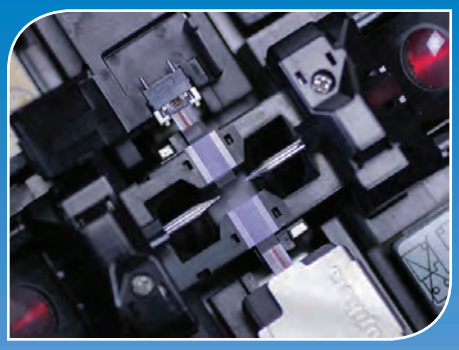
# Two Big Brands, One Great Company



## We connect.™

AFL's acquisition of AFC has expanded the company's global offering of solutions to the telecommunications, infrastructure, enterprise and industrial markets. AFL's diverse product portfolio includes fibre optic cable, enclosures, connectors, fusion splicers, test equipment, cable assemblies and much, much more.

With a passion for innovation and product development, AFL is the fibre optic specialist of choice. AFL's combined operation now has two factories, including cable manufacture in Melbourne, and offices and warehouses in Sydney, Brisbane, Canberra, Perth, Adelaide and Auckland.

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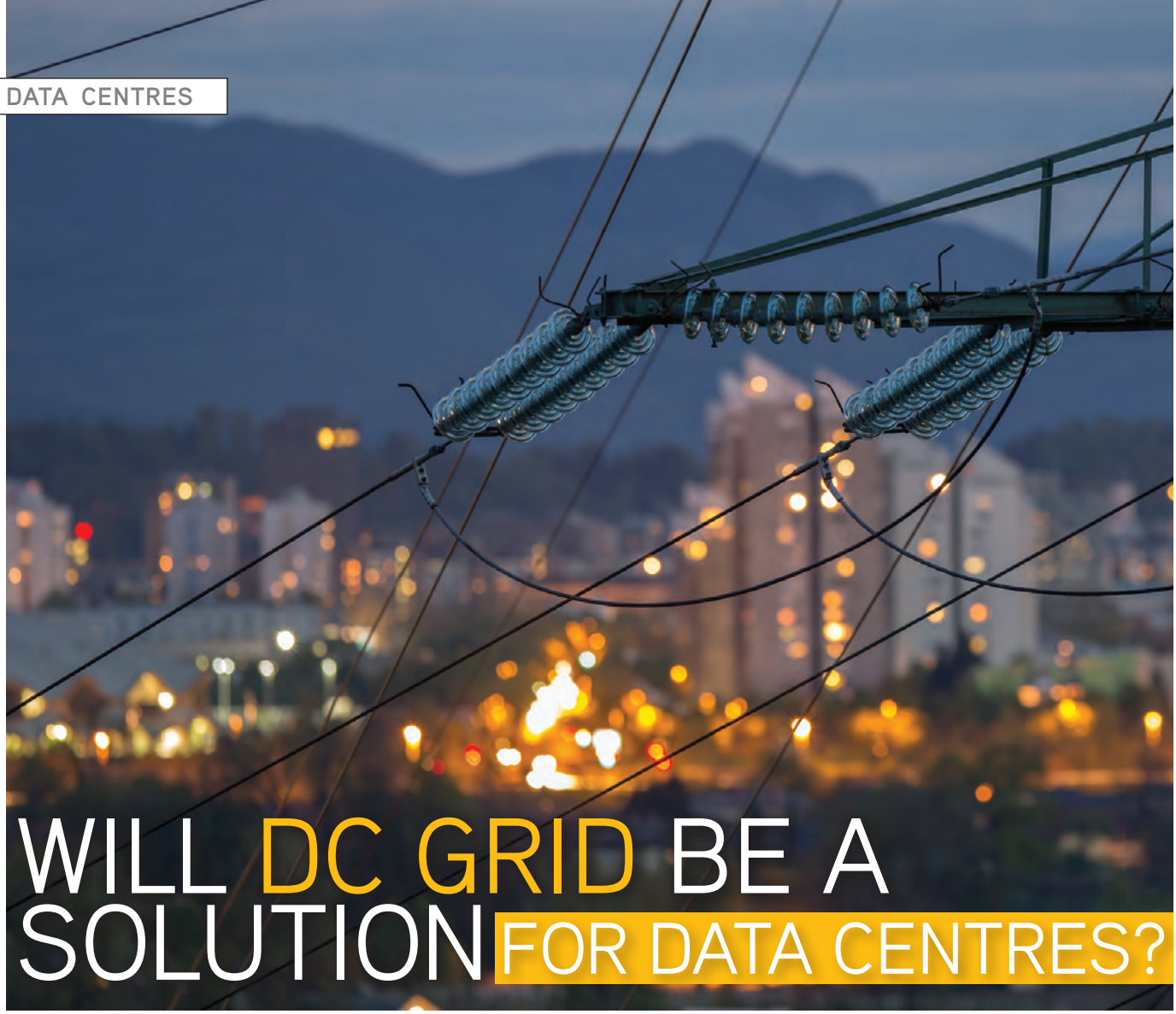
AFL has operations in the U.S., Mexico, Canada, Europe, Asia and Australia. The company is a wholly-owned subsidiary of Fujikura Ltd. of Japan.

For more information please visit **www.afcgroup.com.au** or call **1300 232 476**





# WILL DC GRID BE A SOLUTION FOR DATA CENTRES?

Ever-increasing internet traffic and the video streaming boom is set to encourage large data centre investments in the coming years, according to Yole Développement (Yole).

The market research and strategy company has released an analysis of the trends, market and opportunities of development for the next generation of data centres, including new architectures and technologies.

The report 'New Technologies & Architectures for Efficient Data Centres' presents market forecasts between 2010 and 2020; the key players and their market share for servers, UPSs and cooling systems; and an overview of each technology's technical evolution, including silicon photonics, non-volatile memory (NVM) and wide-bandgap (WBG) materials.

Yole said that last year, around US$143bn was invested worldwide in new data centre projects. In particular, internet companies like Amazon, Facebook and Google are leading the investment in next-generation 'green' data centres.

"At Yole, we clearly identify a trend to develop larger data centres with an increased server concentration," said Mattin Grao Txapartegi, technology & market analyst at Yole.

Analysts say this trend has a direct impact on the blade server market for data centres, which may anticipate a 2015–2020 CAGR of 10.8%, while the entire server market may increase by 2.3%.

Global server market share for data centres is also set to increase to almost 35% by 2020, compared to less than 20% in 2014.

"Our regional split shows that North America, particularly the US, has the biggest share of the server market at 34% (US$3.5bn)," said Txapartegi.

"Europe, however, leads the UPS equipment and cooling systems markets for data centres. In fact, Europe's large UPS (up to 100 kVA) market was estimated at US$931m in 2014." Yole has also identified a smaller, high-potential parallel market consisting of 'container data centres'. These containers are rugged, portable, energy-efficient plug-and-play solutions that have enjoyed rising sales over the last few years. Hewlett Packard (HP) leads this new market, which will enjoy a 23.2% CAGR from 2015 to 2020, with Huawei following closely behind.

Yole says traditionally rigid AC architectures are evolving towards flexible and modular solutions since established data centres are not able to enlarge their IT equipment, as the power architecture and the centralised cooling system were designed for rated power. The company says such designs cannot be modified either and present many inefficiencies when servers work in 'low load' mode, while modularity brings a fresh approach to data centre design, enabling the incorporation of additional servers when needed.

"At Yole, we clearly identify a trend to develop larger data centres with an increased server concentration," said Txapartegi.

"Other solutions exist to minimise distribution chain power loss, such as DC grid data centres. Thanks to a simplified architecture and fewer conversion steps, losses can be reduced by 20%. Players like ABB, NTT and Huawei have several DC grid data centre demonstrators that use a 380 VDC distribution voltage.

"The main barrier for this new architecture is the lack of appropriate DC components, especially 400 VDC safety breakers." A detailed description of this report is available at i-micronews.com.


## Industrial camera

The OB-300Np Star is a consolidation of several models of the Brickcom Industrial Bullet Camera Series designed to cover all requirements for industrial and commercial surveillance or for upgrade camera installations.

The industrial camera features Brickcom's WDR (wide dynamic range) technology and a 3 MP Sony Exmor CMOS sensor for low lux situations. Additional features include: IR (infrared) illumination up to 25 m, high-quality video output (2048 x 1536 at 30 fps resolution), IP67 outdoor design, POE and 12 V power supply, and Rapid Auto Focus.

***Ethernet Australia***

*www.ethernetaustralia.com.au*

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## Security cameras


The Sony SNC-VM772R 4K network security camera offers clarity and sensitivity to critical video monitoring and surveillance applications. The camera has a highly sensitive 1.0-type back-illuminated Exmor R CMOS image sensor, as well as a high-speed image processing engine and high-quality zoom lens, which captures 4K/30 fps video footage with a minimum illumination of 0.06 lx. Picture settings are automatically selected to suit weather, time and lighting conditions.

The device can stream an overall low-resolution situational view, plus cropped original 4K resolution views of specific areas of interest in the scene, with Multi Tracking to chase moving subjects. The 20 MP sensor also enables high-quality still image recording beyond 4K resolution to allow close examination of a scene for evidence purposes.

Other key features: low-light capabilities with in-built IR illuminators for night-time coverage; edge storage (onboard recording with memory cards) safeguards recordings during network outage; Optical Image Stabilisation for steadier pictures; and installation and set-up by a smartphone or tablet PC app for remote field of view adjustment (SNC toolbox mobile). The minidome camera features a ruggedised vandal- and weather-resistant design that is suitable for video security and surveillance assignments, indoors or outside (IK10, IP66).

***Alarmcorp***

*www.alarmcorp.com.au*

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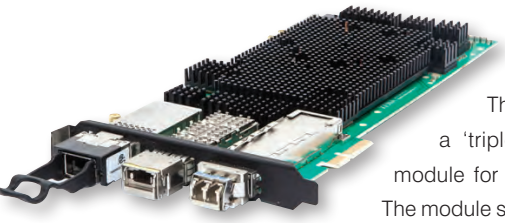

## Triple-media and tri-speed test module

The Xena Networks M1CFP4QSFP28CXP is a 'triple-media' and 'tri-speed' 100/40/10G test module for the XenaCompact and XenaBay chassis.

The module supports three transceiver form factors: CFP4 (CAUI-4), QSFP28 or QSFP+ (CAUI-4) and CXP (CAUI), allowing users to choose any one of these transceiver form factors to be active at any time.

When the CXP form factor is selected, the user can, in addition to a single 100G test port, also use the test module to provide two 40G test ports or eight 10G test ports. This makes it suitable for BERT, load-stress and functional testing of Ethernet equipment and network infrastructure. The device comes with a suite of management and test application software including: 100GBASE-CR4; 40G BASE-CR4; 100G FEC; Ethernet Autoneg Control CL72+CL73; and Advanced timing features.

***TelecomTest Solutions***

*www.telecomtest.com.au*

## Three-phase UPS

The Galaxy VM three-phase UPS from APC by Schneider Electric balances availability and efficiency with three modes of efficiency for data centres and industrial applications.

The UPS employs the ECOnversion mode, which is a setting that provides 99% efficiency. This setting offers higher cost savings and reduced risk while retaining the power conditioning of double conversion.

The compact UPS can link in with a facility's monitoring systems and smart grid requirements. The modular battery architecture allows users to build the system to increase capacity and runtime with flexible energy storage.

Featuring top and bottom cable entry without the need for an additional side cabinet, full front service access, back to the wall installation and included start-up servicing, the product is simple to deploy, install and maintain.

***Schneider Electric IT Business***

*www.apc.com*

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## Grandmaster clock

The Oscilloquartz OSA 5335 Modular PTP Grandmaster is a scalable and IEEE 1588v2 standard-compliant grandmaster clock for distribution of frequency, as well as phase and time synchronisation over packet-based network infrastructure including IP/MPLS, Carrier Ethernet, PON and DSL networks.

The device is designed to deliver accurate and reliable frequency, phase and time-of-day information for telecommunications, media broadcast and power utility communications.

Some of its features include: ITU-T G.8272 primary reference time clock; Stratum 1 Primary Reference Source for GPS and GLONASS; expandable system supporting more than 3000 remote PTP slaves; full redundancy for all modules and functions; and an intuitive graphical user interface enabling full management via SNMP and TL1.

The product also supports Synchronous Ethernet and optional NTP servers, and is compliant with ITU-T G.8265.1 Telecom Profile.

***TelecomTest Solutions***

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## High-density cabinets

The Siemon V800 cabinet system is designed to provide a robust enclosure for both high-density data centre environments as well as floor distributors. Suitable as a stand-alone enclosure, or in a multibayed configuration, the product provides a modular configuration to enable use as a cabling, network switch or server cabinet.

Available in 42, 45 and 48U heights, with a choice of 1000 or 1200 mm depths, the cabinet is designed to be lightweight yet stable, providing a dynamic load rating of 1021 kg and a static load rating of 1361 kg. It can be used in conjunction with Siemon's standard V600 cabinets or premium VersaPOD cabinets.

Thermal efficiency is achieved with its contoured high-flow doors, built with 71% perforation. The cabinet lid includes four integrated brush guards to ensure that cables can enter the cabinet without compromising thermal integrity. Exhaust fans and vertical exhaust ducts are also available for increased thermal management.

Zero-U space in the cabinet is provided on each side of the adjustable equipment rails for cable management, PDU mounting or connectivity on both the front and rear. Four zero-U spaces on the front and four at the rear of the cabinet allow for mounting of eight zero-U panels. Each zero-U panel provides 2U of mounting space for any combination of 19″ patch panels or fibre enclosures, offering up to 16U of additional mounting space per cabinet.

A range of accessories such as various panel mounting and cable management options, brush guards and blanking panels is also available.

***Siemon Australia***

*www.siemon.com.au*

## Polycarbonate enclosures

NHP has introduced a range of Fibox ARCA polycarbonate enclosures, designed for use in harsh and demanding environments. Manufactured using glass-reinforced polycarbonate, it is said this combination is as strong as steel without any risk of corrosion.

The rugged range is high-impact and UV resistant. The enclosures also provide protection against vandalism.

The range is available in seven common sizes; however, customisation can be achieved on-site or in the factory due to the DIN rail frame set design and lockable inner door. Variable depth options for internal plates, as well as multiple locking options, also provide increased flexibility and ensure a safe and secure solution for demanding applications.

The range comes with an IP66 rating.

***NHP Electrical Engineering Products Pty Ltd***
*www.nhp.com.au*

## Layer 3 switch

The Oring RGPS-R9244GP+-P is a layer 3, high bandwidth rackmount switch for use in network backbones and high data flow applications.

The switch incorporates current network standards and security measures along with Oring's high industrial standards, build quality, O-Ring redundancy protocol and industrial wide temperature operation.

The product offers four full 1/10 Gigabit SFP Ports and 24 Gigabit RJ45 ports, each offering full 30 W PoE.

With its 128 Gbps bandwidth and layer 3 features, the switch suits many applications including plant automation, industrial ITS core architecture switch, IP camera network distribution, network backbone and layer 3 network aggregation.

***Ethernet Australia***
*www.ethernetaustralia.com.au*

# HOW TO INCREASE DATA CENTRE EFFICIENCY

*Nathan Tracy**

Cloud computing and bandwidth-intensive applications have made the data centre more important than ever, and managers want to squeeze every last bit of performance out of its architecture, even down to the connector level.

In today's environment, data centres are gaining importance due to the trend of outsourcing access to data (through the cloud) while continuously supporting bandwidth-intensive applications (such as video). Data centre managers want to squeeze every last bit of performance out of the data centre architecture, even down to the connector level. Five key criteria need to be considered when choosing input/output (I/O) connectors that maximise speed and efficiency in data centres — flexibility, cost, thermal management, density and electrical performance. These five criteria must also be optimised in the equipment's backplane and power connectors.

## Flexibility

The I/O connector should offer maximum flexibility in the choice of cable type needed for each application. For example, suppose there's a rack of servers that all connect to a top-of-rack switch. Most of these connections are fairly short — typically three metres or less — so it's less expensive to use copper cable. But some connections may be longer and require optical cable. By using a pluggable form factor connector such as SFP+, SFP28, QSFP+ or QSFP28, the manufacturer gives the data centre operator the ability to choose the right cable to meet specific needs.

## Cost

Based on industry trends, a server's interconnect might be 1 Gbps, but in some of the more demanding applications servers now support 10 Gbps or even 40 Gbps. The 40 Gbps connections have been around for a couple of years, but the latest trend is to go to a 25 Gbps solution. The 40 Gbps solution implements four lanes of data at 10 Gbps each, so the manufacturer can build 'intelligent' equipment that can take the data, break it up over four lanes and then reassemble the stream into 40 Gbps. In contrast, 25 Gbps uses a single lane, so it has lower overhead and makes for easier implementation in the server and the switch.

## Thermal management

When you take a copper cable assembly and replace it with an optical module, the signal is converted from electrical to optical, so the module is now dissipating power. This may be less critical on a server where there are only one or two interconnects, but it's a significant factor on a switch where there might be up to 48 interconnects. Thermal management becomes critically important because now the equipment has 48 little heaters adding to the heat already generated from internal components. With optical interconnects, manufacturers need to optimise for a new set of dynamics,


and they need optical modules that dissipate less power and I/O connectors that can help to manage that thermal load.

## Density

On switches, connectors must be as small as possible to provide the highest I/O density while still accommodating optical modules with the abovementioned thermal loads. Customers desire 24, 48 or even more connections in a 1RU chassis. One way the industry has responded is with the new µQSFP (micro QSFP) connector. An industry consortium is now defining this new connector standard to enable not only higher density, but also better thermal management, enabling up to 72 ports per 1RU chassis.

## Electrical performance

Although standards dictate the overall performance of an interconnect channel (loss of host + connector + cable assembly, etc), connector manufacturers also differentiate their products by delivering enhanced signal integrity performance. For example, a better-performing connector or cable assembly provides more design margin to the equipment designer to enable longer channel reaches or lower-cost PCB materials. Connectors are being shipped today with multiple 25 Gbps pairs for 25, 100 and 400 Gbps applications, and they are in development or shipping now with 50 Gbps pairs as well.

### *Backplane connectors*

As equipment needs to support higher densities of I/O performance, its backplane also must support the increasing aggregate data rate. With a line card that supports 24 or 48 100-Gigabit ports, a backplane connector with adequate capacity is needed. Equipment manufacturers need next-generation backplane connectors that support 10, 25, 50 Gbps and beyond of bandwidth per differential pair.

In fact, the backplane is the first thing equipment designers think about. They're going to sell this equipment to large network providers who want that equipment to last for as many years as possible. If they can design a backplane chassis so it can support a first-generation line card at 10 Gbps, and a second-generation line card can plug into the same chassis at 25 Gbps, then 50 Gbps, then 100 Gbps, the same equipment can be retained in that data centre for a long time — only the line cards need to be replaced.

### *Power architectures*

The equipment development engineer is also focused on the power delivery architecture. As discussed, higher bandwidth and higher I/O density lead to higher power requirements. Connector suppliers enable these power architectures with higher-density, lower-loss (voltage drop) power connector systems for busbar, backplane or cabled power delivery architectures.

Connectors matter in data centre equipment designs. By using the above criteria, network equipment makers can have a significant impact on their products' efficiency and performance. The newest generation of electrical connectors allows equipment developers to keep up with the challenging demands of our highly connected world.

**Nathan Tracy has more than 30 years of experience in technology development, marketing, sales and business development for TE Connectivity. Currently, he is a technologist on the system architecture team and the manager of industry standards, driving standards activities and working with key customers on new system architectures for the data communications market.*

*For more information, contact Robin S Pearce, Bishop and Assoc – ANZ apearce4@bigpond.net.au.*

*Bishop & Associates*
*www.connectorindustry.com*


## TCP test chassis

The Xena Networks XenaAppliance is a Gigabit TCP test chassis for stateful traffic load testing, analysis and characterisation of Ethernet equipment and network infrastructure. The compact device supports 10 and 1G L4-7 interfaces and can be equipped with 1 or 10G L2-3 test modules.

The product offers end-to-end testing of switches, firewalls, routers, NAT routers, proxies, load-balancers and bandwidth shapers, and is also suitable to characterise entire network infrastructure performance for TCP.

Users can characterise their performance by measuring connection establishment and teardown rates, determining packet forwarding rate at large numbers of connections and identifying performance bottlenecks. The platform is also suitable for rapid validation of performance or regression testing. Developers of TCP-based application servers such as web and FTP servers can measure TCP connection rates and verify robustness against TCP SYN attacks.

Some of the device's features include: stateful TCP traffic load generation with 4 million TCP connections; high port density in small (2U) form factor; support for dual-speed 1G and 10G SFP optical and copper Ethernet interfaces for L4-7 and L2-3 testing; configuration and tuning of Ethernet, IP and TCP header fields for advanced traffic scenarios; stateful TCP connection blasting; HTTP get/put/head/post blasting; wire-speed traffic capture with programmable filter and trigger criteria; and switched and routed network topologies, TCP proxy and NAT support.

Free traffic generation and analysis software is included (XenaConnect for L4-7 and XenaManager-2G for L2-3), as well as Xena L2-3 test applications (Xena2544, 2889, 1564 and 3918).

***TelecomTest Solutions***
*www.telecomtest.com.au*

## Ethernet switches with PoE/PoE+

The EKI-9300 series Gigabit Ethernet switches are suitable communication solutions for high-bandwidth Ethernet powered devices (PD) in industrial applications.

They feature high power output (up to 30 W) designed for industrial use, heavy-duty PoE devices, Gigabit Ethernet capabilities for large bandwidth network transmissions, easy management tools (PoE Power Budget Control) for monitoring PDs, and industrial-grade reliability to withstand harsh environments.

The EKI-9316P and EKI-9312P are Gigabit managed PoE+ DIN rail switches equipped with 12 (for EKI-9316P) and 8 (for EKI-9312P) 10/100/1000 Base-T(X), 802.3af (PoE), and 802.3at (PoE+) compliant Ethernet ports, and 4 Gigabit SFP Ethernet fibre ports for data uplinks.

Due to the increasing adoption of high bandwidth power devices in industrial applications, such as outdoor HD cameras and wireless APs with IEEE 802.11n and IEEE 802.11ac capabilities, a switch with IEEE 802.3at, featuring Gigabit Ethernet solutions, allows for a smooth network communication.

The switches are designed with a series of smart management tools that simplify the process of remotely monitoring and controlling the power devices. The tools include a power management function for system optimisation and a diagnostic function to detect PD conditions, failure detection and LED indicators.

***Advantech Australia Pty Ltd***
*www.advantech.net.au*

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## OTDR

With a small pocket-sized form factor, a large, high-resolution, 2.8″ colour LCD display, the OWLTrek OTDR from OWL is suitable for performing basic troubleshooting or restoration tasks on singlemode or multimode optical fibre networks.

The OWLTrek OTDR brings the automatic event location feature to the entry-level OTDR market. While in event location mode, the OWLTrek OTDR marks events on the trace, has an event table showing the location, type, reflectance level, loss of each event, and auto-zooms to the selected event.

With NIST Certification, there will be no issues when testing government or large corporate installations. Other features include live mode, rotatable screen for wider viewing, long battery life and pocketable size.

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CASE STUDY

# Australian invention revolutionises AV industry

What do Lord's Cricket Ground, Wimbledon and Victoria's Parliament House have in common? They're all powered by audio networking technology created by an Australian entrepreneur.

Aidan Williams, a musician, R&D engineer and IT professional, realised there had to be a better way of controlling audio over long distances, to multiple locations, without a mess of analog audio cables.

Over three years, with backing from government-funded body National ICT Australia (NICTA), Williams and a team of researchers developed the foundations of Audinate's Dante technology — a combination of software and hardware that delivers professional quality audio over a standard computer network, with perfect synchronisation and near-zero latency.


Audinate does away with heavy, expensive analog or multicore cabling, replacing it with low-cost, easily available CAT5e, CAT6 or fibre-optic cable for a simple, lightweight and economical solution. Dante integrates media and control for the entire system over a single, standard IP network.

These systems can easily scale from a simple pairing of a console to a computer, to large-capacity networks running thousands of audio channels. Because Dante uses logical routes instead of physical point-to-point connections, the network can be expanded and reconfigured at any time with just a few mouse clicks. Since audio is transmitted digitally, the users don't have to worry about the common analog challenges of interference from other electrical equipment, crosstalk between cables or signal degradation over long cable runs.

Audinate's Dante technology transforms audio into a smart, connected medium that can be used for a huge range of professional audio and commercial needs.

In 2006, Audinate became the first company to spin out from NICTA, the government-funded research lab, and since then has secured investment from Starfish Ventures and Innovation Capital, opening offices in Sydney, Portland, London and Hong Kong. Audinate is now led by CEO Lee Ellison.

Today, more than 225 manufacturers all over the world, including Dolby, Yamaha, Bose and Shure, embed Audinate's Dante technology in its flagship products. In 2014, for the second year in a row, Deloitte named Audinate in the top tier of its Technology Fast 50 for Australia and Fast 500 for Asia Pacific.

*Audinate*
*www.audinate.com*

ECD SOLUTIONS — COMMS + DATA

## IoT wireless I/O modules


Advantech has combined the core functions of data acquisition, processing and publishing into a single I/O module to meet the needs of a wide range of industries, such as environmental monitoring, machine monitoring and smart cities. The company claims its module will improve the way that data is gathered from remote or difficult-to-wire locations.

The Advantech WISE-4000 series wireless ethernet I/O modules can be used without needing to go through a gateway to provide the information. Deployment is easy as a limitless number of I/O modules can be used to gather the information from any third-party sensors and connect to an existing network.

With an integrated HTML5 interface, the module can be configured and accessed from any mobile device using a standard web browser and without needing to go through an access point. The series uses RESTful API, meaning system integrators can adjust the configurator to meet their specific needs.

The module's data logger can send time-stamped information to a Dropbox account or a private cloud. It can also buffer the device's data so that in the event of network failure, no data is lost. Other features include: three levels of security, interchangeable antennas for flexibility and external DIP switches so the factory settings can be easily reapplied.

The series includes the WISE-4050 4-channel digital input, 4-channel digital output module; the WISE-4060 4-channel digital input, 4-channel relay output module; and the WISE-4012E 6-channel input/output module for developers with WebAccess (optional).

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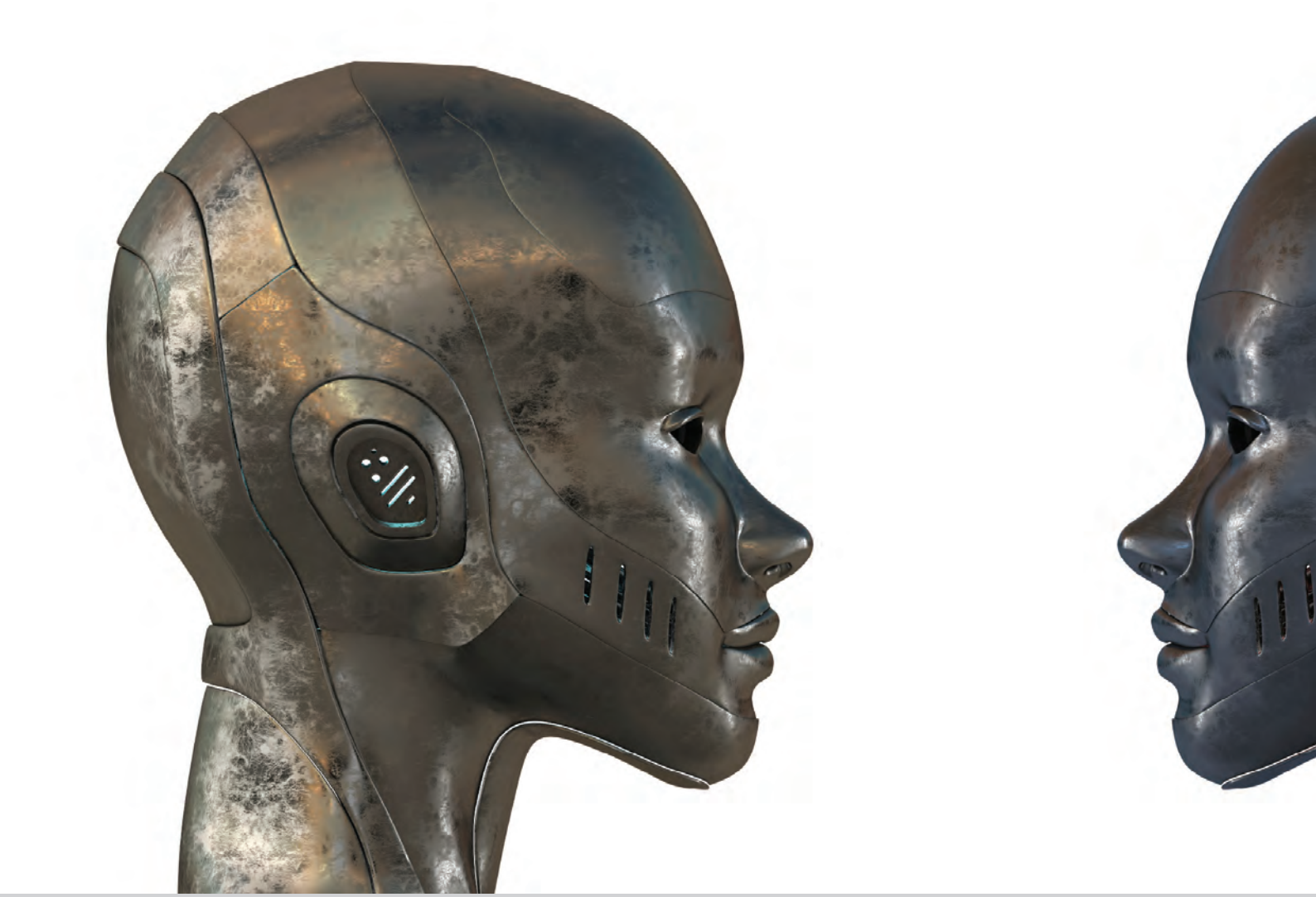

# DIGITAL DISRUPTION — ARE YOU READY?

*Lawrence McKenna**

Digital disruption has only just begun and massive changes are underway for the customer cabling industry. How will the disruptive technologies impact the industry, and how can you best prepare yourself for the era of disruption?

It's predicted that around 80% of Fortune 1000 companies will not exist in 10–15 years. This trend is expected to be seen across all industry sectors. In this article, we will explore the key disruptive technologies, how they will impact the customer cabling industry, when they will impact us, industry trends, opportunities, challenges and suggestions to help you prepare yourself for digital disruption.

## What is a disruptive technology?

A disruptive technology is a technology that displaces an established technology and shakes up the industry. We have already experienced this a number of times in the last 20 years. Some quick examples include: records → tape cassettes → CD → MPEG players; digital cameras; smartphones; video tapes → DVD → IP streaming; storage density; computing; social media; typesetting/printing presses → laser printers. And the list goes on and on. What needs to be understood is that the pace of disruption is accelerating. It is suggested that the volume of disruption expected in the next 10–15 years will exceed the volume of disruption since the industrial revolution.

So what is driving the digital revolution? The answer is computing power. Today, a PlayStation has 170 times the computational power of a 1987 Super Computer. In 18 years, the device size has shrunk massively. Most people aren't truly aware of the speed of change and disruption.

So what type of disruptive technologies can we expect in the next 10–15 years? The Gartner Hype Cycle provides an indication of what technologies will come to maturity, and when they should impact us. This Hype Cycle doesn't cover battery technologies, renewable technologies, nanotech or new materials.

## Opportunities

The key disruptive technologies that are expected to impact the customer cabling industry are: Internet of Things; mobile health monitoring; cloud computing; consumer telematics; autonomous vehicles; mobile robots and computing power. These technologies will also create significant opportunities for the information and communications and technology industry, as we will need to design and build:

- Infrastructure-to-car wireless sites — It is expected that all traffic-lighted intersections and overpasses/bridges will need a 5.9 GHz WLAN AP that will be used to communicate to autonomous vehicles.



> WHAT WILL HAPPEN IF AND WHEN WE COMBINE COMPUTER PROCESSING CAPABILITY, ROBOTICS AND BIG DATA WITH QUANTUM COMPUTING, INTERNET OF THINGS AND NANOTECHNOLOGY?

- Residential customer cabling — 10 million homes will need customer cabling, closets and networks, as noted by the BICSI-SP Digital Homes program. In a decade from now, the level of technology and connectivity in a home will increase a hundredfold. This is another article in itself.
- Internet of Things will lead to the integration of CCTV, security, BMS, audiovisual technologies, lighting control, automation and sensors, video, voice and data, etc on to a single network platform, utilising a single network protocol (ie, IPv6). This will provide opportunities for Registered Cablers to upskill to 'Registered Systems Integrators'.

The above-listed disruptions will lead to changes across the industry. Roles such as security system installers/integrators, audiovisual installers/integrators, home-automation installers/integrators, data cablers etc, will all merge. Disparate technology silos will merge, so will installer/integrator jobs merge. The technology will become easier to deploy and interoperable; hardware and software will be independent; and it will become more ubiquitous.

## Risks

The two key disruption risks for customer cabling are: robotics and computer processing capability.

Robotics — The engineers of the world are moving quickly to develop a bipedal autonomous robot. Robots will take on a 'human-like' form because we will need these robots to operate in the same environment that we work and live in. It will be too expensive for us to alter our built environments for robots to operate in. Robots could offer the following benefits: operate 24/7; operate in hazardous environments; deliver a higher quality of work constantly (no short-cutting); stronger, durable; fewer errors than humans; a doubling in capability every 12 months; quadrupled capability every two years; expected to cost $30,000 per robot. At job sites, robots will initially take on all the laborious tasks, then two years later they'll be capable of doing semi-skilled work. And two years after that, trade-related tasks, then semi-professional tasks, etc. The question is — when is this disruption expected to commence? The answer is 2025–2030. By 2030, almost every household will own a robot.

Computer processing capability — Not many may be aware but there are computers that dream; conduct medical diagnosis, in actual hospitals and clinics; and perform a number of other human tasks. What does this mean? We are developing computers that can problem solve, interact with the real world, design solutions, innovate, learn. Within 10 years, they will be able to do what you can do. On top of that, they will double in capability each year. I expect to be out of a job by 2030. It is expected that hardware capability will meet, and eventually exceed, wetware capability.

## Impact on workforce

What will happen if and when we combine computer processing capability, robotics and big data with quantum computing, Internet of Things and nanotechnology? From a workforce point of view, it's a terrifying thought. The industry faces a similar level of threat faced by farmers when the industrial revolution hit agriculture.

While there are threats from disruption, there will also be opportunities. However, to seize opportunities, industry professionals

will have to be prepared for change — they will have to undergo training and provide themselves with the tools and skills that will allow them to react rapidly to change and take advantage of opportunities.

There will be some new industries and opportunities that will be created post-2020. These include: ITS (intelligent transport systems), nbn (II) and the residential market. As a small saving grace, it has been indicated that home owners have a preference for a human workforce and human interaction in the (residential) sector.

But what has also been indicated is that the traditional Registered Cabler roles will not exist in the 2020s. Jobs will evolve and they will evolve faster than expected — competencies will have to adopt and change.

There will be more jobs than people (ie, trained Registered Cablers). But there is also no appetite to de-skill the Registered Cablers scheme to open it up to a larger, skill-diluted workforce. The economic and safety risks are far too high. We all remember what happened during the home insulation program. Also, allied industries will be displaced by the merging of technologies. There will be significant challenges.

Projects may be delayed but work may eventually ramp up as the technology to deliver those works ramps up. The need for a constant workforce will decrease post-2030.

## How to prepare

The question that you need to honestly ask yourselves is, do I want to be in this business/industry for another 15 years? If the answer is no, do nothing.

But if the answer is yes, you will need to upskill. You will need to move from being just a Registered Cabler to a Registered Systems Integrator and you have about five years to plan, manage and undergo this transition. The skill set that I would expect a Registered Systems Integrator to have is as follows: Registered Cabler; involved in a regular program of continuing development and education; certified designer of customer cabling systems; certified radio systems training; certified IoT training — security devices, cameras, home automation, audiovisual, etc; certified LAN networking; certified project management training; certified business training.

The skill set will expand. As the industries and technologies will merge, businesses and home owners will use a more skilled 'ICT and ICT Infrastructure' contractor. Furthermore, the ratio of larger commercial/industrial/government ICT infrastructure projects compared to smaller ICT and ICT infrastructure projects will change significantly. The need for a Registered Cabler, who only performs cabling work and hands over the job to an integrator, is over.

What is stopping an integrator employing a robot to install the cable? I expect that this will be the norm post-2030. Clients with small projects will expect a leaner, flatter delivery team. These types of projects will not support the 'traditional' multitechnology tiered delivery solution.

This is what disruption will look like. In the next five years, you need to use your time to plan, manage, change and evolve. Those that do nothing will miss out. They will become a number, which will be part of the statistic of businesses that failed due to disruption. So please heed this warning and plan now for tomorrow.

**Lawrence McKenna is the Telecommunications Section Manager at Wood & Grieve Engineers, and is also the Deputy Chair – Engineers Australia VicITEE, and Director – BICSI South Pacific. Lawrence is a highly qualified Specialist Telecommunications and ICT Engineer with over 25 years of industry experience. Lawrence's career started with Queensland Rail as a radio apprentice. His experience includes voice networking (incl. PABXs, regional-wide networks), telecommunication and transmission networks (optical fibre and microwave radio), structured cabling designs, WAN/CANs, LANs, audiovisual systems, security systems and various radio communication systems<h8>. Lawrence is a member of the Standards Australia (Standards development) CT-001 (Communications Cabling), CT-002 (Broadcasting and related services), the ITU-T SG5 working group and the ITU-R ARSG-5 working group.*

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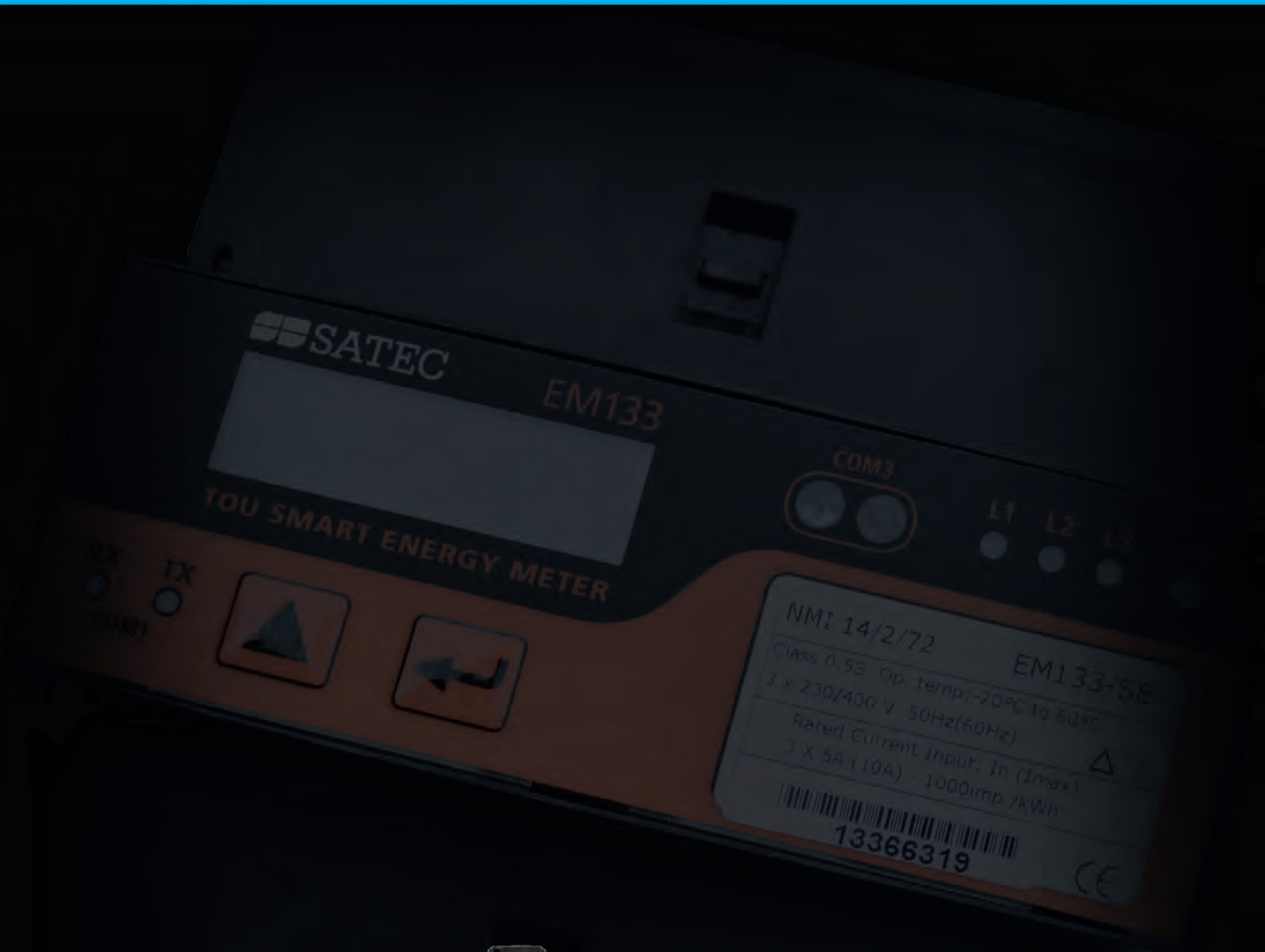
# ELECTRICAL DISTRIBUTION





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# ELECTRICAL SWITCHBOARDS — DESIGN BASICS

*Shanaka Unantenne*

A switchboard is an important asset in a power distribution network and provides the base for circuit, equipment and user protection.

The Q & A below explains the basis of switchboard design.

**Q: What is the Australian standard for main switchboards?**

The current Australian standard for main switchboards is AS/NZS 3439.1: 2002, which is based on IEC 60439. Once published, the new series AS/NZS 61439 standard will supersede the current standards five years from the initial publication. However, when the new standard comes into effect, the specifiers and end customers in Australia may request the board builders manufacture the switchboards in accordance with the new standard.

**Q: What are the type tests that need to be carried out to verify standard compliance?**

- Verification of temperature-rise limits
- Verification of the dielectric properties
- Verification of the short-circuit withstand strength
- Verification of the effectiveness of the protective circuit
- Verification of clearances and creepage distances
- Verification of mechanical operation
- Verification of the degree of protection and internal separation

**Q: Can you claim type tested assembly if the switchboard construction is different to the tested arrangement or modifications are made to suit different applications?**

No. If modifications are made to the components of the switchboard, new type tests have to be carried out, but only in so far as such modifications are likely to adversely affect the results of the seven type tests listed above.

**Q: What is a PTTA?**

A partially type tested assembly (PTTA) is a low-voltage switchgear and control gear assembly, containing both type tested and non-type tested arrangements. In this construction, non-type tested arrangements need to be derived (eg, by calculation etc) from type tested arrangements. This switchboard construction is mostly used as it is not possible to cover all the possible configurations in your type tested arrangements and therefore customised switchboard arrangements derived from type tested arrangements are more practical in real-world applications.

**Q: Do you need to perform any other tests even if you have type test certificates?**

Yes. Every switchboard needs to be routine tested (four tests) by the manufacturer. Routine tests are intended to detect faults in materials and workmanship as follows:

1. Inspection of the switchboard including inspection of wiring and, if necessary, electrical operation test.
2. Dielectric test.
3. Checking of protective measures and of the electrical continuity of the protective circuits.
4. Verification of insulation resistance.

**Q: How do you calculate the distribution busbar size of 10 circuits in the absence of actual currents of those circuits?**

In the absence of actual currents, rated diversity factor is used to calculate the minimum busbar sizing. Below conventional values are used as per table 1 of AS/NZS 3439.1:2002.

| Number of main circuits | Rated diversity factor (RDF) |
|---|---|
| 2 and 3 | 0.9 |
| 4 and 5 | 0.8 |
| 6 and 9 inclusive | 0.7 |
| 10 (and above) | 0.6 |



(eg, If 10 x 100 A MCCBs are fitted in a distribution chassis the diversity factor is 0.6 allowing a minimum busbar size of 600 A.)

**Q: What is the minimum clearance distance in a low-voltage installation?**

Table 14 of AS/NZS 3439.1:2002 is referred in obtaining this information and if you consider a maximum of 12 kV rated impulse withstand voltage with pollution degree of 4 (worst case), the clearance distance should be more than 14 mm between phases and neutral/earth.

**Q: What is the minimum creepage distance in a low-voltage installation?**

If pollution degree is 1 or 2 (normally non-conductive pollution occurs; occasionally, however, a temporary conductivity based on condensation may occur), the creepage distance should not be less than the associated clearance distance. This leaves the creepage distance at 14 mm.

**Q: What is the minimum IP rating allowed for indoor switchboards?**

IP2X, considering there is no need for protection against ingress of water.

**Q: What is the minimum IP rating allowed for outdoor switchboards?**

IP23. For assemblies for outdoor use having no supplementary protection (protective roofing of the like), the second characteristic numeral shall be at least 3.

**Q: Are higher IP-rated (eg, IP66) enclosures better for switchboards?**

This is not necessarily true unless the switchboard is installed in a location where there could be more damage due to water or presence of dust and gases that could increase the pollution degree inside a switchboard.

Switchboards need to be properly ventilated to enable the switchgear to operate within its tested conditions (normally 35–40˚C maximum temperature) and the heat generated during the operation (through watt loss of conductors and switchgear) should have passage to escape. If the switchboards are constructed with higher IP rating, the switchgear will have to be derated and the conductors shall be upsized to make the switchboard run cooler. Also, you need to consider pressure release valves to enable the release of pressure build-up during an arc.

**Q: Apart from a properly enclosed switchboard, what is another important environment factor to consider for outdoor switchboards?**

Where the switchboards are intended to be installed in a location with high humidity and temperature varying within wider limits, suitable arrangements (ventilation and/or internal heating, drain holes, etc) shall be made to prevent harmful condensation within the switchboards.

**Q: What are the temperature rise limits for components inside a switchboard?**

Temperature rise limits given in this standard or calculated apply for mean ambient air temperature less than or equal to 35˚C. (Therefore, this does not apply for outdoor switchboards where the ambient temperature reach above 35˚C and the effect of solar irradiation on the switchboard operating temperature is unknown.)

- Switchgear and controlgear:

1. Temperature rise should be as per the manufacturer's recommendations.
2. Normally switchgear is calibrated at 35–40˚C operating temperature and higher operating temperature would mean derating the circuit breakers as per the manufacturer data. Also, you may need to consider the maximum operating conditions in order to limit the temperature rise within the assembly.

- Terminals for external conductors

1. 70k rise is based on conventional tests

- Busbars and conductors

1. Generally considered to be compliant if the temperature rises do not exceed 70k for H.C copper busbars and 55k for H.C aluminium busbars. This is based on 105˚C and 90˚C maximum temperature within an assembly.

**Q: What is the maximum length of unprotected cable that can be installed in a switchboard where a circuit breaker is fitted at the end of it?**

Three metres. There are conditions that need to be met with this and are available in table 5 of AS/NZS 3439.1:2002 (eg, single insulated cables with operating temperature above 90˚C where no applied external pressure on them or sheathed, double insulation cable).

**Q: What is the recommended minimum height from ground/platform for the terminals of a circuit breaker?**

200 mm as per section 7.6 of AS/NZS 3439.1.

**Q: What is the maximum height for the operating devices such as handles, push-buttons etc from ground/floor?**

# Cable Assembly @ Ampec

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For floor-mounted switchboards, indicating instruments which need to be read by the operator should not be located higher than 2 m above the base of the switchboards. Applicable for operating devices, such as handles, push-buttons, etc.

**Q: Will internal separation guarantee the integrity of the assembly (switchboard) in the event of an arcing fault?**

No, this will only limit the probability of an arcing fault and extra measure to be taken as per section 2.5.5 of AS/NZS 3000:2007 and Annex ZC of AS/NZS 3439.1.

**How is internal separation achieved?**

There are two methods of achieving this:

- Standard construction

1. By barriers or partitions (these can be metallic or non-metallic)
2. Form 1, 2a, 2b, 3a, 3b, 4a, 4b

- Alternative construction

1. By using integral housing (IP2x) of functional unit denoted by 'h'. Applicable forms are 3ah, 3bh, 4ah and 4bh
2. Insulation of busbars or shrouds denoted by 'I'. Applicable forms are 2bi, 3bi and 4bi
3. The combination of housing (h) and insulation (i). Applicable forms are 3bih, 4aih and 4bih

**Q: Why are there different methods of internal separation of switchboards and who decides which one to use?**

Internal separation is agreed on by the manufacturer and the user as per section 7.7 of AS/NZS 3439.1.

Following points are considered in determining the appropriate internal separation by the user, or in absence of specification by the switchboard manufacturer.

- Is the rated current of the switchboard less than 800 A? If YES, you are free to select any form of separation (eg, Form 1, 2a, 2b, 3a, 3b, 4a, 4b, etc.)
- Is the rated current of the switchboard more than 800 A? If YES, you are restricted to use one of the prescribed forms of separations as per section 2.5.5.2 of AS3000:2007 to reduce the probability of initiating an arcing fault (eg, Form 3b, 3bi, 3bih, 4a, 4ah, 4aih, 4b, 4bi, 4bh and 4bih.)
- Can the assembly be isolated elsewhere before removing covers, etc? (If the answer is YES, you may decide to go with the lowest form of separation [form 1] without adding pressure on the switchboard price.)
- Do you require additional integrity by having separation between functional units and busbars where the access of busbars in live conditions results in risk of contact with live busbars? (If the answer is YES, you will need to go with minimum form 2 construction.)
- Do you require access to functional units (eg, circuit breakers) for limited maintenance (eg, changing the settings) with adjacent circuits live? (If the answer is YES, you will need to go with minimum form 3 construction providing also separation between functional units.)
- Do you require access to cable terminals (eg, connecting cables to a spare circuit breaker in future while the switchboard is live) of a functional unit with adjacent functional units live? (If the answer is YES, you will need to go with the maximum form of separation — form 4.)

**Q: What measures need to be taken for increasing security against the occurrence or the effect of internal arcing faults?**

- By insulation of all live conductors.
- By the arrangement of busbars and functional units in a switchboard where there are vented compartments designed to promote rapid extinction of the arc and to prevent the arc or arc products affecting other parts of the switchboard.
- By the use of devices (eg, fuses or circuit breakers) designed to limit the magnitude and duration of the arcing current by interruption of the fault.
- Combinations of above items, or other methods designed to either prevent the initiation of an arc, or to reduce the damage or risk of injury resulting from an arc, by sensing of the fault followed by interruption.

**Q: Can a successful internal arcing fault test guarantee to withstand all arcing faults that may occur in service?**

No. It is not possible to simulate all the conditions that can produce arcing faults in service and that the arc does not always behave in a repeatable manner.

*Reference: AS/NZS 3439.1:2002 and AS/NZS 3000:2007.*

*DaRa Switchboards*
*ElectricalSwitchboards.com.au*

# MORE FIREPOWER IN THE TOOLBOX

## THE TG165 SHOWS WHAT'S HOT FOR INSTANT TROUBLESHOOTING.

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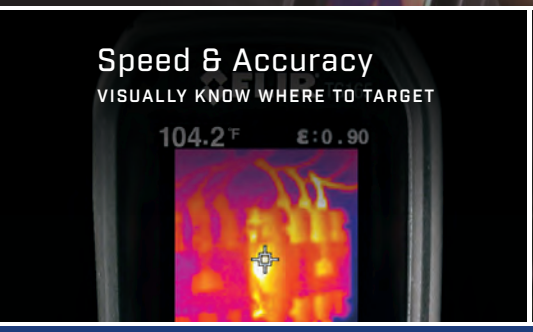




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## Residential energy storage system

The Magellan Residential Energy Storage System (RES1) stores solar power during the day and makes it available for use when there is no sun. Australian made, it is designed for use in homes or small businesses, and can installed in a garage or under the eaves by the side of a building. It is capable of storing low-cost grid power at night for use at peak demand time.

It consists of a 5 kVA bidirectional inverter and 9.2 kWh of safe and reliable lithium iron phosphate batteries. The batteries are similar to those used in electric vehicles and give good cycle life and reliability.

The product is also available 'Reposit Ready', meaning it is comes fitted with Reposit Power's control system. Reposit Power's Grid Credits technology enables the customer to store, shift and trade their energy onto the grid and earn money for it, which substantially improves the energy storage payback to consumers.

The storage system has been issued a Certificate of Suitability, which certifies that it complies with the Australian Standard AS4777.

***Magellan Power***

*www.magellan-power.com.au*

## Arc flash solution

The Fluke PRV240 Proving Unit is designed to reduce the risk of shock and arc flash by providing a known voltage in a controlled, low-current state in accordance with safe work practices. The unit provides a safe method for Test Before Touch (TBT) verification of electrical test tools without placing the technician in potentially hazardous electrical environments, which would generally involve using known live voltage sources.

The pocket-sized device sources 240 V of both AC and DC steady-state voltage for testing of both high- and low-impedance multimeters, clamp meters and two-pole testers, eliminating both the need for multiple verification tools and the use of a known high-energy voltage source for test instrument verification.

To avoid accidental contact, the voltage is supplied through recessed contacts that are activated only when test probes are inserted into the module's insulated access points. A single LED indicates the sourcing of the voltage to verify the test tool, simplifying test tool verification without the need for personal protective equipment.

The proving unit can perform up to 5000 tests per set of four AA batteries and comes with a TPAK magnetic hanging strap for easy accessibility.

***Fluke Australia Pty Ltd***

*www.fluke.com.au*

## Weatherproof light-sensitive switch


HPM has added the Programmable Weatherproof Light Sensitive Switch (PE170R2) to its outdoor light-sensitive switch range.

Unlike conventional light-sensitive switches which work on a time delay from sunset, the product allows an off-time to be defined to remain consistent all year, regardless of seasonal changes in sunrise or sunset times.

Engineered with a built-in algorithm that controls and maintains the nominated off-time, adjustments can be made using a dial system in 30-min increments or for dawn, which is natural light dependent.

Suitable for commercial and multiresidential premises, the switch is compatible with the existing HPM Weatherproof Light Sensitive Switch (PE170/10) mountain base for simple retro-fitting. The product has been upgraded to include better screw terminal connectors, a larger internal cavity for cable management and a more suitable cover design.

Other features include: an adjustable lux setting (for on-time); non-volatile memory to ensure the program is restored after power loss; and multiple side and back cable entries for easy wiring.

The switch has the weatherproof rating IP56.

***HPM Legrand***

*www.hpmlegrand.com.au*

PRYSMIAN

# Tick Tock.

Act now and get your cables checked before it's too late.

An estimated 40,000 homes and commercial offices could be affected by poor quality **Infinity electrical cable** which has been recalled by 18 wholesalers across Australia. If you have purchased a new property, renovated or had electrical work done between 2010 and 2013, Prysmian is urging you to ACT NOW and get your wiring inspected by a licensed electrician.

Protect your most valuable assets from fire or electrocution and get your cable checked before it's too late.

For more information watch this ACCC video: https://youtu.be/aPsel50Itn8

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## High-voltage test set

The PFT-301CM hipot test set is designed to test various substation apparatus, motors/generators, Isolated Phase Bus (IPB) and other loads requiring an AC withstand test. It will also test the integrity of insulating materials, vacuum bottles and interrupters, vacuum switches, and automatic circuit reclosers. It is available to rent from TechRentals.

There is also a built-in overload, factory set at 120% of rated output current. The lightweight nature of the unit makes it suitable for field applications.

Other features include: output 0 to 30 kVAC, 1 kVA resistive/capacitive load: 33 mA; duty: 1 kVA, 1 h on, 1 h off 700 VA continuous; one-piece design weighing 20 kg; shielded output cables; distortion <5%.

***TechRentals***

*www.techrentals.com.au*

## Coil clamp meters

The FLIR Systems range of CM55/57 Flexible Clamp Meters is designed for electrical inspections, making it easier to take measurements around multiple conductors, crowded panels, tight switch gears, large bus bars and wire bundles. Available in 10 or 18″ coil lengths and made with narrow, flexible coil clamps, these tools allow electricians to take accurate measurements in tight spots that are difficult to access with a traditional hard-jaw clamp meter.

The flexibility of the meters enables up to 3000 A AC current for multiple conductor measurements. They are portable, lightweight and ruggedly built to withstand a 3 m drop. They also provide dual LED work lights for illumination when taking readings in poorly lit locations.

The devices feature Bluetooth communication for remote viewing and data transfer to iOS and Android devices via the FLIR Tools mobile app, enabling data to be shared and analysed directly from a job site. Users can also connect multiple units wirelessly for remote viewing of multiphase systems.

***FLIR Systems Australia Pty Ltd***

*www.flir.com.au*


## DC converters

The Mornsun PVXX-27BxxR2 series DC converters are specifically designed for use in the photovoltaic industry.

The 12:1 input voltage range (100-1000 VDC input) can access power from solar panels directly. The converters also feature a wide operating temperature range of -40 to 70°C and high isolation voltage of 4000 VAC, which ensures the stability of the power supply.

The series also has CE approval and output overvoltage protection, short circuit protection and input against reverse protection.

***DLPC Pty Ltd***

*www.dlpc.com.au*

## Industrial switch

Rockwell Automation has expanded its Allen-Bradley Stratix family of industrial switches with the Stratix 5400 switch, an all-gigabit option that helps manufacturers achieve higher network speeds for their increasingly high bandwidth applications.

The switch supports Layer 2 switching and Layer 3 routing for multiple network configurations.

When used as a Layer 2 switch, the device is suitable for industrial environments experiencing an influx of high-performance, gigabit-speed end devices, such as IP video cameras and telephony. It is also fit for heavy industry applications that require resilient network topologies.

When used as a Layer 3 switch, routing is enabled between segmented networks to help achieve better performance. The GE Power over Ethernet (PoE) and additional GE fibre port options also enhance scalability. The product is available in 18 different models and offers up to 20 gigabit ports in a single switch. Default configurations help simplify set-up, optimise performance and enable faster diagnostics retrieval. The product also comes with Network Address Translation to help reduce commissioning time.

***Rockwell Automation Australia***

*www.rockwellautomation.com.au*

## Outdoor radio

Panasonic has released the EY37A2 radio that is specifically designed for on-site and outdoor use by workers.

The radio has a robust body design with a protective cage, as well as an LED light on the front that illuminates the controls at night or in dark areas. The radio features high-quality speakers for dynamic bass sound and comes with Bluetooth connectivity so users can stream and play back music via their smartphone or download apps such as DAB+ for live streaming of digital radio. The radio also features five sound settings and includes FM/AM radio and alarm.

The product also has a USB charging port, and users of Panasonic Power Tools can power the radio with their existing Panasonic 14.4 or 18 V Li-ion batteries. AC power can also be used.

The product is IP64 rated for protection against water sprays and dust.

***Panasonic Australia Pty Limited***

*www.panasonic.com.au*

## Power meters

The PowerLogic PM8000 series power meters have been added to the PowerLogic portfolio of power and energy meters from Schneider Electric, suitable for power-critical facilities such as hospitals, data centres and utilities.


In accordance with power quality standards IEC 61000-4-30 Class S and IEC 62586, the range is suitable for helping to ensure contractual obligations for the quality of electrical supplies. The meters have power quality analysis capabilities, such as EN 50160 compliance, sag/swell detection, waveform capture, disturbance direction detection, and trending and forecasting to help facility managers detect, mitigate and correct adverse conditions.

If a PQ event occurs, the disturbance direction detection feature can help to identify the location by determining if it occurred upstream or downstream of the meter, allowing the problem to be corrected more quickly.

Meters are available in both panel-mount and DIN rail-mount form factors.

***Schneider Electric***

*www.schneider-electric.com*

MASTER ELECTRICIANS AUSTRALIA

# Nipping workplace politics in the bud

*Malcolm Richards, CEO*

The success of every organisation depends on its personnel, so allowing conflict to fester can ultimately take down your entire operation.

There are a whole host of factors that affect a company's status quo — each staff member's age, job title and responsibilities, their individual pay rate including the way it is calculated, their level of education, target performance levels, or how long they've been with the organisation.

And that's not including each staff member's personality type, differences of option, political leanings, external influences such as family demands, and their coping mechanisms for stress. Together, these factors combine to affect group productivity, morale and your business's overall success (or failure).

Human communications are an incredibly important component of any business; however, when they turn sour, they can also get in the way of your core business — one of the great frustrations for management teams the world over.

Something I've learned the hard way over the past few years is that there will always be conversations you simply don't want to have, but, no matter how difficult and uncomfortable, they really must be had, and quickly. For the good of the entire organisation. Internal discord can derail your business's core business quicker than a broken rail on a train track, so allowing an issue to fester can, and will, have dire consequences in the long term. Ignore at your own peril!

After acknowledgement comes the assessment period — just how far along has this issue advanced? Is the atmosphere in your workplace amicable or distrustful? Or has it reached the point where everyone is about to explode? What about productivity — to what level is your core business suffering as a result?

Detoxifying a workplace isn't easy, nor is it pleasant. It means you must open the channels of communication and then put the organisation's rules into practice in order to resolve internal conflict. Successful resolution takes time, negotiation, communication and then action. It's not always an easy endeavour when you're busy trying to focus on doing business, but it's just one of the challenges that comes with running a business, one that Master Electricians Australia is always here to help you navigate.

While many Australians think of MEA as a strong voice for advocacy in the electrical industry, we are first and foremost an organisation dedicated to helping our members achieve within your own businesses. We have a committed team of personnel on hand to help guide any of you through a multitude of workplace issues — with organisational politics always high on the list. We provide a range of services to help you navigate the trade environment — including HR, education and training, apprenticeship services and safety management systems — helping you to get on with the job.

Each of our separate services together ensure electrical workplaces around the country are safe. Collectively, they help facilitate product and service quality; increased business efficiency and productivity; improved customer satisfaction; improved business image and reduced errors and costs; and staff safety (physical and mental) through a reduced risk of accidents and ultimately prosecution. Our services help members create consistency throughout your business models, developing staff through traineeships, education and higher learning, and give you a chance to increase your business through strong industry relationships.

We place great value on our members' goals — each year recognising those who have excelled in a number of different fields through our National Excellence Awards. This year's will be like no other, after a complete revamp of the selection criteria, nomination process and the overall judging procedure.

We've recently closed the 2015 nominations, meaning that over the next couple of months, you'll be seeing a host of finalists across eight different categories, including our Accredited Master Electrician of the Year Award. The national winners will be announced in Brisbane on 21 November.

*Master Electricians Australia*
*www.masterelectricians.com.au*

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## Thermal imaging cameras

FLIR Systems has added the FLIR K2 and FLIR K65 to its K-Series range of thermal imaging cameras. These cameras provide firefighters with the ability to see through smoke, locate and rescue victims, identify hot spots, as well as navigate safely and stay better oriented during response missions.

The FLIR K65 camera has been fully certified to the National Fire Protection Association's NFPA 1801-2013 standard for usability, image quality and durability for firefighting thermal imagers. It has an intuitive user interface and can be controlled by three large buttons on top of the unit, suitable for a gloved hand.

The device produces crisp images at 320 x 240 pixels and features FLIR's Flexible Scene Enhancement (FSX) technology which enhances thermal images through real-time onboard digital processing inside the camera. The resulting images show detailed structural, edge and other instantly-recognisable objects.

The FLIR K2 is powered by the Lepton camera core delivering detailed thermal images at 160 x 120 resolution. It is also equipped with FLIR's Multi-Spectral Dynamic Imaging (MSX) technology that significantly enhances image quality, allowing firefighters to see key structural details in a variety of environments.

Warranty on selected models when registered within 60 days of purchase is also available, which covers the full camera for five years, the detector for ten years and batteries for two years.

***FLIR Systems Australia Pty Ltd***
*www.flir.com.au*

## Cat 6A cable

The Belden Category 6A 10GXS Cable is designed as a small diameter cable with high performance, suitable for LANs and enterprise data centres that require both high-density and high-bandwidth connections for current and emerging network applications. The product has a 25% diameter and weight reduction over standard category 6A cables, as well as fewer pair twists and easy tape removal to make terminations easier for installers. The cable can therefore accommodate tighter spaces and workstations, leaving room for future expansion.

The product also has standards-compliant channel performance to 100 m. The EquiBlock Barrier Technology improves heat transfer while maintaining insertion loss performance. By delivering 100 W of Power-over-Ethernet, the cables supply energy efficiently without overheating, ensuring they are suitable for emerging technologies. The product is also backward compatible with the range of 10GX hardware, including connectors, patch panels and patch cords. Belden is offering free samples of the product.

***Belden Australia Pty Ltd***
*www.belden.com*

## High-voltage test system

The HV Diagnostics HVA34 High Voltage Test System accommodates testing requirements for 25 kV rated cabling, as per the IEEE400.2 testing standard revisions. The test set is suitable for testing capacitors, switchgear, transformers, insulators, bushings and rotating machines (IEEE 433). It is available to rent from TechRentals.

This single-piece system, weighing less than 20 kg, includes: ±34 kV DC hipot; 24 kV/34 kV (RMS/peak) AC Very Low Frequency (VLF) hipot; fault conditioning mode; sheath testing mode; and vacuum bottle testing mode. VLF is preferable to traditional DC proof testing for applications involving rotating machines and medium-voltage (MV) solid dielectric cables, such as XLPE and EPR. The product can output a symmetrical, load independent, sinusoidal output waveform across the full load range. The unit also features automatic or manual cable test sequences complying with IEEE 400.2, VDE 0276, CENELEC, HD620 S1, NEN 3620, SANS 10198 and IEC 60060-3.

Other features include: large output load capability (up to 12 $\mu$F); short circuit protected; downloadable to PC or USB; and internal storage of test reports. A set up and download service for this product is also offered.

***TechRentals***
*www.techrentals.com.au*



# COULD SMART METERS CAUSE MORE OUTAGES?

While smart meters improve efficiency and reduce electricity costs, a new study questions whether these gadgets actually perform what is expected of them.

Researchers at the University of Bremen's Institute for Theoretical Physics have created simulation models of the market that will emerge once intelligent electricity meters are deployed on a large scale. And they arrive at some surprising conclusions. According to their calculations, the intelligent electricity meters will create a new artificial market for electricity that — as happens on all markets — could easily give rise to bubbles and crashes. The Bremen physicists recently published their findings in the *Physical Review* of the American Physical Society.

Thanks to the turnaround in energy policy and technological progress, instead of having to pay a 24-hour flat rate price for electricity, home owners can program electrical devices to use cheaper electricity — for example, a programmable washing machine could avoid peak consumption times and only switch itself on when electricity is at its cheapest. All that these devices need is an intelligent electricity meter that monitors electricity prices and takes advantage of lower prices at non-peak hours.

It has always been a problem to feed power evenly into the electricity grid. Today, though, the advent of wind and solar energy means that fluctuations in the power supply are becoming even more pronounced. The idea behind making it mandatory to use intelligent electricity meters is to dampen such fluctuations. At times when energy is being generated and fed into the grid — for instance when the wind is blowing strongly — electricity becomes cheaper, and when less power is available it will be more expensive and hence less in demand.

Washing machine users will be quick to catch on. With the aid of intelligent electricity meters they will program household devices to be activated when a certain price level is reached.

So far, so good. "The basic assumption behind all this is derived from economics, which tells us that prices are regulated by supply and demand. This is now to be applied to the market for electricity: at times of high supply — lots of consumers; low supply, fewer users," explained Professor Stefan Bornholdt from the Institute for Theoretical Physics. "Applying the standard theory of supply and demand, though, fails to take into account what happens when large numbers of consumers all compete for the lowest price at one and the same time. After all, we will all want our washing machines to switch on when electricity is at its cheapest."

However, according to the Bremen professor and his colleagues Stefan Börries and Sebastian Krause, this is not going to work. Their computer simulations of competitive consumer behaviour reveal how this new segment of the market for electricity is likely to become "chaotic, unpredictable and jittery" — similar to the financial markets.

As Stefan Bornholdt explained, "At times when there is less power available in the grid and the price is subsequently high, washing the clothes will simply be put off. This can't go on forever, though, because clean laundry is a basic need. The more programmed washing machines in stand-by mode waiting for cheaper electricity, the higher the pent-up demand. This results in the occurrence of a demand bubble." And as soon as the price begins to fall this bubble will burst. Due to the pent-up need for clean clothes, large numbers of consumers who initially raised the level of their 'pain threshold' will suddenly switch on innumerable washing machines all at the same time. "This will trigger a collective avalanche mechanism, placing an extreme burden on the power grid which could easily lead to blackouts as a consequence of unexpected overloading," said the Bremen physicist.

According to his team's research findings, mass introduction of the new intelligent electricity meters constitutes "a quick-fix solution that has not been sufficiently thought through". It is important to make electricity suppliers aware of the potential scenarios. "We integrated a number of variables in our computer model to illustrate how real people will logically react in such situations," said Bornholdt. "Individuals naturally don't think about the consequences of their behaviour when everyone follows suit. Unfortunately, the suppliers may also still be blissfully unaware."

For more information on this article, please contact Prof. Dr Stefan Bornholdt at bornholdt@itp.uni-bremen.de.

## Handheld partial discharge tester

The Baur PD-SGS handheld PD detector is used to conduct rapid initial tests for partial discharge (PD) activities on live switchgear.

The survey instrument is suitable for determining the state of health of electrical assets such as HV and MV switchgear, and potential weak points are immediately signalled acoustically and numerically. The user is provided with recommendations for how to deal with the switchgear under test by a traffic light system, making it possible to evaluate the condition of the entire substation to action maintenance work or to conduct further investigations. The product can also conduct checks to determine whether the work area around the switchgear is safe. The capacitance coupled TEV detector measures surface voltage in the frequency range of 20 to 200 MHz. Ultrasound measurement for internal PD has a range of -6 to 70 dBμV and results are displayed on an OLED with dB indicator. It also has an automatic detection of background interference signals.

The product has a connector for a parabolic aerial for examining difficult-to-reach system components. The instrument is also supplied with a Li-ion rechargeable battery (12 h functional time) and chargers for use in vehicles and with mains power.

The plastic housing with a protective rubber sleeve around the sensors has an IP54 rating, making it suitable for outdoor use. The product package includes stereo headphones, chargers and a transport case.

***Power Parameters Pty Ltd***
*www.parameters.com.au*

## 8-outlet metered network power switch

The VMR-8HD16-3 Outlet Metered Switched PDU from WTI, available through Interworld Electronics, is designed to provide secure, remote power control, metering and reboot capabilities for IT infrastructure such as blade servers, LAN switches and other network devices. The product features one 16 A input and eight individually metered and switched 10 A IEC C13 outlets. Each circuit breaker protects one IEC C13 outlet and supports up to 10 A.

The device not only controls power and reboot functions, it also meters energy use and reports findings in text or a graph format. This is useful for those who need to track power usage and energy costs. Advanced metering capabilities allow the metered switch to measure and report kilowatt hours, kilowatts, amps, voltage and temperature. When any of these factors exceed threshold values, the product can switch or reboot power and promptly send notification. It can also perform remote on demand or scheduled reboots and power shutdowns, or automatic reboots when a device fails to respond to a ping command.

***Interworld Electronics and Computer Industries***
*www.ieci.com.au*

CASE STUDY

# Integrated smart grid solution improves outage management

Nova Scotia Power has implemented a new system from Schneider Electric to provide more sustainable and reliable energy by accurately locating faults and managing power outage incidents faster than ever in its electric distribution network.

The utility's Advanced Distribution Management System (ADMS)-based Outage Management System (OMS) will allow the company to better react to outages, as well as gain useful information for grid observation and outage predictions.

"Our employees now have real-time information at their fingertips where available, allowing them to quickly react to and repair any faults in the network," said Paul Casey, senior director of transmission and distribution at Nova Scotia Power.

"Our goal is to offer our 500,000 customers the best service possible and our integrated ADMS helps us achieve that."

A main advantage of an OMS capable of distribution management system (DMS) analysis is its ability to assist with fault locations and isolations. With a traditional OMS, when a fault in the network occurs, a utility needs to manually create a plan to isolate the problem before implementing safe and electrically sound restoration plans based on the current state of the electric grid.

The Schneider Electric OMS is designed to model current network loads in real time and look ahead at forecasted network loading.

The OMS can automatically create switch orders and integrate with its current standard protection requirements, reducing a significant amount of outage time and improving estimated time to restore (ETR) information for utility customers.

With the ADMS web-based crew management and outage reporting application, and an ADMS mobile field client, Nova Scotia Power can dispatch crews to the fault location, giving them more timely information on current network conditions.


"Schneider Electric OMS technology integrates with other enterprise utility systems to give utilities a true smart grid solution," said Dragan Popovic, executive vice president, Smart Grid IT at Schneider Electric.

"We're pleased Nova Scotia Power chose our OMS to help operate a more reliable network for their residential, commercial and industrial customers."

The Schneider Electric ADMS solution suite includes OMS, DMS and Supervisory Control and Data Acquisition (SCADA) tightly integrated with the Schneider Electric Geographic Information System (GIS).

Nova Scotia Power's new ADMS solution is implemented as a complete information technology/operations technology convergence solution allowing the utility to provide more employees with access to real-time information.

Schneider Electric ADMS is currently deployed in over 26 countries serving more than 88 million utility customers.

*Schneider Electric*
*www.schneider-electric.com*

ECD SOLUTIONS ELECTRICAL DISTRIBUTION

## Prefabricated DC rail substations

ABB has introduced a range of modular and transportable substations for the rail sector designed to offer a reduction in civil works, footprint and land acquisition costs, making them suitable for engineering, procurement and construction management use. They enable fast-tracking power to both new projects and the replacement of existing substations that are due for renewal.

The ABB DC Prefabricated Rail Substations require minimal on-site labour and are quick to install. The designs are flexible and adaptable with the ability to specify between incoming voltage and outgoing power designs, as well as customising the capacity of the unit to suit specific operational requirements.

Three basic rail substation models are on offer including a transportable building DC rail substation with customisable cladding options, a skid-mounted DC rail substation for installation into permanent buildings and a stackable modular design for partial substation refurbishment.

Each unit comes preassembled with medium-voltage switchgear in either 11, 22 or 33 kV, DC switch-gear with a rectifier in 750 to 1500 VDC, and a rectifier transformer with variable power options of (1, 2, 3, 4 or 5 MW) and voltage (750 or 1500 V output). The range is fully self-contained and includes an integrated power supply, which reduces overall risk to a project.

***ABB Australia Pty Ltd***
*www.abbaustralia.com.au*

## Electro-hydraulic system

Nexans has launched its next-generation SUTA-FLEX Subsea Umbilical Termination Assembly, an electro-hydraulic system that enables multiple wells to be controlled via one umbilical. This is made possible by connecting a number of subsea control modules to the same communications, electrical and hydraulic supply lines.

The system has a modular design, based on standardised features that fit well within the perimeters of the reel, improving reel packing as well as ensuring smoother handling and lifting operations.

Its compact design also allows a wide range of offshore vessel tensioners to be used for installation and is developed to withstand high pressure (up to 15,000 psi) and deep waters (1000′). The product is able to accommodate hydraulic, electrical or fibre-optic components - or any combination of the three - within its compact outer dimensions.

The product is supplied with Nexans' Electrical Field Installable Termination Assembly (FITA) and Fiber Optic Termination Unit (FOTU).

***Olex Australia Pty Ltd***
*www.olexcables.com.au*

## Infrared cameras

Fluke Corp has introduced the Fluke TiS Performance Series Infrared Cameras, designed to help industrial, HVAC and maintenance professionals analyse equipment health more quickly and accurately.

The TiS models deliver up to 2.5 times more pixels and a 70% improvement in distance-to-spot than previous series cameras. The improved image quality enhances identification of potential equipment problems in industrial and electrical maintenance, process industries and in building applications.

The models feature large 3.5″ screens to help pinpoint issues while still in the field and offer one-touch image access, which eliminates the need to scroll through a menu to view images. Eight models are available, five fixed focus and three manual focus, with resolution up to 260 x 195 pixels.

The cameras upload images to the Fluke Connect Cloud via a wireless connection to securely store and manage images. Reports can also be managed remotely by creating and emailing them from the jobsite via Fluke Connect.

***Fluke Australia Pty Ltd***
*www.fluke.com.au*

## NEW SOFTWARE SAVES TIME FOR ELECTRICIANS

A new application is saving time for electricians when it comes to data entry and other manual administrative tasks, according to an innovative Australian software company.

The new application, AUTOflow, launched by 3stack Software, has been designed to eliminate costly data entry time for businesses. The company says electrical contractors like Brisbane-based Cartella Electrical have reported time savings of over 30 hours per month through the use of the application.

"What we have done is to change the game completely by automating the extraction of data from emails and PDFs straight into programs such as simPRO," said 3stack Chief Executive Nolan LeSueur.

"Electricians and their staff can configure their own job creation rules and let AUTOflow automatically create jobs for them straight from an email." LeSueur said that work orders can be easily produced from emails without pressing a key.

## STRONGER VIGILANCE NEEDED ON NON-COMPLIANT PRODUCTS


The trade in counterfeit and non-compliant products that fail to conform to Australian standards is posing a threat to the sustainability of Australia's electrical contracting industry, says the CEO of the National Electrical and Communications Association (NECA).

Suresh Manickam stated that the industry body has been concerned for some time about the lack of enforcement for businesses distributing non-compliant products and is calling upon stronger action by the government. "The installation of unsafe, non-compliant electrical equipment can be costly for business and consumers and presents the risk of electrical fire, shocks and property damage," Manickam said.

"NECA has previously called upon the government to do more to support the testing and measurement of new products entering the market."

Manickam said more needs to be done following recent of ACCC-issued product recalls, such as Infinity cables and Ecables, which have cost the industry. "We have been the leaders in supporting product quality and safety initiatives, such as the Does It Comply? campaign, and we really need the government to commit more resources so that a larger number of random batch tests, and more effective enforcement, can be put into place to ensure product quality," said Manickam.

"Our industry has a sound reputation for upholding safety - we call on the government to inject more funding into compliance, product batch testing and enforcement. "Measures such as these continue to protect the safety of electrical contractors and consumers," he said.

## SAFETY ALERT FOR WORKING NEAR ENERGISED ELECTRICAL PARTS

A 26-year-old worker was recently electrocuted in an industrial workplace incident in Glenella, Mackay. It is believed the man was working with a mobile transformer at the time.


The incident is currently being investigated by Workplace Health and Safety Queensland and the Electrical Safety Office.

A safety alert has been issued for organisations to consider the effectiveness of their safety management systems in preventing a similar incident in their workplace.

The alert targets those who work near energised electrical parts reminding workers that in some circumstances the risks of carrying out electrical work near exposed energised parts can be just as great as working on energised electrical parts.

Where it is reasonably practicable to do so, WorkSafe Queensland states it is advisable to turn off power to the adjacent parts to eliminate the risk. If this is not practicable, workers are advised to minimise the risk, which may involve a single control measure or a combination of two or more different controls.

WorkSafe Queensland states the following factors may be taken into account in assessing risks:

- Type of work carried out and tools or equipment used.
- Proximity of the work to energised parts.
- The types of tools and equipment used in the work, particularly the conductive properties of tools.
- Environmental conditions such as confined space, wet surfaces or unfavourable weather.
- Assessing the need to repair equipment while it remains energised, such as cleaning a low-voltage switch room.
- Work that may impose additional risks, such as welding or grinding, that could damage adjacent electrical lines or equipment.

Workers are advised to work through the hierarchy of controls to choose the control that most effectively eliminates or minimises the risk.

For further information on electrical safety, visit www.worksafe.qld.gov.au.

## WA BANS LIVE ELECTRICAL WORK

In the wake of the deaths of three electrical workers in Western Australia over the past two years, electrical work on energised installations will now be prohibited.

The state government is introducing a package of safety reforms that require main switches to be turned off while work is undertaken in a roof space.


One man died from an electric shock in 2013, while two other men were killed in an explosion at the Morley Galleria while conducting maintenance work earlier this year.

Commerce Minister Michael Mischin said, "Following these tragic accidents, I sought advice from EnergySafety, WorkSafe and the Commission for Occupational Safety and Health on how to prevent such incidents from happening again.

"I was informed that the main contributing factor in both cases was the fact the electrical equipment and installation were energised."

The new measures include:

- introducing a general prohibition of electrical work on energised electrical installations, including in roof spaces. Exceptions will be provided where it is not possible to conduct work without the electrical installation being energised, such as testing, and specific control measures when operating under an exception;
- mandating that the main switch must be turned off whenever non-electrical work is being undertaken in a roof space. This will apply to all workers who are doing work other than electrical work in a roof space, such as installing insulation;
- providing a general exemption in these regulations where live electrical work must be conducted but that does not fit within the exception. Control measures will be specified in the exemption.

The Minister said feedback from the industry about the changes had been positive.

"Earlier this year, I asked EnergySafety to circulate a discussion paper to gauge the industry's views about banning live electrical work," he said.

"In general, they were very supportive of the proposal to prohibit live electrical work and sought assurances that special exceptions in certain cases would be factored in.

"I have requested EnergySafety and WorkSafe to prepare a preliminary impact assessment to enable the reforms to be implemented as soon as possible."

## Safety eyewear

Honeywell Hypershock safety eyewear is suitable for applications where high-performance medium impact protection is essential and vision can't be compromised. Being 100% dielectric, the safety glasses are also suitable for environments with a possibility of accidental exposure to electrical charge.

The eyewear's rugged design recognises the diversity of facial shapes and features to deliver a secure fit that is comfortable throughout the working day.

The eyewear is available in clear and espresso lenses, with either Honeywell's hard coat or Anti Fog lens coating. The hard coat is permanently bonded to the lens so that it won't wear off. The high scratch resistance means that the visual clarity of the safety eyewear remains high over time as the glasses themselves resist scratches and other disfigurements that would otherwise impede workers' view. Honeywell Anti Fog lenses feature a combination of hydrophilic and hydrophobic materials, using the best properties of both water-releasing and water-repellent coatings to prevent lens fogging.

For outdoor work, Hypershock polarised lenses are available to cut through glare for visual clarity. The polarised lenses block horizontal light waves that bounce off roads, water, metal and other flat surfaces, removing glare, improving perception of fine details and reducing eye strain.

Approved to Australian and New Zealand Standard AS/NZS 1337.1 by SAI Global, the glasses are comfortable to wear and provide the wearer with good clarity of vision.

***Honeywell Safety Products Australia Pty Ltd***
*www.honeywellsafety.com*

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## Infrared thermal image camera


The FLIR E8 Infrared Camera is suitable for fault-finding sources of energy loss, overheating electrical and mechanical equipment, structural abnormalities and moisture intrusions. It is available to rent from TechRentals.

The camera's MSX mode interlaces detail from a visible light camera over infrared images in real time, resulting in enhanced imagery for inspections and documentation. Picture-in-picture (PiP) mode (with the option to insert a thermal image over the top of a visual image) is also available. The product handles extreme temperature detection with automatic hot/cold spot and above/below colour alarms.

Features include: a temperature range -20 to 250°C; resolution 320x240; thermal sensitivity/NETD <0.06°C (0.11°F)/<60 mK; and thermal, visual and MSX viewing modes.

The unit also comes with a removable battery and FLIR tools reporting and analysis software. TechRentals offers a set up and download service for this product.

***TechRentals***
*www.techrentals.com.au*

## Wireless DC clamps

Fluke Corp has added the a3003 FC Wireless DC Current Clamp and the a3004 FC Wireless DC 4-20 mA Current Clamp to the Fluke Connect system of wireless test tools.

Both current clamps can wirelessly send measurements to Fluke Connect-enabled master units and the mobile app so users can view measurements from multiple devices simultaneously, review equipment history and share measurements with other team members for faster troubleshooting.

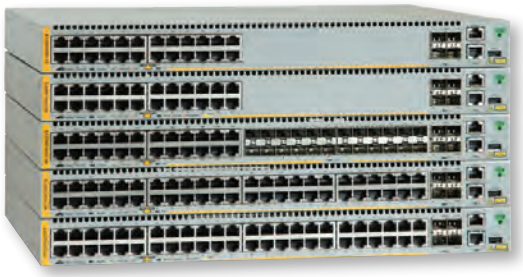
The a3003 FC Wireless DC Current Clamp measures up to 2000 A DC making it suitable for high DC current measurements typically found in utility and DC machine controller applications. It features a large jaw size (64 mm) for clamping around and measuring on large, high-current conductors.

The a3004 FC Wireless DC 4-20 mA Current Clamp measures 4 to 20 mA signals without breaking the loop so process control technicians can make accurate measurements without interrupting the workflow. It features a detachable clamp with extension cable for measurements in tight locations.

Both current clamps can record and store up to 65,000 measurements with the logging feature to isolate intermittent events or record fluctuations without the user being present.

***Fluke Australia Pty Ltd***
*www.fluke.com.au*

## Distribution switches



The Allied Telesis x930 Series of distribution switches has five models offering several port configurations. It is suitable for medium to large organisations such as schools, hospitals or government agencies.

The AT-x930-28GTX and -28GPX models feature 24G ports with 10G uplinks, while the -28GPX also provides 30 W of PoE+ on all ports. The AT-x930-28GSTX model features 24G combo ports with 10G uplinks, and can mix copper and fibre connectivity for flexible deployment.

The AT-x930-52GTX and -52GPX models feature 48G ports with 10G uplinks, while the -52GPX also provides 30 W of PoE+ on all ports. Additionally, the switches are stackable to eight units for distributed campus applications or dual-core disaster recovery scenarios. They also have dual hot-swappable PSUs which allow for maintenance and continuous service.

The series also supports Allied Telesis Management Framework (AMF). By automating common management tasks such as replacing failed units, modifying configurations, upgrading firmware or extending the network, AMF provides users with a unified management interface and zero-touch device installation and recovery. The Allied Telesis Wireless Manager, designed to improve service levels across wireless infrastructures, can also be run in conjunction with AMF.

The series will offer a 40 GbE line rate speed protected access transport rings, enabling providers to aggregate gigabit speeds from integrated multiservice access platforms directly to line-speed 40 GbE. The switches are SDN ready and software upgradeable to 40G ethernet.

***Allied Telesis International (Aust) Pty Ltd***
*www.alliedtelesis.com.au*

CASE STUDY

# Redeveloping the Sydney Cricket Ground

It may not be the biggest stadium in Australia, but it's one of the oldest with a rich history dating back to the early 1800s.

The Sydney Cricket Ground (SCG), as it stands today, blends distinctive original architecture with state-of-the-art features due to an extensive redevelopment project spanning the last several years.

NHP played a role in the first stage of the plan, which was completed in 2008 with the opening of the Victor Trumper Stand, and was again involved in 2012 when work began on stage two.

The stage-two developments involved the replacement of the MA Noble, Sir Don Bradman and Dally Messenger stands, which was completed last July, boosting the SCG's capacity to 48,000.

NHP worked closely with Barnwell Cambridge and its nominated switchboard builder, SMB Harwal, to ensure the design and ultimate installation of the electrical switchgear was integrated throughout the entire site.

These developments involved the design of a three-tiered stand comprising five levels designed to align with the existing SCG Hill Grandstand profile. Improvements for spectators included seating closer to the field of play, increased undercover seating and the promise of unobstructed views. An extensive set of electrical works was also required to power one of the largest video screens of any Australian sportsground as well as the extensive catering, corporate, media and AFL player facilities.

To fulfil these power requirements NHP, Barnwell Cambridge and SMB Harwal delivered four main switchboards (MSBs), four main distribution boards (MDBs), four low-voltage distribution boards (LVDBs) and 60 distribution boards (DBs).

"Barnwell Cambridge selected the NHP product for many reasons including engineering support, product range, quality of products and specific features to ensure the final solution met the needs of the complex project," said Anthony Cambridge from Barnwell Cambridge.

"This was enhanced with the ability of NHP to deliver products on a project with tight time frames, where the power reticulation needs to be completed and operational before the rest of the building. This was to ensure that the major international sporting events of the Fifth and deciding Cricket Ashes Test and Major League Baseball would be played without interruption."

The various board requirements included a range of Terasaki air circuit breakers and automatic transfer switch units, Socomec load break switches, DIN-T miniature circuit breakers as well as other NHP chassis assembly components.

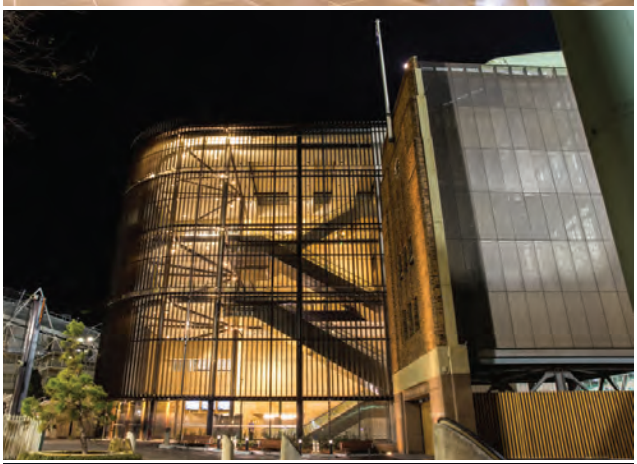
"Whilst future development requirements and continuity of brand throughout the site were important considerations, it was our proven product range and working relationships at all levels of a project that made us the right electrical supplier for the stage two developments," said NHP Business Development Manager–Projects Paul McIlwain.

"Our feedback from the consultant, contractor and switchboard builder has been positive and given the project was delivered in a manner that met all parties' expectations, it has been a great outcome for all involved."

Other additional features of the sporting ground now include free Wi-Fi, IPTV and in-seat ordering, and a world-class media centre.

The SCG won Project of the Year for the MA Noble, Don Bradman and Dally Messenger stand redevelopment at the global 2015 TheStadiumBusiness Awards held in Barcelona on 10 June.

*NHP Electrical Engineering Products Pty Ltd*
*www.nhp.com.au*



## Energy meter

The EM270 Dual-3-Phase from NHP is a quick-fit energy meter that has been developed to reduce metering space and save up to 90% on installation time.

There are three different size triple current transformers to meet the needs of various panelboard applications (160, 250 and 630 A). The form factor of the 250 and the 630 A match well with the NHP Moulded Case Circuit Breakers.

By means of two RJ11 current inputs, each managing a triple current transformer, the product is capable of monitoring all the electrical variables and energy of two independent three-phase loads or six independent single-phase loads. The energy meter may then also be set to aggregate these two circuits with a third virtual meter.

A pair of triple current transformers may also be connected to the device with only two clicks. This simple connection system removes all chances of connection errors as well as automatically setting the CT ratio.

***NHP Electrical Engineering Products Pty Ltd***

*www.nhp.com.au*

## Driverless LED downlights

The dSeries from Aurora comprises the d13, d19 and d32 compact profile LED downlights. The series has three wattage options including 13, 19 and 32 W respectively.

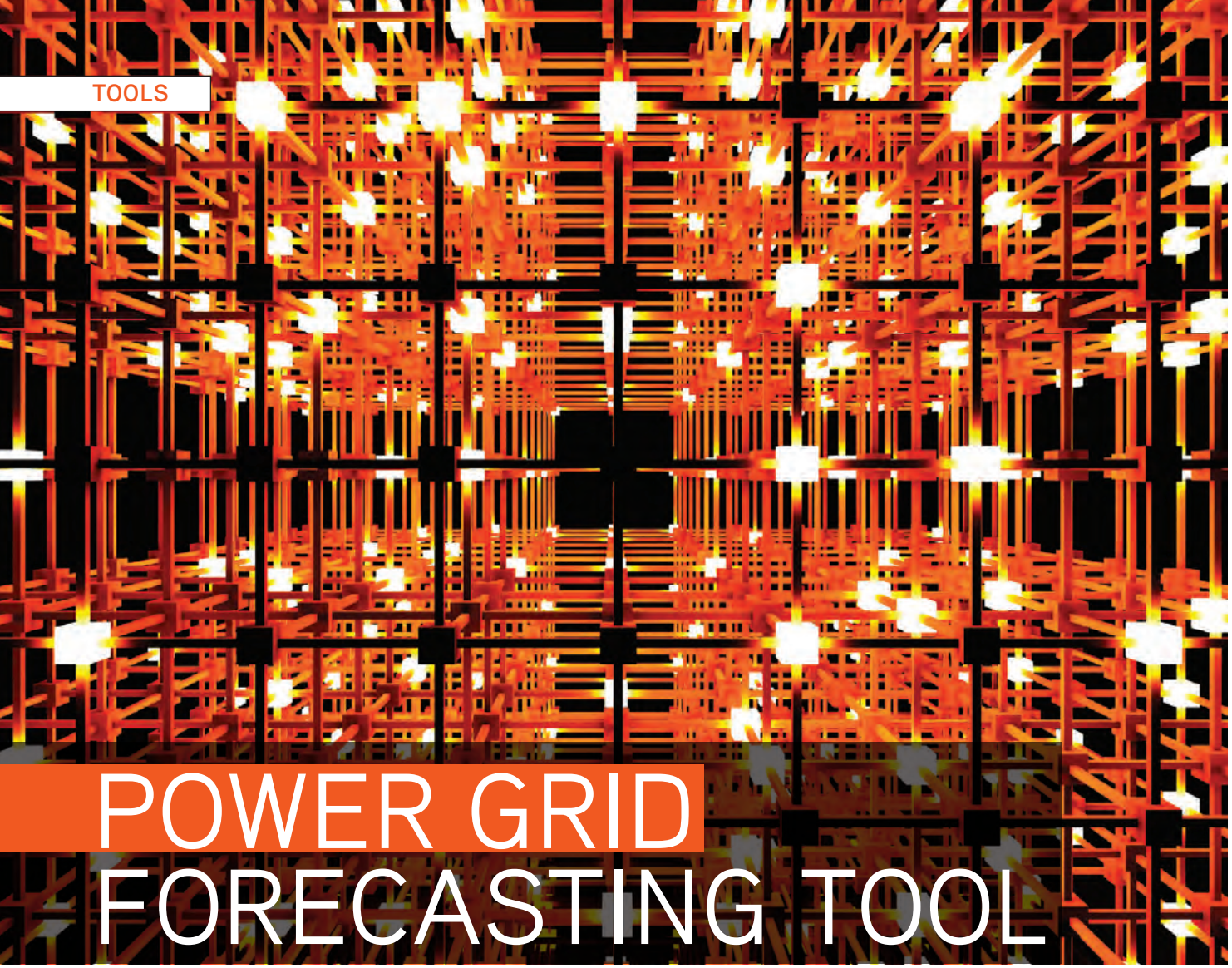
The downlights are designed with a slim form, enabling them to be installed into shallow ceiling voids, and are suitable as a high-performance replacement for CFD. They are also available in emergency and baffle versions.

Inside the dSeries, a small active heatsink, CrystalCool, provides effective thermal management, allowing for higher quality and brighter light for longer periods.

Key features of the downlights include: 650-2250 lm; 3000 and 4000 K CCT; 220-240 V mains voltage; CRI (Ra) 80+; dimmable as standard; IP44 rated and ErP, L1 and L2 compliant; 40,000 h to L70 (70% original lumen output); and extended 5-year warranty.

***Aurora Ltd***

*au.auroralighting.com*





# POWER GRID FORECASTING TOOL

A new tool that is said to increase the accuracy of forecasting future electricity needs by up to 50%, and may also have the potential to save millions in wasted energy costs, has been developed by researchers at the US Department of Energy's Pacific Northwest National Laboratory (PNNL).

Accurately forecasting future electricity needs can be difficult due to sudden weather changes or other variables impacting projections minute by minute. The Power Model Integrator has been designed to assist with addressing costly errors that can lead to serious impacts, from blackouts to high market costs.

Performance of the tool was tested against five commonly used forecasting models processing a year's worth of historical power system data.

"For forecasts one to four hours out, we saw a 30–55% reduction in errors," said Luke Gosink, scientist and project lead at PNNL.

"It was with longer-term forecasts — the most difficult to accurately make — where we found the tool actually performed best."

Fluctuations in energy demand throughout the day, season and year along with weather events and increased use of intermittent renewable energy from the sun and wind all contribute to forecasting errors. Miscalculations can be costly, put stress on power generators and lead to instabilities in the power system.

Grid coordinators have the daily challenge of forecasting the need for and scheduling exchanges of power to and from a number of neighbouring entities. The sum of these future transactions — the net interchange schedule — is submitted and committed to in advance. Accurate forecasting of the schedule is critical not only to grid stability, but a power purchaser's bottom line.

"Imagine the complexity for coordinators at regional transmission organisations who must accurately predict electricity needs for multiple entities across several states," Gosink said. "Our aim was to put better tools in their hands."

Currently, forecasters rely on a combination of personal experience, historical data and often a preferred forecasting model. Each model tends to excel at capturing certain grid behaviour characteristics, but not necessarily the whole picture.

To address this gap, PNNL researchers theorised that they could develop a method to guide the selection of an ensemble of models with the ideal, collective set of attributes in response to what was occurring on the grid at any given moment.

The resulting tool has the ability to adaptively combine the strengths of different forecasting models continuously and in real time to address a variety scenarios that impact electricity use, from peak periods during the day to seasonal swings. To do this, the tool accesses short- and long-term trends on the grid as well as the historical forecasting performance of the individual and combined models. Minute by minute, the system adapts to and accounts for this information to form the best aggregated forecast possible at any given time.

"The underlying framework is very adaptable, so we envision using it to create other forecasting tools for electric industry use," Gosink said.

"We also are exploring other applications, from the prediction of chemical properties studied in computational chemistry applications to the identification of particles for high-energy physics experiments."

*Pacific Northwest National Laboratory*
*www.pnnl.gov*

## LED incandescent replacement

The Marl 241 Series of LED bulb replacement is designed to replace a 20 W halogen with a BA15d base.

The series is suitable for general illumination or high vibration applications. The replacement bulb also does not radiate heat and is therefore suitable for applications where proximity to the light may be a factor.

The series operates at 12 VAC/DC, drawing a maximum of 5.6 W. It has in-built protection against spikes and transients with thermal protection (auto dimming). Other features include: a beam angle of 23°; bipolar operation; internal potting; linear regulation of current; no electrolytic capacitors or switching inductors; zero EMI noise; and a long life of 50,000 h.

***Aerospace & Defence Products***
*www.aerospacedefenceproducts.com.au*

## LED high-bays

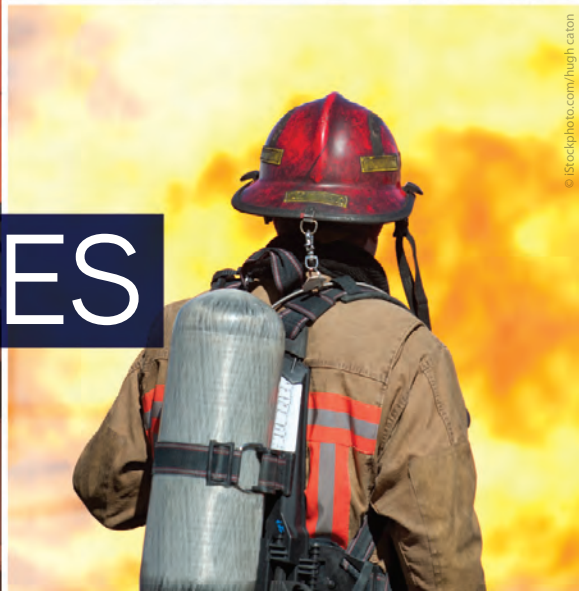
The IP65-rated Ostia LED high-bays are suitable for use in warehouses, industrial spaces, canopies, manufacturing and conference centres.

The widely efficient aluminium heatsink enables a lower operating temperature and leads to an average operating lifetime to L70 (70% lumen maintenance) of 50,000 h, backed by a 5-year warranty.

With instant-on, a power factor of 0.95, colour rendering index (Ra) of 80+ and up to 20,000 lm, these high-bays can be controlled by choice of optional aluminium or acrylic reflectors. At just 100 to 200 W and with built-in 1-10 V dimming, Ostia can be used in conjunction with daylight or occupancy sensors and promises significantly lower energy and maintenance costs over HID alternatives.

***Aurora Ltd***
*au.auroralighting.com*






# UNSAFE CABLES COULD CAUSE HOUSE FIRES NEXT YEAR

The degrading Infinity cable could cause fires from as early as 2016, the Australian Competition and Consumer Commission has warned.

An estimated 3900 km of unsafe cable was supplied and approximately 2800 km is yet to be remediated, recovered or scheduled for remediation under the recall. Approximately 28% of the cable has been accounted for.

"The ACCC is extremely concerned that over 70% of the cable supplied has not been accounted for under the recall," said ACCC Deputy Chair Delia Rickard. The commission is urging electricians, builders and contractors to notify their customers and cable suppliers if they installed Infinity cables between 2010 and 2013.

In August, the ACCC held an Infinity Regulatory Taskforce meeting with electrical, building and Australian consumer law regulators to discuss and agree what more is needed from businesses on this front. "It is clear that all businesses in the supply chain need to be doing more to alert consumers to the recall and remediation options."

The ACCC recently undertook an advertising campaign to warn consumers about the risks of Infinity cables.

"Consumers that purchased new properties, undertook renovations, had appliances installed or had electrical work carried out in the past few years should contact a licensed electrician for a safety inspection to determine if Infinity cables were installed," Rickard said.

"Consumers should not attempt to inspect cables themselves. Any affected cable installed in accessible areas or near heat sources must be removed and replaced under the safety recall."

Infinity cables were recalled last year after they failed electrical safety standards due to poor quality plastic insulation coating, which will become brittle prematurely. Once the insulation is brittle, physical contact with the cables could dislodge the insulation and lead to electric shock or possibly fires.

The risk of physical contact is highest in roof spaces and under raised floors. Cables exposed to prolonged high temperatures will degrade at a faster rate.

| State | Installation period | KM supplied | KM remediated | KM covered from warehouses | KM scheduled for future remediation | KM outstanding | Properties made safe |
|---|---|---|---|---|---|---|---|
| NSW | 2010-2013 | 1,849 | 19 | - | - | 1,830 | 92 |
| QLD | 2012-2013 | 680 | 8 | - | - | 672 | 17 |
| SA | 2012-2013 | 44 | 0 | - | - | 44 | - |
| TAS | 2013 | 4 | 0 | - | - | 4 | - |
| VIC | 2012-2013 | 910 | 5 | - | - | 905 | 7 |
| WA | 2012-2013 | 251 | 0 | - | - | 251 | - |
| ACT | 2011-2013 | 162 | 5 | - | - | 157 | 182 |
| NT | - | 0 | - | - | - | - | N/A |
| State not specifie | - | - | 191 | 403 | 479 | - | 61 |
| TOTAL | - | 3900 | 228 | 403 | 479 | 2790** | 359 |

**Remediated is replaced, rendered safe under the recall or returned to stores. **Cable remediated or recovered for unspecified states/territories has been deducted from total KM outstanding, as has cable scheduled for future remediation.*

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# ALL-ENERGY AUSTRALIA 2015

All-Energy Australia's 2015 program will focus on the themes of technology and innovation, featuring experts and leading exhibitors from across the global clean energy sector.

Plenary chair Greg Bourne, the chairman of the Australian Renewable Energy Agency (ARENA), will lead the panel discussion 'The Clean Energy Evolution and Revolution'. The panel debate will feature industry voices including Enphase co-founder Raghu Belar, DNV GL Regional GM Mathias Steck, Redflow BDM Bruce Ebzery, Powershop CEO Ben Burge and Clean Energy Council CEO Kane Thornton.

International keynotes will discuss the role of industry and government in the future of renewables and clean energy. They will be delivered by Volker Beckers, RWE npower CEO until the end of 2012; and the Rt Hon John Gummer, Lord Deben, the longest-serving Secretary of State for the Environment the UK has ever had. He created and now runs Sancroft, a Corporate Responsibility consultancy working with blue-chip companies around the world on environmental, social and ethical issues.

The conference will hold new module sessions that will consider small-scale technologies, hybrid energy through combining multiple power sources and the future opportunities of residential and commercial energy storage projects. All-Energy Australia's partnership with the Clean Energy Council will also offer attendees both professional development and ATRAA sessions for installers free of charge.

The All-Energy Australia Exhibition and Conference is taking place in Melbourne from 7–8 October 2015. Anthony Reed, from event organiser Reed Exhibitions, noted, "Both days provide attendees with valuable access to the very latest innovations and ideas from industry, government and academia to help guide future discussions and investment.

"All-Energy Australia remains the single largest meeting point for the clean energy sector, attracting 4000 visitors, more than 100 exhibitors and top-tier talent from around the event all in one place."

The event also has a mobile app available for iPhone (plus iPod Touch and iPad) and Android mobile users, which includes an interactive floor plan; a list of exhibitors and what they are featuring; an interactive program outlining the events that are on each day; as well as event alerts and reminders. To register for the free exhibition and conference, visit www.all-energy.com.au.

*All-Energy (Pty) Ltd Events*
*www.all-energy.com.au*

## LED downlight

Brightgreen has added the P900 Curve LED pendant to its surface series of LED downlights.

The light has an adjustable 1.2 m cord, which can be looped through ceiling hooks or hung at a range of levels, and it increases thermal efficiency as it does not require cut-outs or gaps in insulation. The product also features a deeply recessed, low-glare lens and an aluminium body. It emits 802 lm on 16.5 W and is designed to last for up to 70,000 h, which is about 30 years on average daily use.

The product comes with a 7-year warranty and is also compatible with leading Australian control systems and dimmers.

***Brightgreen Pty Ltd***
*www.brightgreen.com*

## Utility-scale solar panel

Yingli Solar has developed a framed utility-scale solar panel designed for a maximum system voltage of 1500 V.

Designed specifically for use in utility-scale PV power plants, the new panel is said to improve system performance and reduce balance-of-system costs. Compatible with most tracking and mounting systems, it includes an aluminium frame. An extra layer of protective coating on the solar cells ensures high resistance to potential induced degradation (PID).

Due to its 1500 V maximum system voltage, the panel drives balance-of-system savings by decreasing the required number of home run cables, combiner boxes and fuses. The higher maximum system voltage also improves performance by reducing resistive losses, thus increasing system-level energy yield.

***Yingli Green Energy Australia Pty Ltd***
*www.yinglisolar.com*


## Solar actuator

The Airstroke actuators from Firestone can continuously orient a solar tracker's payload towards the sun to optimise the amount of energy produced from the installed power generating capacity. The product is suitable for commercial installations, where continuous focusing of the arrays through single- or dual-axis arrangements enhances energy returns.

The rubber and fabric actuators can be used to solve the problem of stationary solar collection panels becoming inefficient as the sun shifts from a 90° angle to the panels.

Usually inflated or deflated by standard fixed or mobile compressed air, typically 7 bar (100 psi), the actuators move photovoltaic systems to minimise an angle of incidence between the incoming sunlight and a photovoltaic array.

The actuators do not contain internal rods of seals to wear, unlike conventional metal cylinders, and have the ability to rotate through an angle without a clevis. They also have the ability to bend with load and to tolerate high side loadings to prevent breakage and wear.

***Air Springs Supply Pty Ltd***
*www.airsprings.com.au*

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# GRID INTEGRATION

*Jochen Kreusel, ABB Smart Grids*

Today, the new renewable energies are a global reality, no longer dependent on the support from individual countries. But the approach of connecting renewable energies to the existing systems is too shortsighted. Instead, electric power supply systems must be further developed to integrate new sources on a larger scale.

More than 10 years ago the new renewable sources of electric energy — sun and wind — began to make their way into the electric power supply system. At that time, they were seen as two additional primary energy sources that could be connected to the existing systems without making any fundamental changes. Today, these new renewable energies have, in some countries, become the largest generation subsector.

Countries from all regions are active, and some of the early pioneers — recognisable by their high installed capacities — have been overtaken by other countries.

The strongest driver of this change is photovoltaics, which — after the significant cost reductions at the end of the last decade — has reached or fallen below grid parity in a number of countries. That is, photovoltaics has achieved competitive end-consumer prices in low-voltage grids.

Photovoltaics is an economical option for meeting the demand of individual households, provided that the grid usage fee is largely energy based. This makes it independent from direct subsidiaries for a large scope of applications as long as it reduces the owner's own demand.

## New renewable energy sources and system integration

New renewable energies have three main features that fundamentally change the electric power supply system: remote generation, distributed generation and volatility.

### *Remote generation*

The share of remote generation of renewable energy is much higher than with power plant systems in which a regional balance of generation and demand is preferred for both economic and technical reasons. This development is mainly driven by the heavily location-dependent sources of wind and water and can lead to very large generation units or clusters.

### *Distributed generation*

The growth of distributed generation is primarily driven by photovoltaics and combined heat and power generation (CHP). For photovoltaics, this is mainly due to the relatively low economies of scale in terms of costs combined with economic performance, relative to the end-consumer prices in a low-voltage grid. CHP must be distributed in order to provide the heat close to the consumer. Very small PV systems in particular can lead to a considerable share of the generation being covered by a very large number of smaller units feeding energy into the distribution networks.

### *Volatility*

Volatility is mainly introduced to the electric power supply system by wind and solar energy, both of which lead to faster, larger and, especially in the case of wind energy, less predictable fluctuations than before.

Remote generation, distributed generation and volatility affect all areas of electric power supply and utilisation. Figure 1 gives an overview of these areas, including the influence of new loads as drivers for change.

## Conventional provision of electric power

The rising share of renewable energies is influencing the operation of conventional power plants. The increased frequent use of power plants originally intended as base-load plants for loads following operation with steep power output gradients poses a great technical challenge.

Another factor influencing the operation of conventional power plants is that, as wind and solar energy have no variable costs, they will always be placed at the lower end of the merit order in an energy-only market. This means they displace conventional generation, reducing the utilisation of conventional power plants and making fixed-cost coverage more difficult.

These economic effects mean that building and operating conventional power plants is no longer attractive. But as conventional generating capacity is indispensable both as backup for periods of low renewable power output and for power system control, suitable adaptations of the market design are now being discussed. ABB is deeply involved in the discussions and is helping to shape the modern electric power supply system.

| Driver | System affected | | | | |
|---|---|---|---|---|---|
| | Conventional generation | Transmission | Distribution | System operation | Application |
| Remote generation | | – Long-distance transmission<br>– FACTS[1]<br>– Overlay grid/ HVDC | | – Stabilization with FACTS[1] | |
| Distributed generation | | | – Automation<br>– Voltage regulation | – Communication<br>– Control<br>– Virtual power plants | |
| Volatile generation | – Part-load capability<br>– Flexibility | – Trans-regional leveling<br>– Overlay grid/ HVDC<br>– Bulk storage | – Distributed storage | – Load management<br>– Virtual power plants<br>– PMU/WAMS[2] | – Storage (in applications)<br>– Demand response |
| New loads (eg, e-mobility) | | | – Charging infrastructure | – Demand response | |

1 FACTS: flexible alternating current transmission systems
2 PMU/WAMS: phasor measurement unit/wide-area monitoring systems

*Figure 1: Effects of the main drivers for change on different parts of the electric energy supply and utilisation value chain*

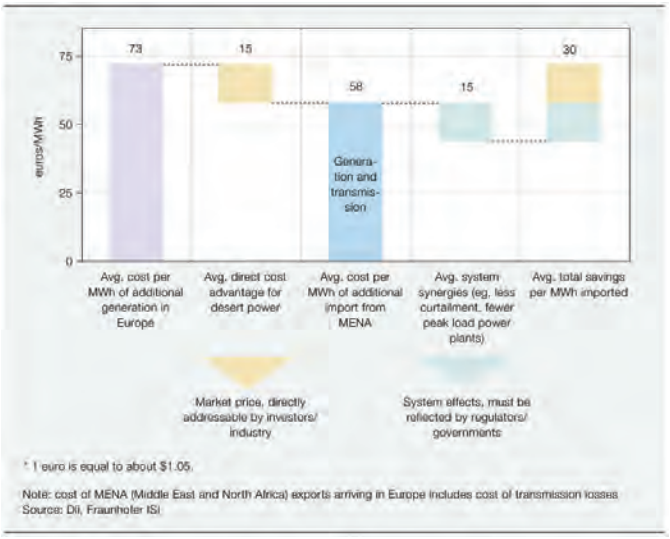


*Figure 2: Reducing the costs* for renewable energy by integrating the power supply systems of Europe, North Africa and the Middle East [3]*

## Transmission level

In transmission networks, remote generation leads to increased capacity requirements. Additionally, the volatility of the generation — particularly in combination with the low number of full-load hours of the renewable energies — increases transmission requirements. Expanding the interconnected power system represents the most cost-efficient option to match volatile generation and consumption. The benefit of regional expansion for the integration of a very high share of renewable energies into the electric power supply is illustrated in Figure 2, using the expansion of the European interconnected power system to North Africa and the Middle East as an example.

## Distribution level

The changes occurring in the distribution networks are manifold. In many cases, an increase in distributed generation requires a reinforcement of the grids. However, especially in rural grids with relatively long transmission lines, voltage support problems occur first. As this is not caused by the one load situation the network has been designed for, but by the multitude of operating conditions between feeding and extracting power, the traditional solution of manually adapting the transformation ratio of the local distribution transformer is no longer sufficient. In such cases, the often significantly more expensive grid reinforcement can be postponed or even entirely avoided by installing a voltage regulator such as a voltage-controlled distribution transformer (see, eg,[1,2]).

The increasing variety of operating conditions in the distribution networks increases the information requirements. This leads to an at least partial automation of the distribution substations, which thus far have been minimally monitored or remotely controlled. Distributed generation as well as e-mobility (due to the mobile nature of the consumers) will lead to an insufficient capacity of distribution networks in some situations. This means that measurement and control will be required — and as every technical system, including measurements, can be faulty, the solution will be to transfer well-known approaches from the transmission networks, such as state estimation, to the distribution level and into the secondary distribution systems.

If the grid is unable to offer sufficient capacity for all situations, possible congestion must be proactively detected and resolved — a task that is not new in the electric power supply domain. In fact, it is common practice in the coordination between (large-scale) power plants and system operators. Hence, the solutions for this electric power supply area must be largely standardised and automated. An example of predictive distribution network operation, which also takes the requirements of the deregulated market into account, has been developed and successfully taken into operation within the scope of the MeRegio E-energy project in Germany[3].

## Consumption

Due to the volatile power output associated with renewable energies, the short-term demand response is gaining in importance. Demand-response measures, particularly those involving loads with inherent storage, may contribute to this.

Figure 4 shows the requirements associated with the balancing of loads and generation for different time domains, the solutions commonly used today and the solutions expected in the future. This clearly shows that demand response can make an important contribution especially in the first 15 min. This is an important period because it is sufficiently long enough to ramp up power plants with fast start-up capability when generation capacity is suddenly lacking. Whether demand response can help in the very short time frame in which the rotating mass of power plants has a stabilising effect today depends on whether an autonomous reaction of the load to imbalances between generation and consumption can be achieved. After 15 min the use of demand response is only realistic for selected applications.

Demand response is particularly suitable for heating and cooling applications as thermal energy storage can, in most cases, be implemented at a relatively low cost. Hence, a holistic approach considering the supply of electric energy as well as of heating and cooling is essential for the utilisation of demand-side flexibility options.

## Storage

Storage is another important building block for the integration of renewable energies. But due to the variety of applications and available solutions it is a highly complex topic, which requires a separate discussion.

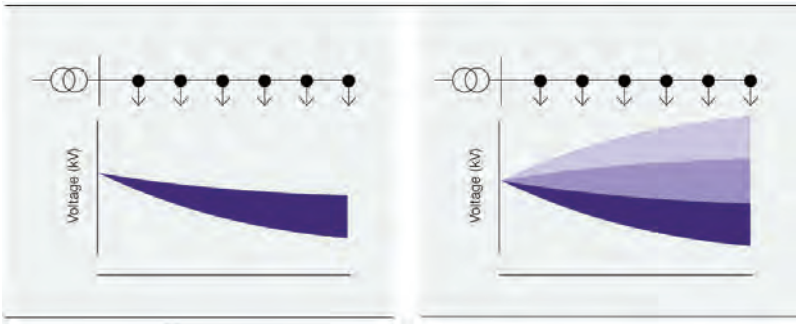


*Figure 3: Change of the voltage support task in distribution networks with increasing distributed generation (schematically)*
*(Left) Past: Distribution; voltage is decreasing along the LV lines and voltage band can be guaranteed by a fixed setting of the distribution transformer (Right) Now and in the future: Distribution and feed-in, resulting in a broader variation of voltage at the end of the line, possibly requiring on-load voltage adjustments*

"THE MOST SIGNIFICANT CHANGES IN THE SYSTEM MANAGEMENT WILL BE THE INTEGRATION OF A VERY LARGE NUMBER OF DISTRIBUTED UNITS ON BOTH THE GENERATION AND THE CONSUMPTION SIDE, AS WELL AS ACHIEVING FREQUENCY CONTROL WITH A DECREASING NUMBER OF ROTATING MASSES ACTING AS STABILISING ELEMENTS.

| Time domain | Task | Traditional solutions | New solutions for the future |
|---|---|---|---|
| <30 s | Instantaneous reserve, balancing of short-term variations | – Rotating mass of the power plants | – Battery storage<br>– Renewable energy resources and load management may also contribute |
| <15 min | Minute reserve, balancing of short-term variations | – Hydropower plants<br>– Power plants on the grid<br>– Fast start-up power plants | – Load management<br>– Battery storage |
| 1-3 d | Balancing of diurnal variations of the residual load | – Pumped storage<br>– Power plants (fuel storage) | – Pumped storage<br>– Load management (selected applications) |
| Weeks to months | Balancing of annual variations of the residual load | – Power plants (fuel storage)<br>– Water reservoir (natural inflow) | – Water reservoir (natural inflow)<br>– Expansion of interconnected power system |

*Figure 4: Requirements for balancing generation and demand in different time domains and possible solutions today and in the future.*

## The road ahead

The transition from an electricity supply based on thermal power plants to a supply using new renewable energies as its main source has technical implications in all areas of electric power supply and utilisation, and will lead to a fundamental redesign of power systems.

Future conventional generation will require plants that can be operated economically even at low loads and in frequently and fast-changing load situations. The transmission networks will have to take over more long-distance transmission tasks with strongly varying load flow situations compared with the past. To compensate for the volatility of the new renewable sources, wide-area interconnected systems can be an option.

The consequences of the integration of distributed generation into the distribution networks will be particularly far-reaching, both quantitatively and qualitatively. First of all, an increase of grid capacity will be inevitable in many cases. As the combination of extracting power from and feeding power into the grid leads to a larger range of operating conditions, additional voltage monitoring and regulation will often be required. And finally, it will no longer be sensible to design the distribution networks for rare extreme situations — this is mainly due to the low number of full-load hours associated with solar energy and because of e-mobility. Thus monitoring and control down to the secondary distribution level will be necessary.

Balancing loads and generation will become more difficult in systems with a strongly varying primary energy supply that is not storable. Besides the proven but landscape-profile-dependent pumped storage plants, battery storage facilities can contribute in the short term, eg, for frequency stabilisation and peak shaving. In the long term, ie, mainly for the compensation of seasonal variations, the system boundaries will likely be expanded by extending the interconnected systems or interconnecting other systems such as heat and gas supply.

The most significant changes in the system management will be the integration of a very large number of distributed units on both the generation and the consumption side, as well as achieving frequency control with a decreasing number of rotating masses acting as stabilising elements.

The greatest challenges in the necessary further development of the systems are — from a more organisational perspective — the coordination of the required measures in all system areas and — from a technical perspective — the development of suitable storage, the operation of the system without rotating masses and the integration of large numbers of distributed units into the system management. With its commitment to innovation, ABB continues to drive the growth of renewables, paving the way for the new electric power supply system.

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*ABB Australia Pty Ltd*
*www.abbaustralia.com.au*


# RULES TO LIVE BY TO AVOID A SHOCK

Electricity is a constant hazard in many workplaces and those who work on or near electricity are most at risk of shocks, burns or even death.

If you work on or near electricity, 'never work live'. This is the most important rule for electricians, those most at risk of electrical injuries, according to WorkCover NSW.

In the past four years, six people have died in NSW workplaces and eight have been permanently disabled as a result of electrical work.

Eris McCarthy, who has 30 years' experience in the electrical industry and is the managing director of ENN Electricians, said never working live is a basic rule to live by.

"The biggest hazards in our line of work are falls from heights, electrocution and arc faults," McCarthy said.

"Many years ago a workmate was pressured by a client into fitting a circuit breaker while a board was still live. While fitting the breaker he slipped and created a short circuit, resulting in an arc flash that severely burnt his face and hands.

"He spent ages off work — and the client lost power for considerably longer than the 15 minutes it would have taken to isolate the circuit and complete the job."

McCarthy said a second life-saving rule is 'test before you touch'.

"You can de-energise what you believe should be the circuit you are to work on, but you need to test before you touch in case things are incorrectly labelled, which they often are," he said.

"I saw a case recently, only last year, when someone worked on a board and, after isolating the circuit, pulled the cable out believing it to be safe, only to find it was incorrectly labelled and live.

"It had been put in the wrong terminal, and this happens all the time!"

McCarthy said injuries at work affect everyone and lead to a heavy burden of guilt on workers and supervisors. They question themselves endlessly about how it happened and what they could have done to prevent it.

"I think electricians are very aware of the risks they face, but like anyone they can become complacent or fatigued under stress and time pressures," he said.

"After an injury, attitudes change and everyone starts looking after each other."

The growth of established safety cultures, however, is a positive trend in many organisations, but often as a result of a workplace injury. Tony Robinson, director of WorkCover's specialist services, agrees that the single most important thing you can do is never work live.

"Start with the golden rule and then do a mental check you've covered the other basics," Robinson said.

When working with electricity, people are advised to:

- never work live
- identify all electrical sources before starting
- assess the risks
- isolate the supply
- lock the switch
- test before touching
- reassess if anything changes

*WorkCover NSW*
*www.workcover.nsw.gov.au*

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