

Extremely accurate, fast and robust: EtherCAT measurement technology modules

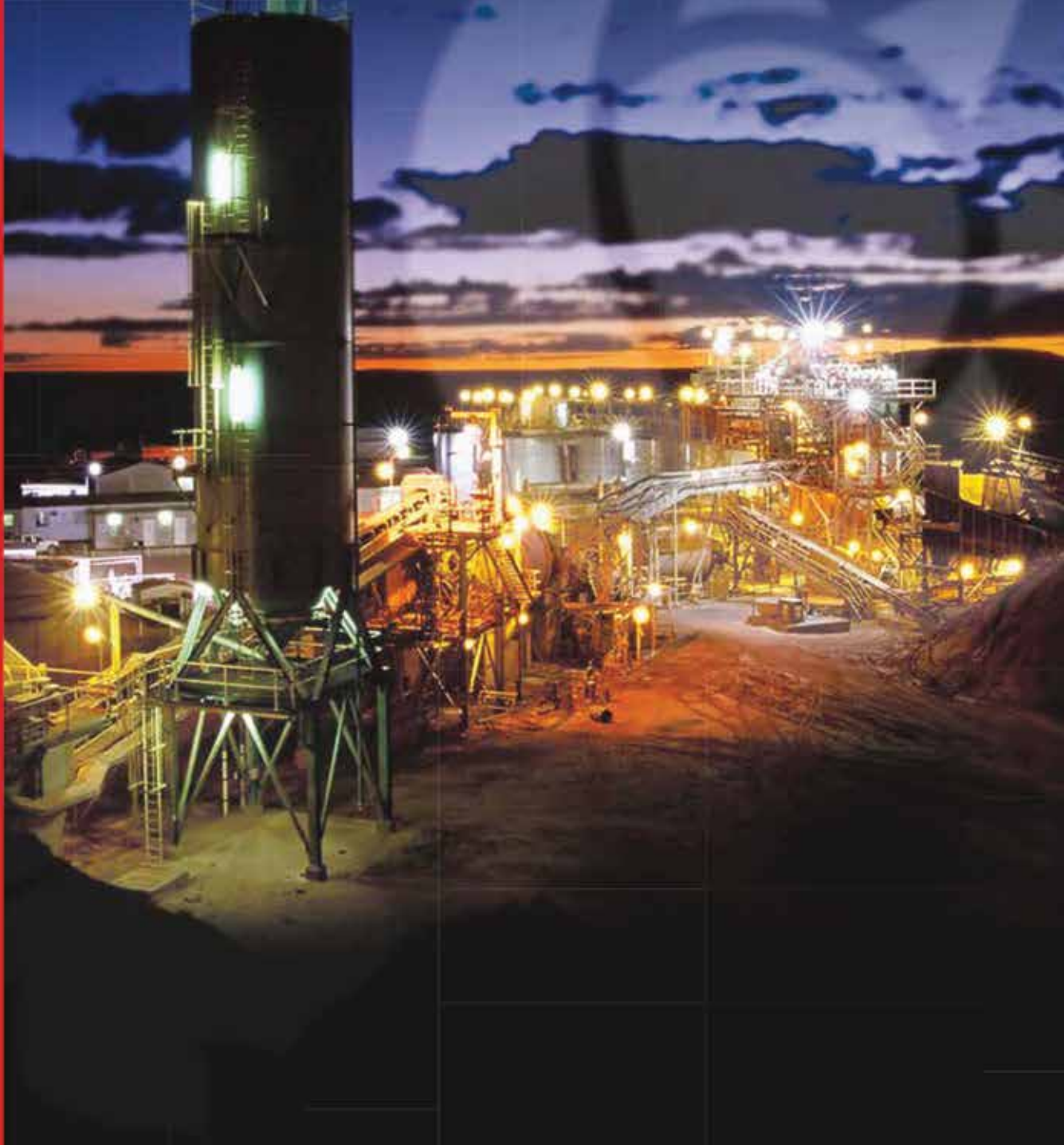


FEATURES:

- Control systems + automation
- Drives, motors + switchgear
- *Earthing + lightning protection*
- Pressure + level measurement
- Standby + back-up

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**Power
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Here we are in the New Year. It is, as it should be, a time of hope. It is important to start the year with a brief reflection on the past, and a strong focus on the future.

I am more convinced than ever, looking back, that the State must stick to setting up a policy environment that enables economic growth and the achievement of our goals – rather than dabble in other endeavours. Dabbling just muddies the water.

We recognise that the manufacturing industry, in particular, struggled during 2016. What this tells us is that we need to find a way out of this situation. There is no doubt that there are systemic issues that could assist – but let's not look back again.

One of the key elements, and an element that continues to evolve, is how you do better ... better in a way that ensures sustainability, and profitability. It is evident that the role of our processes and the efficiencies of those processes are becoming increasingly important. In this context, the process may or may not be continuous; it could be any manufacturing process that adds value to raw material and prepares it for distribution.

What we have seen over the past few years has been a focus on energy – not only because it has become costly, but because we have learned what happens when you simply no longer have it to use! Frankly, that was a long-overdue wake up call as energy had been taken for granted for too long in our economy. What has been intriguing over the past two decades is the realisation that plant information is the key to better efficiencies – being able to measure and predict increased optimisation – and indeed, learning how best to perform a task.

This magazine, Electricity+Control, has always been about the two essential commodities of modern industry: Energy and Information. The message that we convey is that you need both in order to run your business, deliver your service, or manufacture a product. While energy was cheap, we automated and controlled, measured and optimised. In fact, we included the distribution network, the delivery network, and human performance into how we ran and managed our plants. Energy remained that 'thing' that came into the plant and

was used. Then, our focus shifted to energy. Where was it? How much was it costing? And how could we effectively ensure no interruptions due to loss of supply.

Now we find ourselves in an almost artificial predicament: Energy is costly. There is enough of it. But our industry is shrinking.

Now, more than ever, we need to combine Energy and Information about our plants to better do what we already do. We have entered the Fourth Industrial Revolution, and as technologies fuse more and more, we need recognise the threats and the massive opportunities. Embedded right in the middle of it all is that intersection of Energy and Information; we need to find ways to fuse them more, and ask how, from that fusion, can we improve the bottom line?

This vision will continue to guide our content, and I invite anyone of you to contribute as an author. We would be delighted to share your thinking as we walk forward into this exciting future. It is a future, I might add, where I imagine Africa will play an increasingly important role. Let us not miss that!

May I wish you, your families and your colleagues, the very best for 2017.

Ian



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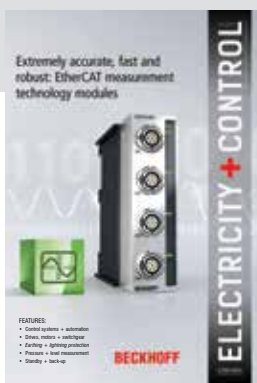
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Cover

With **Beckhoff's** new EtherCAT measurement technology modules, high-end measuring devices and traditional automation technology can be combined into one universal system. *Read more on page 9.*

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Looking Forward **VEGA**

The Elephant in the Industrial Control Room

Katherine Brocklehurst, Belden

While the opinion expressed in this article relates to the American situation, it applies to many parts of the world, South Africa included.

There is an elephant in the industrial infrastructure control room. Much of the equipment within our US critical infrastructure sectors is at risk of ageing out, needing replacement or upgrade, yet still in production use. There has to be a way to secure ageing and legacy industrial critical infrastructure, referring particularly, in this case, to water and wastewater plant.

This means industrial networks, endpoints, control systems and various types of specialised systems and production equipment across a number of industries are in drastic need of replacement or upgrade. For water and wastewater treatment, the useful life of system components is estimated to be 15 to 95 years, according to the American Society of Civil Engineers (ASCE) and their report: *Failure to Act – The economic impact of current investment trends in water and wastewater treatment infrastructure* [1]. Many of these components were installed in the 1950s for most major cities, long before today's modern networks, technical advances, application architecture, industrial protocols, cyber security risks, compliance requirements, safety regulations and other factors would have applied. It was therefore no surprise when, in 2012, a large, growing California metropolis proposed funding for a new power generation and water treatment plant to increase capacity and replace its ageing infrastructure.

Background

One of the biggest cities in California is also in the top 10 largest metropolitan areas within the United States based on its size. With a current population of near 1,2 million residents, this city is home to one of the fastest-growing regions in the country. Its city managers could no longer ignore the elephant in their wastewater treatment plant.

In 2012, the city had completed an energy management strategic plan that assessed its wastewater facility's existing and future power demands and also the condition of existing energy systems. At the time, they identified that their current facility equipment age ranged from 20 – 61 years and had been experiencing increasingly frequent-to-severe breakdowns. Aside from the equipment age, sourcing replacement parts was becoming unviable. Urgency was high to approve funding for a proposed new state-of-the-art cogeneration and wastewater treatment plant to begin services in 2016 and designed to meet nine regional cities' needs through 2036. However, in 2016, despite achieving construction and operational readiness, there were

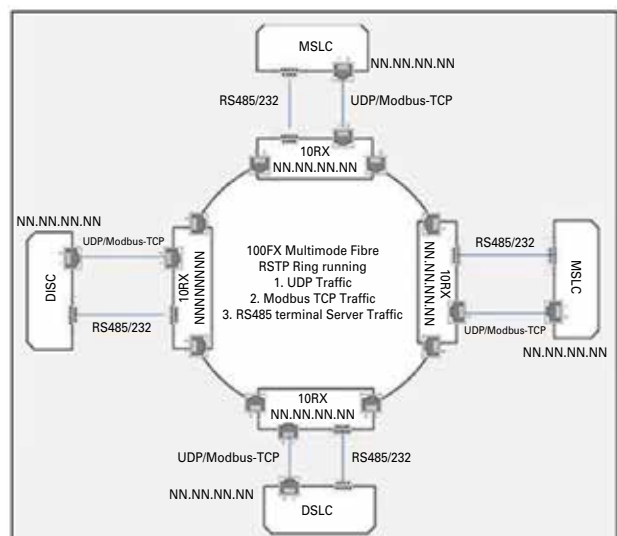
network communication problems plaguing the facility and crippling its PLCs and other systems. After three prior manufacturers had failed, Belden was able to resolve the issues allowing the plant to become fully operational.

”

Wastewater processing plant operations require high service and availability from every aspect of the operational design.

Challenge

Wastewater processing plant operations require high service and availability from every aspect of the operational design. Therefore an 'always up' connection between the master and slave PLCs for power generation was required, and the network architecture design had interconnected switches deployed in a redundant ring. The benefit of this architecture is that it allows a redundant path to end devices in case of an intermediate link or node failure. However, by its inherent nature this architecture can also generate excessive broadcast traffic when connections are lost or transmission is incomplete.



Architecture for the water treatment plant's redundant ring using the GarrettCom Magnum 10RX Configurable Router and Security Appliance supporting UDP traffic, Modbus TCP and various types of serial connections.

Many PLCs are not able to handle high volume traffic, connection losses and heavy retransmission demands, and the system can therefore reboot unexpectedly, causing disruption and network

unreliability. The switches in the design needed to prevent this traffic from reaching the PLCs and help stabilise the network.

UDP and Broadcast storms

One of the mainstay communication protocols used within IP networks is the User Datagram Protocol (UDP). UDP combined with IP provides several modes of communication between end devices; such as Unicast, Multicast and Broadcast. Broadcast communications involve hosts or end-devices sending UDP datagrams to broadcast addresses so that all devices in the network see that message and can act upon it. One of the benefits of using a broadcast is that it reduces the overhead for an end-device seeking to learn the peer IP address. However, UDP has only minimal recovery services and in some cases devices may become overrun with the communications traffic. A broadcast storm can also be created when a host or end-device receives a broadcast UDP message and is unable to process it. Network communications become unreliable and the L2 switches in this plant's case didn't properly terminate the UDP transmissions, causing the storms to be able to reach the PLCs which were therefore intermittently rebooting.

Solution

Belden personnel proposed a revised architecture after examining many aspects of the wastewater treatment plant's network architecture and subnet mapping, placement and types of devices and capabilities, serial connections, etc. The weary plant team was welcomed into Belden's Fremont offices where the test lab could be utilised to validate the architecture using the high performance GarrettCom Magnum 10RX Configurable Router and Security Appliance. This device is highly configurable and has security capabilities built in. After preparations, the team had completed all the test cases within one day and immediately moved with the decision to replace all switches within the plant facility by the end of that same day. Following implementation they were able to then successfully bring all operations and services online without further broadcast storms and unreliable performance of their PLCs.

Research shows that much of our nation's critical infrastructure is ageing out and based on current requirements should have upgrades, replacements, or new facilities created to limit risk of service disruptions, increase public safety, and reduce the risk of cyber security weaknesses. What elephants are tough to ignore within your own industrial networks, endpoints and control systems?

Download the SANS 2016 State of ICS Security Survey [2] to see responses and concerns from global ICS professionals' responses to an in-depth survey by the highly regarded SANS Institute.

Deteriorating infrastructure, long known to be a public safety issue, has a cascading impact on our nation's economy, impacting business productivity, gross domestic product, employment, personal income, and international competitiveness. ASCE 2016 Report 'Failure to Act: The Impact of Infrastructure Investment on America's Economic Future'.

Planning and implementation teams need empowered stakeholders not only from IT and OT but also from business operations. Plans are living documents that need to be updated and expanded over the course of transition activities and must include:

- Comprehensive, detailed documentation of current IT and OT assets

ASCE	– American Society of Civil Engineers
HMI	– Human Machine Interface
ICS	– Industrial Control System
IT	– Information Technology
OT	– Operational Technology
PLC	– Programmable Logic Controller
SANS	– SysAdmin, Audit, Network, and Security
TCP	– Transmission Control Protocol
UDP	– User Datagram Protocol

Abbreviations/Acronyms

Wastewater Treatment Plant Use Case: Key Industrial Networking Requirements

- All control and monitoring activities must be seamlessly and securely connected to a central control HMI
- Processes must run 24 hours a day and 365 days a year without failure
- Networking equipment should be resistant to threats of possible network malfunction and malware intrusion
- Rugged physical product design
- Hardware redundancy protocol technology and integrated network security

- Comprehensive, detailed analysis of operations (with impact analysis of planned convergence changes)
 - Road map to the future state of the converged technological environment
 - Identification of skillset/resource shortages (gap analysis) and plans to address them
 - Overarching governance model establishing responsibilities, authority and top-level mandate for implementation of the strategy
 - Change-management plan
 - Coordination plan with existing asset management processes
- This requires the use of future-proof infrastructure components flexible enough to adapt to network changes or growth.

References

- [1] American Society of Civil Engineers (ASCE) and their report: Failure to Act – The economic impact of current investment trends in water and wastewater treatment infrastructure. http://www.asce.org/uploadedFiles/Issues_and_Advocacy/Our_Initiatives/Infrastructure/Content_Pieces/failure-to-act-water-wastewater-report.pdf
- [2] SANS 2016: State of ICS Security Survey. SANS Institute Reading Room.

- Systems and production equipment across a number of industries are in drastic need of replacement or upgrade.
- Think of the processes that must run 24 hours a day and 365 days a year without failing.
- We need to ask ourselves... what elephants lurk in our industrial critical infrastructure control rooms?



Katherine Brocklehurst is director of ICS cyber security segment line marketing for Belden's industrial cyber security division and has been involved in network and internet security product management and marketing since 1997. Katherine has also held senior positions at RSA, McAfee, IntruVert and Nokia's security division. She is a subject matter expert on security technologies and compliance policies in the U.S. Enquiries: Email Katherine.brocklehurst@belden.com

New contrast sensor

A new contrast sensor that combines product usability with high performance has been added to the Leuze sensing solution product line-up. Ideally suited to packaging processes, the innovative sensor will provide reliable detection in foil bag packaging machines as well as for label detection in filling systems.

Available from **Countapulse Controls**, the new Leuze KRT 18B contrast sensor is a flexible multi-colour device which uses the three LED colours of red, green and blue to automatically determine the colour that produces the maximum contrast with the detected mark.

A significant feature is that reliable detection is possible even on glossy surfaces or when marks are faded. This is due to the automatic sensitivity readjustment. Equipped with a high switching frequency of up to 22 kHz, shortened response times are possible when using the Leuze KRT 18B.

An alignment aid on the 13 mm focal point means the sensor can be easily aligned and rapidly put into operation.

Different models of the sensor are available for simple switching point adjustment and each incorporates a self-adjusting bar graph for optimal display of the signal quality. One variant of the Leuze KRT 18B has two teach buttons for calibration on background and mark, while another has a potentiometer and a colour selection button.

The device is housed in an ECOLAB tested housing that is rated to IP 67 and IP 69.

Enquiries: Gerry Bryant. Tel. +27 (0) 11 615 7556 or email bryant@countapulse.co.za



New M8 inductive sensors

At this year's SPS IPC Drives fair in Nuremberg, **Turck** presented its new range of M8 inductive proximity switches. The technology within these ferrite core sensors has been completely upgraded, increasing the switching distance by up to 50%. As a result, M8 devices for flush mounting

can now also be offered with an extended switching distance of 3 mm as well as with the conventional switching distance of 2 mm. The non-flush sensors are also available with a 3 or 5 mm switching distance. Thanks to the newly developed sensor electronics, Turck is also

able to produce devices with an ultra-short 15 mm housing length. The modular development approach for this device series has led to a broad range of variants that allows users to find the optimum M8 switch for their application, without any compromises. The sensors are available in 15, 22, 30 and 40 mm lengths. On the output side Turck is offering M12 or M8 connectors as well as devices with a cable outlet. Other variants are possible due to the choice between devices for flush or non-flush mounting with standard or extended switching distance. The sensors with a cable outlet are provided with a cable suitable for drag chain use, and a semi-transparent LED ring at the sensor end, which shows the switching state from any viewing angle.

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Stainless steel submersible pressure transmitter

The PS series submersible pressure transmitters are used for level measurement in containers, tanks, wells, flowing water, bore holes and wastewater plants. The accuracy of 0,5% and the long-term stability of 0,2% per year contribute to the reliable operation of the transmitter. All submersible pressure transmitters have a robust high-grade stainless steel housing. For standard applications the favourably priced PUR cable can be used. For applications where a high resistance to media is requested (e.g. slurry, oils or fuels) the FEP cable is available. The ATEX submersible pressure transmitters of the PS3xxA series are designed for level measurement

in areas subject to explosion. The sensors can be used in zone 0, 1, 2 as well as in mining. The GL approval allows an application in the maritime sector.

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SPS IPC Drives Expo

PROFIBUS and **PROFINET** International, the **ODVA** and the **FDT Group** were present again at the SPS IPC Drives Expo in Nuremberg. The international trade fair for electrical automation, systems and components took place from 22 – 24 November 2016 and encompassed the entire spectrum of automation technology. Endress+Hauser experts have been present on various user organisation stands. The umbrella organisation PROFIBUS and PROFINET International participated in the Expo. Endress+Hauser PROFIBUS and PROFINET devices as well as their integration into Siemens' systems

were on show on a newly designed demonstration wall. Additional highlights were the gateway Fieldgate SFG500 and FieldCare, Endress+Hauser's software tool for device configuration and plant asset management. Typical use cases, which demonstrate the advantages of digital communication, completed the presentation.

Endress+Hauser's growing EtherNet/IP device portfolio was demonstrated as a working application, cleaning in place (CIP), typical for the Food and Beverage and Life Sciences industries, which was showcased on the ODVA stand. A multi-vendor demon-

stration model impressively demonstrated how EtherNet/IP components could be seamlessly integrated into well-established systems.

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Weld nut sensor detects M5 nuts

Turck is adding variants with a Ø4 mm sensor probe to its range of weld nut sensors. This makes the detection of missing M5 nuts before welding even simpler. Turck has also improved the abrasion resistance of its weld nut sensors with optional titanium nitride coatings (TiN). As steel plates and nuts have to be placed onto these sensors before welding, they are exposed to a high degree of friction over their entire service life. The TiN coating offers protection against wear, scratches and accumulated welding spatter.

The sensors offer the user a favourable

and reliable way of checking the correct seating of weld nuts. The work piece and the weld nut required for welding are placed on the new sensor probe. Alternative ways of checking the presence of nuts using laser sensors or camera technology are considerably more complex and also more prone to faults. Unlike these alternatives, the weld nut sensors are easy to install and can be configured to detect the nuts with just a few button presses of the associated teach adapter. The weld nut sensors and pigtail cables are also weld resistant. In addition to the TiN-coated

variants, Turck is also still offering the weld nut sensors in conventional stainless steel or brass housings. The various designs are used to detect nuts with M5 to M20 threads.

Enquiries: RET Automation Controls. [Brandon Topham. Email brandon.topham@retautomation.com](mailto:brandon.topham@retautomation.com)



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ifm RFID systems are optimised for quality assurance and production control, e.g. for identifying tools or monitoring production steps. What used to be written in the documents accompanying the goods is now stored on electronic transponders.

The new DTE103 evaluation unit with EtherCAT – which is the fastest Ethernet technology with exceptional performance. The free network topology flexibly adapts to the plant structure. Switches and hubs are not required. This saves costs.

The devices can be exchanged during operation. This ensures a high plant uptime. The automatic address allocation simplifies set-up and device replacement. Specialist IT knowledge is not required.

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New servo range boosts machine productivity

The new 1S servo range from **Omron** offers optimised installation and set-up, with features to enhance machine productivity significantly. Designed specifically to meet the needs of today's machine builders, the range offers outstanding performance, complemented by space-saving compact construction. Power ratings range from 100 W to 3 kW.

Omron Country General Manager Victor Marques explains that all models incorporate a 23-bit high-resolution encoder as standard, and all have an exceptionally short 125 µs network cycle time. "These features allow users to achieve faster machine speeds, without impairing accuracy or repeatability," Marques stresses.

Controllers in the 1S range allow accurate profile generation, while the high-resolution encoders, in conjunction with enhanced loop control, ensure that profiles are followed accurately.

Compared with previous models, Omron's

new 1S range enable savings of up to 50% in setup and installation time. A software tool makes servo sizing fast and easy, while system configuration is handled quickly by NJ Project Autobuilder and the setup wizard for key parameters.

Further aids to rapid implementation are a patent-pending 'best effort' feature for quick stabilisation time, and an easy-tuning feature that performs smart gain searches in minutes.

Advanced safety functions are standard, with the 1S range supporting safety control via EtherCAT. The systems have fail-safe over EtherCAT (FSOE) safe torque off functionality which carries safety approvals PLd (EN ISO 13849-1) and SIL2 (IEC 61508). Also supported is

the hard-wired safe torque off functionality that meets the requirements of PLe (EN ISO 13849-1) and SIL3 (IEC 61508).

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Faster plant diagnostics, collaboration with zero friction

Rockwell Automation has introduced a new app, FactoryTalk TeamONE, for iOS and Android smartphones. As part of the company's expanded Information Solutions strategy to help employees make better decisions across their enterprise, the app seamlessly connects to the technology that manufacturers adopt during their digital transformation. The app boosts team productivity by enabling users to collaborate and share knowledge, view live production diagnostics, interact with machine alarms, and troubleshoot devices. Teams that use the FactoryTalkTeamONE app could drive a reduction in mean time to repair (MTTR).

By offering near-instantaneous incident and device data, plant floor, engineering and IT workers can collaborate as a team to quickly solve problems.

From their smartphone, employees can choose from the variety of modules with the FactoryTalkTeamONE app to directly view informa-

tion from devices, such as Allen-Bradley PowerFlex drives, or see the high-level health status of any EtherNet/IP device. This information is shareable across the app's collaboration and troubleshooting modules with other trusted team members.

"The FactoryTalkTeamONE app introduces a new, zero-friction-to-value paradigm where teams can download the app, form a team and use their knowledge alongside device data to drive productivity increases.

The app doesn't need teams to install servers, have pre-existing infrastructure like OPC servers, or connect automation assets and devices to the cloud in order to use the modules," said Christo Buys, Business Manager for Control Systems, Rockwell Automation sub-Saharan Africa

Enquiries: Christo Buys. Email cbuys@ra.rockwell.com



EtherCAT measurement technology modules

Extremely accurate, fast and robust



Beckhoff recently introduced a new device series for high-end measurement technology. The new EtherCAT measurement technology modules can be directly integrated into the modular EtherCAT communication system and combined with the extensive portfolio of more than 500 other EtherCAT Terminals. New metal housings optimise shielding and cooling in measurement technology applications. At the same time, the durable housings provide enhanced flexibility at the interface level, such as for LEMO or BNC plug connectors or for the established Push-In as a quickly customisable standard solution. Measurement accuracy of 100 ppm at 23°C, precise synchronisation of <math><1 \mu\text{s}</math>, and the high sampling rate of up to 50 000 samples per second guarantee high-quality data acquisition.

High-precision measurement technology reduces the use of raw materials and energy in machines and plants while forming the basis for condition monitoring and predictive maintenance. With the new EtherCAT measurement technology modules, high-end measuring devices and traditional automation technology can be combined into one universal system. For this purpose, Beckhoff offers the winning combination of a comprehensive I/O system that supports all common sensor types, and TwinCAT as a central software platform for engineering and control. The robust metal enclosures of the new measurement modules feature a flexible connector front-end for all standard measurement technology interfaces, and permit straightforward integration into all typical measurement technology environments. The new generation of measurement technology hardware

ensures extremely high-quality measurement data, owing to the full utilisation of EtherCAT features, among other reasons:

- **Fast:** Sampling rates of up to 50 000 samples per second, depending on the interface
- **Precision timing:** Precise synchronisation <math><1 \mu\text{s}</math>
- **Precision values:** Measurement accuracy of better than 100 ppm at 23°C
- **Proactive:** Integrated connection and functional diagnostics in individual modules

The new high-end measurement technology series complements the existing range of measurement terminals. The offering includes 11 modules with different interfaces and input circuitry. These can cover, for example, voltage measurement of 20 mV...30 V, current measurement of ± 20 mA, IEPE, thermocouples, RTD (PT100/1000), or strain gauge/load cells with full, half or quarter bridge with internal extension or potentiometer. The measuring ranges of the input channels can be flexibly parameterised, both electrically and on the software side. Additional properties include integrated distributed clocks as well as the 'ExtendedRange' feature, which provides users with the full technical measuring range, that is, up to 107% of the specified nominal measuring range can be achieved, depending on the measuring range in question. The EtherCAT measurement technology modules are optionally available with a factory calibration certificate. With new EtherCAT measurement technology modules, Beckhoff

charts the course for its next generation of high-precision I/Os for measurement applications. The analogue input modules in metal housings integrate high-end measurement technology directly into the standard I/O system.

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Complete Trolley Assist Solution

Karl van Rensburg, Siemens South Africa Rail Electrification

Open cast mining has always been an opportunity for operation of diesel-electric driven haul trucks, which are powered by a diesel-electric drive system consisting in principle of two electric drive motors, integrated through gears into the rear wheels of the trucks, an electric generator/alternator and a powerful diesel engine.

Trucks with electric drive systems can be fitted with a Trolley Assist System, while mechanical trucks cannot be operated on a Trolley system. The Siemens (referred to as the company) truck Trolley Assist system involves the substitution of the diesel fuel by cheaper more ecological electric energy.

Instead of generating electricity from the diesel engine and generator on the truck, the electric energy is supplied from a dedicated substation (E-House) and fed to the electric drive and motors of the truck via overhead feeder lines.

The overhead feeder wires (catenary) are fed from a transportable rectifier substation called an E-House while the transformers are installed on a base/skid. The modular design allows for ease of relocating the system as mine activities progresses over time.

The E-House and equipment are robust and designed to cope with rough environmental and operational conditions, which include the continuous varying load conditions of between zero and 150%, depending on the duty cycle of the trucks.

The company provides the complete Trolley Assist solution, from the design stage, static calculations, supply and delivery of material to installation and commissioning of the entire system. The Trolley system can be used for mine operations, which has high demands for mechanical stability, operating reliability, low maintenance cost and a high availability.

Trolley Assist has been utilised at mining sites around the world since the early 1980s.

South Africa is regarded as a world-leader in installed capacity of this technology – having recently celebrated the launch of the 4th generation Trolley Assist substation technology.

The 11 MW substation boasts an output of 1,8 kV of dc voltage and up to 10 000 A to ensure the running of haul trucks with a nominal gross vehicle weight of 550 000 kg and a payload of approximately 325 000 kg.

The substation can accommodate a duty cycle of running two fully loaded trucks continuously, and under overload conditions allows for three trucks for ten minutes or four trucks for one minute along the overhead feeder lines of approximately 850 m sections.

The substation is housed in a 6 m x 3,3 m x 3 m E-house that weighs approximately 8 500 kg, and includes the 1,8 kV dc switchgear, rectifiers, 33 kV ring main unit, cooling equipment, battery charger,

control panel and the Siprotec ac - Sitras Pro dc feeder protection devices.

The control and protection of the entire substation is automated with a PLC and distributed Input/Output units interfaced via an industry standard Profinet fieldbus which significantly reduces the number of interface cables between equipment and allowing for the effective control and monitoring of the substation and equipment via a touch panel or from a remote location.

Cooling of the E-House is provided by two inverter air conditioners, keeping the inside temperatures between 18°C to 22°C under all operating conditions.

Another breakthrough is that 90% of components in the E-House are entirely manufactured by this company, compared to past E-Houses that contained approximately 30% the company's components. Sourcing nearly all of the components from the company's portfolio, guarantees compliance with International standards, greater quality control and improved functionality.

A further major benefit when compared with the previous generation of E-Houses is the improved safety features, as a result of the modular design of the ac/dc switchgear and rectifier modules that prevent direct access to live high voltage components.

Correct switching sequences and dc feeder line test procedures can now be implemented with failsafe software procedures, doing away with mechanical interlock keys.

From humble beginnings

In its early days, Trolley Assist involved two single copper contact bars, one for each of the positive and negative supply feeds, and heavy duty current collecting poles. Electric power was provided to the overhead lines via a roadside rectifier substation rated at a maximum power output of 3 MW.

In these first generation traction substations for Trolley Assist, the traction substations were fed from the public network, (typically 3 phase 11 kV to 36 kVac) and converted to the 1 200 Vdc voltage required by the trucks, which were equipped with dc motors.

These substations were generally constructed in two parts (a transformer skid and E-House) for portability, making it easy to relocate them as mining operations developed. The equipment for the



substations was largely pre-installed when delivered to the mine. This results in a shorter installation and commissioning period.

In the second-generation Trolley Assist system, the substation power increased to 5 MW, supplied from a medium voltage transformer (11 kV or 33 kVac).

It also consisted of ac switchgear, rectifier, dc switchgear, parallel feeder contact lines for the positive and negative poles, and a pantograph with sensor system to guide the truck driver along the haul road.

With a Trolley dc voltage range between 1 200 – 1 600 Vdc, it was possible to power dump trucks with a payload of around 170 000 kg.

The third-generation substation technology gave rise to the demand for bigger trucks and the introduction of ac wheel motors. Output power increased to 10 MW with a nominal feeder voltage of 2 600 Vdc.

The change from dc wheel motors to ac wheel motors and the associated drive technology significantly reduces costs and increased availability due to less scheduled maintenance. The higher torque produced by the ac motors and drive system means that the trucks can accelerate faster and reach higher speeds when carrying heavier loads.

Faster and more sophisticated dc feeder protection relays were introduced to protect feeder lines against thermal overload and short circuit faults.

Logic control systems were introduced to allow the substations to be fully automated, with auto reclose dc feeder breakers which further reduced down time in the event of an external fault on the feeder lines.

Advantages of trolley assist

Normally the speed of a truck on a gradient is limited by diesel engine power. If the same truck could get more power by connecting to an overhead electric feeder line while travelling on an uphill gradient, it could sustain a higher speed. The diesel engine would be idling, and fuel consumption would be reduced by 95%, greatly reducing noise and emissions to the environment.

Billions of litres of diesel are consumed annually by the global mining industry, which is under severe pressure from weak commodity prices. Loaded haul trucks on uphill gradients typically accounts for 70 – 80% of a truck's total fuel consumption.

A Trolley Assist solution is installed on any uphill stretch between the loading area (pit) and offloading points (dump or process plant).

”

South Africa is a world leader in installed capacity of Trolley Assist technology.

With the inclusion of the electric drives, the electric power supplied to the wheel motors of the haulage trucks enables the vehicles to move faster uphill, which results in quicker turnaround times and higher productivity for the mining operation.

For example, if the duty cycle time is reduced by 20% as a result of the increase in speed on the uphill gradient, a fleet of 32 trucks on trolley can produce the same results as 40 trucks operating on diesel. This results in reduced capital costs if the study is done at the feasibility stage.

Engine operating and maintenance costs are directly linked to hours of operation of the haul trucks and using Trolley Assist on gradients reduces the cycle time of the haulage trucks, thus increasing the intervals between maintenance schedules.

The technology has been supplied to open cast mines in South Africa, Namibia, the DRC, Zambia and as far afield as North America. New business interest has come from mining companies in Botswana, DRC and Sweden.

The goal of mining corporations is always to reduce the cost per ton of the commodity produced over the life cycle of the assets, and the trend is clearly toward larger trucks, shorter cycle times with a leaner fleet and overall lower cost of ownership, all of which can be achieved by the benefits of a Trolley Assist solution.

Conclusion

This E-House concept is being promoted to the rail customers. Recently, a 5 MW, 3 kV dc containerised substation was commissioned in the Northern Cape. This E-House solution was designed to comply with the specifications of the rail customer.

The recent developments in the 11 MW dc E-House solution and the 5 MW, 3 kV dc solutions make it exportable to international markets.

- Trolley Assist has been used at mining sites around the world since the early 1980s.
- South Africa recently launched the 4th generation Trolley Assist substation technology.
- A major advantage of this Trolley Assist substation is its improved safety features.



Karl van Rensburg works in rail electrification at Siemens South Africa. Enquiries: Jennifer Naidoo. Email Jennifer.naidoo@siemens.com

Points to Consider to Ensure VSD Installations Meet IEEE 519

Glen Ward, ZEST WEG Group

This is an extensive subject and as such the points below are intended as an introduction to highlight relevant portions of the IEEE 519 [1] and to encourage further discussion and analysis.

Although the IEEE 519 [1] is not a mandatory standard, its recommendations are being used as a reference to specify the harmonic distortion limits allowed by the utility companies and in the design of industrial power systems.

ANSI/IEEE Standard 519 [1] was published in 1981. It recommended maximum levels of Total-Harmonic-Voltage-Distortion (THDV) at the point that the utility connects to different types of users (Point of Common Coupling (PCC) (see Figure 1a)). Different maximum levels were provided for different types of buildings (see Figure 1b).

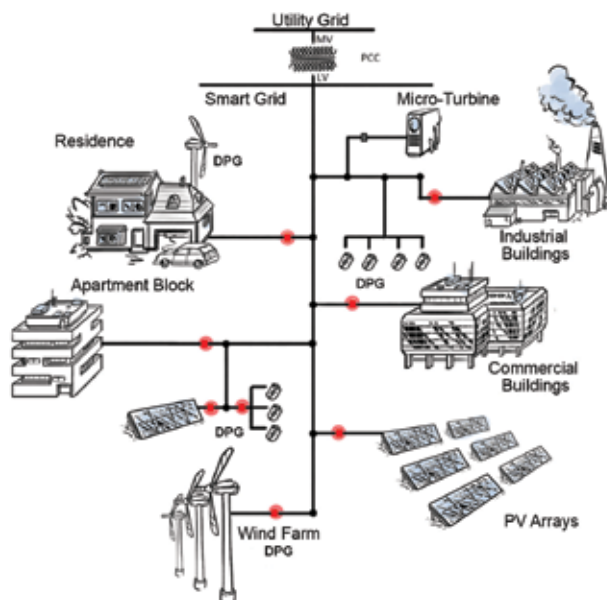


Figure 1a: PCC.

THDV Level	Applications
3%	Airports, Hospitals, Telecommunication Companies
THDV Level	General Applications
5%	Office Buildings, Schools
THDV Level	Dedicated Systems
10%	Factories

Figure 1b: THD levels.

IEEE 519 was revised in 1992 to provide recommendations on maximum allowable levels of harmonic current distortion (see Figure 2). The new standard also defined the maximum recommended contribution of individual current harmonic orders. The amount of allowable distortion is based on a ratio of the short circuit current available to the distribution system (I_{sc} – maximum short circuit current available at point of common coupling), and the maximum load current recognised by the distribution system (I_L – the maximum load current of user at the point of common coupling). The larger the user’s load in relation to the utility transformer supplying that user, the greater that user’s contribution to the overall harmonic distortion will be. Hence, stringency of the limits is increased with decreasing I_{sc}/I_L ratio.

I_{sc} / I_L	< 11	$11 \leq n < 17$	$17 \leq n < 35$	$23 \leq n < 35$	$35 \leq n$	TDD (%)
< 20	4	2	1,5	0,6	0,3	5
$20 < 50$	7	3,5	2,5	1	0,5	8
$50 < 100$	10	4,5	4	1,5	0,7	12
$100 < 1000$	12	5,5	5	2	1	15
> 1000	15	7	6	2,5	1,4	20

Figure 2:

- Maximum harmonic current distortion in percent of I_L
- I_{sc} - maximum short-circuit current at PCC
- I_L - maximum demand load current (fundamental frequency component) at PCC

Importantly PCC is the electrical connection point between the utility distribution system and the user's electrical distribution system. The distortion at the PCC can be evaluated by the current TDD and the voltage THD, as well as the individual order current harmonics according to the table.

Often, the limits defined in IEEE 519 [1] have been applied by engineers to individual equipment instead of the system as a whole, at the intended PCC. While this approach could well be effective, it is a misapplication of the standard and can result in unnecessary use of costly and energy consuming reactors, passive filters, multi-pulse drives and active filters. It is important to understand the intent and purpose of this standard and implement it accordingly. Modern reputable VSD products share a common build typology (VSD design)

AFE	– Active Front End
ANSI	– American National Standards Institute
AUHF	– Advanced Universal Harmonic Filter
EMI	– Electromagnetic Interference
IEEE	– Institute of Electrical and Electronics Engineers
IGBT	– Insulated Gate Bipolar Transistor
Isc	– Short Circuit Current
IL	– Load Current
LCL	– Inductor/Capacitor/Inductor
RFI	– Radio Frequency Interference
TDD	– Total Demand Distortion
THD	– Total Harmonic Distortion
THVD	– Total Harmonic Voltage Distortion
VFD	– Variable Frequency Drive
VSD	– Variable Speed Drive

Abbreviations/Acronyms

that, in turn, relates to a comparable harmonic output for any given size. Some manufacturers offer VSD products with built-in harmonic mitigation components in the form of inductors/reactors that will, in turn, further reduce output harmonics. For those that don't, external input reactance can be added to achieve similar results.

In many applications, a 6 pulse VSD rectifier with an external input reactor or one with internal reactors on the dc bus, will meet the IEEE 519 [1] recommendations perfectly. When this is not possible, some of the typical available solutions for the reduction in harmonic currents are to increase the number of rectifier pulses, using 12, 18 or 24 pulses, the use of Active Input Rectifiers (AFE Drives) or using standard 6 pulse VSDs in conjunction with specialised passive harmonic filters.

A variety of information is required to determine whether or not any form of harmonic mitigation is necessary to comply with a recommended level of distortion as defined by IEEE 519 [1]. This includes:

- The utility source short circuit power
- The total number of drives and their cumulative power must be defined (few small drives on a very large network will have very little effect)
- The total user demand load current (non-linear plus linear)

Using this information, an estimate of the current and voltage distortion can be made. More accurate calculations can be made if additional information is available such as existing harmonic distortion levels and cable lengths/sizes between the drives and the PCC.

As a rule of thumb, unless the drives constitute more than 30% of the load on the main distribution transformer from which they receive power, there is little need to be concerned about harmonics and standard 6 pulse drives should be sufficient.

If any doubt remains, however, a harmonic analysis of a given installation should be performed. Given all the required details, the majority of reputable suppliers will be able to assist with a theoretical study.

AFE drives versus alternative harmonic mitigation techniques

For new or existing VSD installations where harmonic requirements are stringent, engineers often opt for AFE drives, as these designs are commonly known to generate less harmonic content, without knowing that there are comparable alternative solutions available.

If an AFE supply is under consideration for the aim of purely reducing harmonic content, then the following should be considered.

VSD manufacturers often push AFE technology as the best solution for treatment of harmonics associated with VSDs. Benefits over standard 6 pulse VSDs equipped with diode bridge rectifiers such as reduced line current harmonics, improved power factor and inherent regenerative capabilities are often pointed out. But the fact that current harmonics are much higher when measured above the 50th harmonic and that very serious problems can result from the introduction of these higher frequency harmonics are often overlooked.

Over and above this, there is often a substantial loss in efficiency due to the increased losses in the input IGBTs.

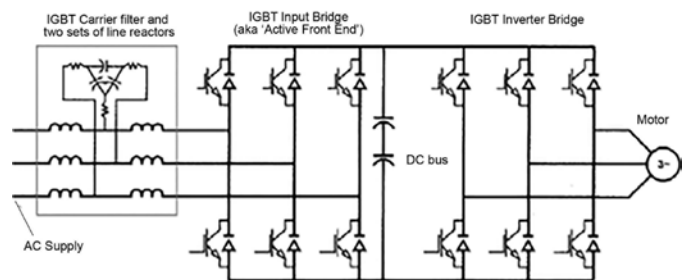


Figure 3: AFE drive topology with LCL filter.

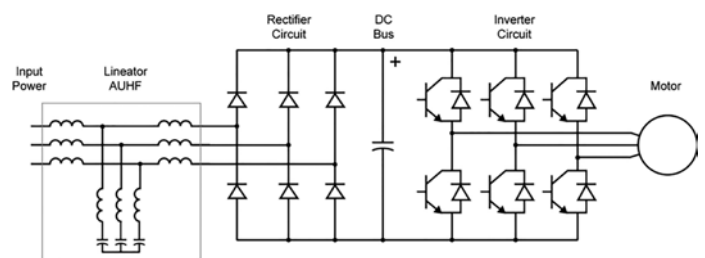


Figure 4: 6 Pulse drive topology with lineator AUHF.

The reality is:

- AFEs are not the best solution for a low harmonic VSD
- A properly designed Wide Spectrum Passive Filter, such as the Lineator AUHF, can outperform AFEs, especially when harmonics up to the 100th order are taken into consideration
- AFEs generate high frequency harmonics which can have more serious consequences than low frequency harmonics. As a passive device, a lineator AUHF cannot introduce high frequency



The criteria for each application must be taken on merit in consultation with the VSD manufacturer.

harmonics and will, in fact, help reduce them when they are present

- If there is a mixture of 6 pulse and AFE drives on the same switchboard, the ripple in voltage from the AFE drive can raise the dc bus voltage in the 6 pulse VFDs creating overvoltage conditions
- Although an active solution, AFEs still require input passive filters (LCL and EMI/RFI filters) to control switching frequency harmonics and to attenuate ripple in the mains side voltage and current
- LCL and EMI/RFI filters are more likely to resonate with the power system at rectifier harmonic frequencies (ie. 5th, 7th, 11th, etc.) than the Lineator AUHF. Also under lightly loaded conditions, the reactive power of the LCL capacitors can cause over-excitation of generators
- AFEs generate significant levels of ground leakage current which can cause inadvertent ground fault trips and failure of sensitive equipment
- AFE losses are significantly higher and efficiencies much lower than a 6 pulse VFD with Lineator AUHF



Type	VSD Rating (KW)	VSD Losses (KW)	AUHF Losses (KW)	Total Losses (KW)	Efficiency	Difference
AFE Drive 6-P with Lineator	75	4,4		4,1	94,80%	
		1,9	0,8	2,7	96,50%	1,70%
AFE Drive 6-P with Lineator 20 < 50	400	20		20	95,20%	
		9,1	3,6	12,7	96,90%	1,70%

Figure 5: Efficiency comparison – AFE vs 6-P VSD with lineator.

Conclusion

In conclusion, the criteria for each application need to be taken on its own merit, in conjunction with the VSD manufacturer, in order to ensure the correct product supply for your requirements.

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[1] IEEE 519: 1992. Recommended practice and requirements for harmonic control in electric power systems. (ANSI/IEEE Standard 519 – Guide for harmonic control and reactive compensation of static power converters – first published in 1981).

- IEEE 519 was published in 1981.
- IEEE 519 is not a mandatory standard but rather a reference to specify harmonic distortion limits.
- IEEE 519 was revised in 1992 to provide recommendations on maximum allowable levels of harmonic current distortion.



Glen Ward was born in South Africa in 1972. Glen has more than 20 years’ experience with VSDs and associated products. He completed an N6 diploma and T4 between 1993 and 1995. Thereafter he worked for various contract electronics companies that operated in the industrial motion control sector (Variable speed drives). In 2004 Glen joined Zest Electric Motors as a sales engineer to support the WEG range of automation products. In 2009 he was promoted to Drives and Automation manager in the KZN region where he has remained until present. His main area of interest has been to investigate and highlight areas of efficiency improvement. Enquiries: Kirsten Larkan. Tel. +27 (0) 11 723 6000 or email marketing@zestweg.com

High-performance, portable oscilloscopes

Fluke, represented locally by the **Comtest Group**, has on offer the high-performance portable oscilloscopes with two or four independently insulated input channels, an IP51 dust and drip waterproof rating and a CAT III 1000V/CAT IV 600V safety rating. Users can choose from 500 MHz, 200 MHz, 100 MHz or 60 MHz bandwidth models. Especially designed for plant maintenance engineers, there is a choice of either a 2- or 4- channel scope for the harsh conditions or industrial electronics. A 5 000 count digital multimeter (DMM) is included in the 2- channel models. The 190 Series II has up to four independent floating isolated inputs, up to 1 000V and a real time sampling of up to 5 GS/s (depending on model and channels used). Frequency spectrum using FFT-analysis and automatic capture and REPLAY of 100 screens, as well as a deep memory of 10 000 points per trace waveform capture (scope mode), are all features of this new generation oscilloscope. THE 190 Series II has an impressive seven hours of battery operation using BP291, as well as an 'easy access' battery door for quick battery swaps in the field. The isolated USB host port allows for direct data storage to a USB memory device. The 190 Series II is compact, weighing in at only 2,2 kg, and features a security slot, locking the oscilloscope down with Kensington lock while unattended.



Enquiries: Tel. +27 (0) 10 595 1821. Visit www.comtest.co.za

Repairs in no time at all

Paul Clark has been appointed head of **SEW EURODRIVE's** Repair Service Centre. Clark explains that all units that can be repaired are passed onto the Repair Service Centre, or the Sales Department if a quotation is required for a new replacement unit. In addition, any equipment that breaks down or requires attention on-site is attended to by the Field Service Department. Effective and efficient repairs are an integral part of the OEM's Zero Defects drive, with Clark also having given significant input on the assembly line at the Johannesburg manufacturing facility.

The Repair Service Centre is flexible enough in that it can turn a repair around in a single afternoon, if required. They have to be very responsive, especially if you take into account an important client such as a brewery or manufacturing plant,

where any downtime has a major impact on total production and the bottom line.

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- 12 MV Drive
- 13 Automation Control Room
- 14 Invicta Vibrator Motors
- 15 Diesel Generator
- 16 Electrical Construction
- 17 LV Motors & Drives

The Zest WEG Group, a subsidiary of leading Brazilian motor and controls manufacturer WEG, started out as a South African company and maintains its strong commitment to contributing to the development of the African region.

The Zest WEG Group has been servicing the mining sector for more than 35 years and by leveraging best practice engineering and manufacturing capabilities, the group is able to offer a range of standard off-the-shelf products as well as end-to-end energy solutions.

An in-depth understanding of the harsh conditions found within the mining sector and years of experience on the African continent, have ensured that the Zest WEG Group service offering is fit-for-purpose.

From single product installations to individually customised solutions, which are application specific, the latest technology is used to ensure optimum performance and reliability without compromising on energy efficiency.

WEG products are engineered to facilitate a safe and reliable mine and plant with operational stability and the highest possible production levels as an objective. Reduced maintenance and ease of serviceability assist in lowering the total cost of ownership for the mine.

Supporting customers is key and the Zest WEG Group operates a strategically situated network of branches and distributors across the continent. This ensures the highest levels of technical support as well as easy access to product and parts.



SCAN HERE for more about our offerings in the mining sector



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Excellence in refurbishment of critical electrical rotating machinery

A recent project undertaken by **Marthinusen & Coutts**, a division of ACTOM, was the rewind and refurbishment of three gearless mill drive rotor poles for a platinum mine in the North West Province. The enormous 17,5 MW 4 220 V 2 531 A 12 r/min 5,8 Hz grinding mill motors, that are 15 metres in diameter, are driven by cycloconverters which supply the motors with a variable

frequency to control their torque and also allow the speed to be controlled for optimum metallurgical processing.

Rob Melaia, engineering and technical executive at Marthinusen & Coutts, said: "The rotor poles were subjected to overheating due to an operational error, and we were approached by the mine to assist," Melaia says. "While this contract could be seen as a simple procedure, we believe it is the immediate access to a large local service provider with OEM capabilities and back-up that led the customer to award the contract to Marthinusen & Coutts instead of to the international OEM."

The removal of the poles required a two day shutdown during which time Marthinusen & Coutts assisted the mine maintenance personnel with this task. The poles were delivered to Marthinusen & Coutts' Cleveland facility where thorough investigative work was undertaken on the defective poles to determine the extent of the damage caused by the overheating.

"The second part of this activity was to investigate the best method to improve and partially rectify the surface insulation of the remaining poles of which there are 60 in total," adds David Motloung, design engineer at Marthinusen & Coutts.

Marthinusen & Coutts made use of a two part epoxy spray treatment and repeated insulation resistance tests under extremely wet coil conditions.

David Motloung said that this was to simulate the worst case conditions on site with the ultimate purpose of evaluating a method devised by Marthinusen & Coutts to improve the insulation of the remaining poles still fitted to the machine. "This solution can be implemented in-situ negating the need to remove the poles to improve the insulation," he explains.

Motloung says that after studying the design of the pole coil it was decided to use a different conductor for the rewind as this would increase the insulation integrity.

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Marthinusen & Coutts' rotating machines design engineer, David Motloung, records photographic evidence of tests on one of the enormous gearless mill drive rotor poles recently refurbished by the company.

Local company powers Mozambican graphite mine

The remote operation to mine one of the world's largest finds of high grade graphite – the Balama deposit in Mozambique – will be powered by a generator plant being constructed through South Africa-based Zest Energy, part of the **Zest WEG Group**.

According to Alastair Gerrard, managing director of Zest Energy, the plant will begin producing electricity during the first quarter of 2017, with an initial capacity of 12,5 MW from an installation of seven 2 200 kW diesel generators.

"The isolated location of the Balama mine – over 250 km west of Pemba in northern Mozambique – means that while the operation does have access to power from the national grid this will need to be supplemented to ensure an adequate supply for full plant demand," Gerrard says. "We are therefore required by the customer to ensure 100% availability, and have consequently designed the plant with substantial standby capacity to allow for maintenance and repairs without affecting the continuous supply."

He says the plant, which was the largest footprint project yet tackled by Zest Energy, would initially run with seven 2 200 kW generators; six running and one on standby, and would later be expanded to include eleven generators, of which two will be standby units. Equipment for the extensive scope of supply has been sourced from

various companies within the Zest WEG Group, locally and worldwide. The containerised power generators include WEG alternators with automatic voltage regulation systems, as well as motorised louvres, generator auxiliary systems, and fuel and lube tanks.

To cool the engines, a horizontal-type radiator system, rated for 50°C ambient temperature, was manufactured in South Africa and each radiator includes 10 WEG 3 W fan motors positioned in two cooling banks of five fans each.

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Latest-technology assembly cells for geared motors

SEW-EURODRIVE Cape Town has invested in new assembly cells for geared motors to speed up production, increase quality and reduce wastage. As part of its ongoing development, the branch also plans a new assembly cell for electronics in the near future.

"We have definitely started to do more business on the electronics side, especially in terms of servo motors and mechatronic units, which combine electronics with mechanical gearing," comments Branch Manager Byron Griffiths.

He explains that the assembly-cell development embarked upon by the Cape Town branch will increase its flexibility and capability to deliver total solutions for clients. It will also assist in reducing stockholding, as a lot of components are interchangeable, as opposed to having to keep one item in stock in every available size and configuration.

Cape Town is a significant production hub for SEW-EURODRIVE, as it assembles units for other branches, including Nelspruit, Durban, Johannesburg, and Port Elizabeth. In addition, specific sizes and ranges are only assembled in Cape Town, and distributed to other branches when needed. "For example, a smaller location such as Port Elizabeth will rely on us for its production, from servo motors to geared motors," Griffiths points out.

He adds that the Western Cape market in particular is showing growth in terms of both volumes and turnover. "The market is definitely on the uptick compared to last year. We are doing surprisingly well, despite the prevailing tough market conditions."

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Integrated drive system for open cooling circuits

Based on its IDS concept, **Siemens** is now offering an environmentally friendly integrated drive system for open circuits comprising Simotics FD motors and water-cooled Sinamics S120 converters. Using an integrated cooling concept, the new system turns available service water into cooling water for the drive system, enabling a joint open cooling circuit for the plant, motor and converter. The joint cooling circuit allows the recooling module for the converter to be dispensed with, significantly reducing the amount of space required and providing improved economic and energy efficiency.

Water cooling is a highly effective method of dissipating heat generated by the motor and converter, and is particularly vital in the process industry. With its water-cooled drive system, Siemens is providing an efficient overall concept which makes minimal demands on the quality of the water. This means that any kind of available water, from service water customarily occurring in industry through to treated river water, can be used for drive system cooling. Because the overall system is resistant to oxygen enrichment of the cooling water, it is also able to prevent unwanted oxidation. Dispensing with additives in the cooling water not only lessens the environmental impact of the drive system but also guarantees simpler commissioning and maintenance.

Enquiries: Email Stefan.Rauscher@siemens.com or jennifer.naidoo@siemens.com



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Testing exciter gearboxes at full load

Assuring customers of the quality and reliability of **Kwatani's** locally manufactured exciter gearboxes means testing them at full load before they leave the company's workshop. This is according to Kenny Mayhew-Ridgers, general manager engineering at Kwatani.

"As the designer and manufacturer of these products we want to be sure there are no issues with the running temperatures, oil cooling and noise emissions," Mayhew-Ridgers says. "The only way to do that confidently is by applying the load that the machine will be subject to during its lifespan on site."

It is vital that movement in the gearbox is finely synchronised to ensure uniform linear excitation, this is a primary advantage of an exciter gearbox over the alternative of unbalanced motors – which exert

torsional loads on the drive beam of the screen through unbalanced motion before they reach the point of self-synchronisation.

"Our largest exciter can displace 20 tonnes with 10 mm movement – so this needs a strong, heavy frame," he says. "We designed a full-scale test rig so the gearbox can endure a full load on its bearings, and it must withstand this without generating undue noise or heat."

To ensure that the vibrations do not carry into the Kwatani's test building, the rig is placed on a secure sub-frame to dampen the movement and dynamics to the floor.

"We put the rig at an angle, because it is important to test the oil flow in the position in which the unit is going to be used – to make sure there are no oil leaks," he says.

Enquiries: Kim Schoepflin. Tel. +27 (0) 11 923 9000 or visit www.kwatani.co.za



Electric Motors Certification

Mpumalanga-based armature winding specialist, **Mokse Engineering Enterprises cc**, has earned SKF's highly respected Rebuilder: Electric Motors Certification following a stringent audit in September 2016. Mokse Engineering is an approved rebuilder and supplier of leading electric motor brands up to 450 kW. The company is also a CX 0719 certified flameproof rebuilder and its 600 sqm cutting-edge facility is equipped to carry out repairs on pumps, fans, welding machines and generators. After taking over the business from his father, Gorst Hubball in 1994, Managing Member, Christopher Hubball and his team ensure that they uphold the solid values and steadfast commitment to quality that has moulded the foundation of this family-owned company since its founding in 1989. "We continue my father's legacy: If you do something, do it properly." "Quality remains our primary goal when carrying out our core business of repairing and supplying electrical equipment," states Christopher. "We successfully combine old school values with modern technology which ensures quality in our products, procedures and customer service."

Enquiries: Samantha Joubert. Tel: +27 (0) 11 821 or email Samantha.joubert@skf.com



Mokse Engineering, proud recipient of SKF Rebuilder, Electric Motors Certification FLTR, Anton Theunissen, SKF, with Shelley Hubball, Mokse, Reinhardt Joubert, SKF, and Christopher Hubball, Mokse.

Frequency converter range – economical solution

Tectra Automation has added two more products to its Bosch Rexroth frequency converters range. The EFC 3610 and the EFC 5610 provide industrial end users with even more options in how they can implement demand-oriented motor use, both in a simple and economical package for the power range 400W to 90 kW. Scalable and flexible in performance and functionality, these drives can be integrated into a wide range of automation environments with simple commissioning, integrated PID control, open interfaces and various I/O and fieldbus option modules.

"With their multi-Ethernet interfaces, the new EFC drives afford maximum connectivity to automation networks, supporting Sercos, PROFINET, EtherCAT, EtherNet/IP and Modbus/TCP," explains Georg Venter, Divisional Manager, Electric Drives and Controls, Tectra Automation.

Another key feature of the EFC drives is their simple programming through intelligent yet user-friendly software, allowing remote starting and operation. "It's very easy to specify converter speeds, control start and stopping as well as adjust the drive parameters," Venter continues.

"Parameters can be saved and stored to ensure reliable archiving." In addition to the freely definable V/f operation, The EFC 5610 also offers vector control for an optimal torque curve. In heavy duty mode, the overload capacity can be maintained at up to 150% for 60 seconds.

Enquiries: Georg Venter. Tel. +27 (0) 11 974 9400 or email georg.venter@tectra.co.za



Optimised design minimises vibrations and noise

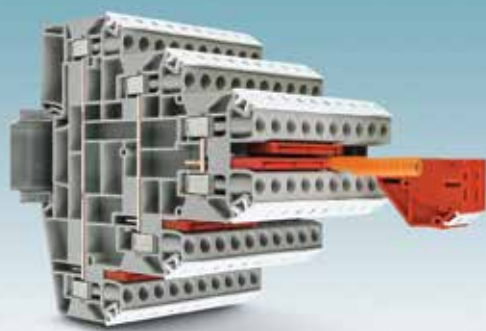
With its new high-voltage motor series Simotics HV HP, **Siemens** is now able to cover an extended power range of up to 70 MW. Its flexible modular concept makes this series ideal for precisely tailored solutions in all kinds of industrial applications in the high power range. The new series benefits from short delivery periods and helps minimise the work involved in planning and engineering, speeding up project completion and bringing forward overall plant commissioning. These high-voltage motors can be used for a wide range of applications in fields as diverse as ship building, power plant technology, and the oil, gas, metal and fibre industries.

The reduced planning and engineering input required is due to integration into the

Siemens standard tools which now permit simple, rapid selection and configuration up to 70 MW. The design is implemented using Siemens PLM software, which allows data generated to also be used for plant planning. The use of standardised interfaces and the simple, compact concept make for easier plant integration. In terms of its structure, the system benefits from an optimised base frame which not only reduces noise and vibrations to a minimum but also makes the motor exceptionally robust and able to cope with extreme ambient conditions, helping to maximise the availability of the overall plant. Overall availability also benefits from integration into condition monitoring systems, a service-friendly design and simplified spare part procure-

ment due to a high degree of component standardisation.

Enquiries: Email
Stefan.Rauscher@siemens.com or
jennifer.naidoo@siemens.com



Space-saving wiring up to 10 mm²

Wire conductors up to 10 mm² in a confined space with the new UT 6-3L three-level terminal block. Thanks to the function shaft on each level, up to three potentials can be distributed in one terminal housing.

The conductors are connected using the maintenance-free screw connection principle from **Phoenix Contact**.

All terminal points can be marked individually, thereby ensuring very clear arrangement of the wired terminal strip. Power ratings of up to 1 000 V and 50 A can be wired with the new three-level terminal block.

Since this terminal block also has all the system features of the CLIPLINE complete terminal block system, standard system accessories can be used. This reduces the logistics costs for the user.

Enquiries: Bruce Patton.
Email brucep@phoenixcontact.co.za

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Surge and Fire Protection

Arresters with SCI Technology for dc Circuits

Kirk Risch, DEHN Africa

With energy needs on a global scale steadily increasing, the future belongs to renewable energy sources.

Wind, water, biomass and the sun are viable alternatives to the dwindling reserves of fossil fuels and complex gas production. Photovoltaics (PVs), in particular, offer huge growth potential for the production of electricity. The increasing popularity of this type of system, both roof- and ground-mounted, is set to continue into the longer term. Each PV system must be maintained to ensure continuous yield and also requires special lightning, fire and surge protection, especially on the direct current (dc) side, in order to prevent failure and ensure a longer lifespan.

Electrical arcing that may occur over high-voltage dc lines is the main cause of solar PV fires. This can occur any time if there is a compromise of the wiring or connection of the electrical system. As a result, the risk of arcs increases over time. And while this can be attributed to the normal 'wear and tear' that a solar PV system is subjected to, it places a significant emphasis on the importance of system maintenance. In line with this sentiment, the EN 50539-11 [1] test standard requires the short-circuit current rating I_{SCP} on the surge protective devices that are used in PV systems to be regularly tested, in order to ensure that the maximum dc short-circuit current of the PV system does not exceed the typical I_{SCP} value of the arrester.

DEHN is the only company worldwide to provide surge arresters that include innovative Short-Circuit Interruption (SCI) technology. This patented technology provides maximum safety and is key to fire prevention. The specifically dimensioned fuse integrated into the short-circuit path ensures the safe disconnection of short-circuit

currents in case of an overload at any time. Moreover, the interaction of the SCI technology and the Y circuit ensures reliable surge protection for maximum operational reliability and fail-safe performance. Surge arresters with SCI technology can also: save extra back-up fuses up to the I_{SCP} value; fulfil customer needs and international standards for surge protective devices; provide excellent surge and fire protection; and offer permanent active protection.

Requirements on arresters used in PV systems depending on the time

The main function of the fuses present within PV systems with central inverters is to protect against return currents. The maximum available current depends on the actual radiation - depending on the time of day and the operation state, these fuses only trip after some minutes. Furthermore, SPDs positioned in generator junction boxes should be dimensioned for the possible total current (operating current and return current) and must be independently disconnected in case of an overload without arc formation.

The selection of surge arresters for PV systems

Roof-mounted and ground-mounted PV systems are equipped with string or central inverters. When correctly dimensioned, surge protective devices provide the combination of surge-, personal- and fire protection all within a single device.

When selecting dc arresters, it is essential to consider the following criteria:

- Place of installation and distance from terminal equipment
- Surge Protection Devices (SPDs) class: type 1 or type 2

”

Photovoltaics (PVs) are among the fastest growing 'green energy' technologies.

MPP	– Message Posting Protocol
PV	– Photovoltaic
SCI	– Short-Circuit Interruption
SPD	– Surge Protection Device

Abbreviations/Acronyms

- Earthing of live conductors
- Maximum short-circuit current I_{SCP}

The short-circuit current is extremely important due to the special characteristic of the dc voltage sources within the PV system. The important thing to consider when selecting an arrester, is to ensure that the maximum dc short-circuit current of the PV system does not exceed the short-circuit current rating of the arrester.

According to the EN 50539-11 [1] standard the short-circuit current rating for the SPD (I_{SCP} value) must be greater than the maximum short-circuit current of the PV system: $I_{SCP} > I_{max}$ PV system. String inverters are used for all PV systems, ranging from small rooftop systems all the way through to large solar parks in the multi-megawatt range. Installation devices for protecting the dc side against surges (at least type 2 arresters) are required for each MPP input. They are either connected upstream of the inverters in generator junction boxes or they are already integrated in the string inverters. Dc short-circuit currents typically do not exceed 100 A.

Central inverters with frequent ratings of 1 MW are mainly used in solar parks. The dc lines from the field are routed in parallel to a common busbar, a system of electrical conductors in a generating or receiving station on which power is concentrated for distribution. This is where several hundred amperes of direct current accumulate. Overvoltage pulses from the entire area are centrally collected on the busbar. Correctly dimensioned surge protective devices will protect the input circuits from damage and increase the life span and availability of the inverter. The generator junction boxes used for these systems are interconnected parallel to one other through the central inverter. Then, the return currents must safely be discharged even if a surge arrester is overloaded. The resulting short-circuit current must not exceed the short-circuit current rating I_{SCP} of the arrester.

Maximum safety and fire protection


SCI is created for surge arresters with a three-step dc switching device. SPDs have an integrated disconnecter that isolates in case of overload. In order to prevent the formation of an internal arc, the disconnecter is combined with a bypass path. In the case of an overload, the disconnecter is then activated and any arc will be quenched on the low-resistance bypass path. The integrated fuse interrupts the flow of current and a safe electrical isolation of the arrester is achieved.

SCI arresters provide protection in case of an overload due to the combination of both disconnecting and short-circuiting devices, making it an effective surge protection system that meets the highest requirements to personal and fire protection

Switching phases

If the disconnecter device is activated:

- The PV system's current changes over to the bypass current path of the arrester
- Arising arcs will be directly quenched
- The fuse integrated in the bypass interrupts the dc current flow.



take note

- Electrical arcing over HV dc lines is the main cause of solar PV fires.
- This company is the only company worldwide to provide surge arresters that include Short-Circuit Interruption (SCI) technology.
- This patented technology provides maximum safety and is key to fire prevention.

Conclusion

The arresters with SCI technology protect photovoltaic systems all over the world, across all continents and under very different climatic conditions. The arresters with SCI technology are internationally approved as they withstand extreme climatic conditions and thus can be used in any climate zone.

Reference

- [1] EN 50539-11: 2013+A1:2014. Low-voltage surge protective devices. Surge Protective Devices (SPDs) for specific application including dc requirements and tests for SPDs in photovoltaic applications.



Kirk Risch joined the South African Air Force in 1988 as an apprentice, learning trade skills in radar technologies and electronics. In 2010, Kirk joined Webb Industries, a specialist ancillary telecommunications company, becoming its lightning and surge protection expert. He joined DEHN Africa as sales and marketing manager in 2013, becoming sales and marketing director the following year. Enquiries: Email kirk.risch@dehn-africa.com

Lightning Protection for Rooftop PV Plants

Trevor Manas, Pontins

Based upon the fact that self-generated electricity is cheaper and provides a high degree of independence from the electrical grid, PV systems are fast becoming an integral part of many electrical installations. Many of these systems are located and installed in exposed places such as rooftops, these PV systems will therefore be subjected to all weather conditions (including lightning) for decades.

The cables of PV systems frequently enter the building and extend over long distances until they reach the electrical connection point. Lightning discharges cause field-based and conducted electrical interference and this effect increases in relation to cable lengths or conductor loops. Surges do not only cause damage to PV systems but can also cause damage to the other internal devices inside the building. Most importantly, production facilities can easily be damaged causing production to come to a halt.

Need for rooftop lightning protection

The energy released by a lightning discharge is one of the most frequent causes of fire, therefore the protection of personal and the prevention of fire is of paramount importance in the case of a direct lightning strike to the building.

At the design stage of a PV system, the building should be assessed to determine whether or not a lightning protection system is installed to the building or for new structures whether lightning protection is required. The necessity of lightning protection for the

installation of PV systems must be distinguished between an installation on a building without lightning protection and buildings or structures that are or have to be equipped with a permanently effective lightning protection system.

The installation of PV modules on buildings does not increase the risk of a lightning strike. The necessity for lightning protection cannot be derived directly from the mere existence of a PV system. There may however be an increased danger for the electric facilities of the building in the event of a lightning strike. This is based on the fact that, due to the wiring of the PV lines inside the building in existing risers and cable runs, strong conducted and radiated interferences may result from lightning currents. Therefore, it is necessary, to estimate the risk by lightning strikes according to SANS/ IEC 62305-2 [1], and to take the results from this into account for the LPS design.

Measures to protect the sensitive electronic system components from failure due to lightning flashes and surges are therefore absolutely necessary. The system concept of competent installers of PV Systems should include and take into account the expenditures for lightning and surge protection from the start.

Surge protection for PV systems

Causes for surges in PV systems are inductive or capacitive voltages deriving from lightning discharges and switching operations in the upstream ac system. Lightning surges in the PV system can damage PV modules and inverters. This can have serious consequences for the operation of these systems, high repair costs, for example, those of the inverter, have a negative effect, and, secondly, the system failure can result in considerable power cuts for the operator of the structure.



IEC	– International Electrotechnical Commission
LPS	– Lightning Protection System
PV	– Photovoltaic
SANS	– South African National Standard

Abbreviations/Acronyms

Surge Protection Devices (SPDs) installed to protect the ac, dc and data systems have proven to be very effective in protecting these electrical systems from destructive overvoltages and surge currents.

Whether the structure and PV system requires a structural lightning protection system or not, the installation of a coordinated surge protection system for the PV installation is imperative. The type and placement of the coordinated surge protection system is dependent on the following factors:

- Structures without an existing structural lightning protection system
- Structures with an existing structural lightning protection system

According to Supplement 5 of IEC 62305-3 [2], even if a building is not equipped with a structural lightning protection system surge protection devices must be installed to rooftop PV systems.

Cable routing of PV systems

Cables must be routed in such a way that large conductor loops are avoided. This must be observed when combining dc circuits to form a string and when interconnecting several strings. Care should also be taken with the routing of data and sensor lines. The prevention of creating large conductor loops must also be observed when connecting the inverters to the electrical grid.

In order to prevent the creation of large conductor loops all power cables (ac and dc) and data lines must be routed together with the equipotential bonding conductors along their entire route.

Earthing and equipotential bonding of PV systems

PV modules are typically mounted on metallic mounting systems, the earthing or equipotential bonding of these metal frames into the lightning protection system or the electrical earthing system (structure without LPS) will ensure the correct bonding and earthing of the PV modules. The way that this equipotential bonding is carried out is dependent on whether or not the structure has a structural LPS and if the separation distances can be maintained.

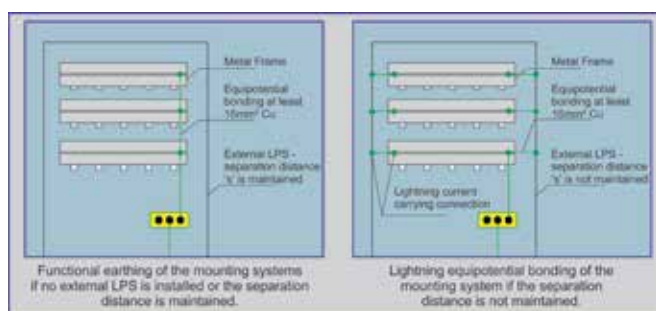


Figure 1: Equipotential bonding of PV systems.

Separation distance(s) as per SANS 62305-3 [2]

A certain separation distance(s) must be maintained between a lightning protection system and a PV system. The separation distance is

the minimum distance required to avoid uncontrolled flashovers to adjacent conductive elements as a result of a direct lightning strike to the lightning protection system. In a worst case the uncontrolled flashover can cause a fire and therefore the separation distance concept should be implemented wherever possible.

The separation distance must be calculated in accordance with SANS 62305-3 [2], the use of HVI conductors is an acceptable method of ensuring separation distances in cases where physical separation of not possible. Where ever possible the correct separation distances between the PV panels and their conductive elements to the structural LPS should be calculated and maintained.

Core shadows on PV panels

The distance between the PV panels and the external lightning protection system is absolutely essential to prevent excessive shading. Diffuse shadows cast by, for example overhead lines, do not significantly affect the PV panels or their yield. Core shadows that cast a dark, clearly outlined shadow will negatively affect the PV panels in such a way that they influence the current flowing through the PV panel.

For this reason, lightning protection air termination masts should be installed as far as possible on the South side of the PV panels (Southern Hemisphere) and the distance of the North side air termination masts should be calculated and maintained so as not to negatively affect the performance of the PV system.

For example, for a 10 mm diameter air termination mast the minimum distance away from a PV panel should be 1,08 m so that only the diffuse shadow is cast onto the PV panel.

Application examples

The protection of rooftop PV systems from lightning is imperative and the decision on what type of lightning protection system will be applicable to the PV system depends on the following parameters:

New structures

For new structures, it is mandatory to carry out a lightning protection risk assessment in accordance with SANS 62305-2 [1]. Once the risk assessments have been conducted, then the appropriate lightning protection level will be selected and the lightning protection system in accordance with the selected lightning protection level installed to protect both the structure and the rooftop PV system.

Existing structures

Existing structures must be assessed and an appropriate lightning protection system for the rooftop PV system be designed and installed based upon the following variables:

- Structures without an existing lightning protection system
- Structures with an existing lightning protection system where adequate separation distances can be achieved
- Structures with an existing lightning protection system where insufficient separation distances are present

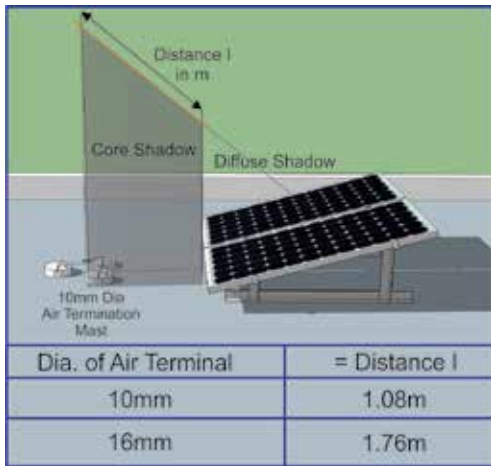


Figure 2: Core shadows on PV panels.

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Photovoltaic systems are booming (and beaming) throughout South Africa.

the lightning protection design for the rooftop PV system should be performed by a lightning protection specialist. The lightning protection system shall be installed in such a way that the PV panels are not vulnerable to direct lightning strikes. The method of protection of the rooftop PV system is via the air termination system with the

preferred protection methods being either the angle of protection method or the rolling sphere method of protection. The size of the sphere and the size of the angle of protection are both dependent on the applicable lightning protection level. If possible, an isolated lightning protection system should be installed where the calculated separation distances are maintained. Isolated lightning protection systems are far more effective than non-isolated LPSs.

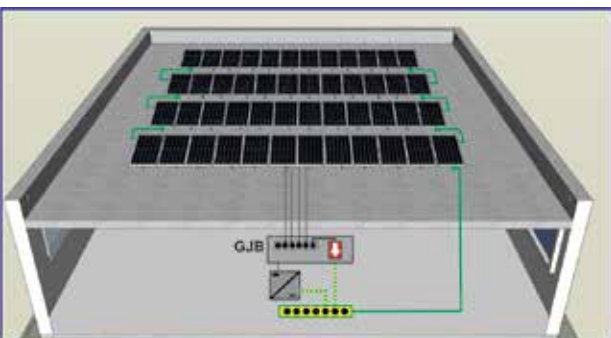
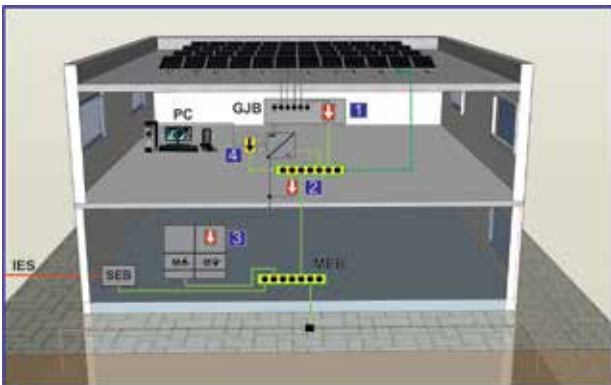
If the installation of an isolated lightning protection system is not possible then the installation of additional Class 1 lightning current arresters on both the ac and dc sides at the inverter boxes is required.

The designer of the lightning protection system should also consider which method of protection will be more economically viable.

Structures without external lightning protection

Once the required risk assessments in accordance with SANS/IEC 62305-2 [1] have been carried out and a structural LPS is not required then the following protection measures are required:

- Surge protection to PV system by means of Class 2 and 3 surge arresters
- Equipotential bonding to electrical earthing system by means of 16 mm² copper conductors



Structures with external lightning protection

Once the structure has been assessed and the presence of an existing structural lightning protection system confirmed, the existing structural lightning protection level should be verified by an inspection of the lightning protection system. The inspection of the existing lightning protection system should also verify that the lightning protection system is intact, fully functional and in accordance with SANS 62305-3 [2]. Any defects should be rectified to ensure that the lightning protection system for the rooftop PV system will work properly. The inspection and verification of the existing lightning protection system as well as

Structures with external lightning protection and adequate separation distances


LPSs where adequate separation distances between the LPS and the PV system can be maintained should be protected as follows:

- LPS in accordance with lightning protection level
- Surge protection by means of Class 1 lightning arresters and Class 2 and 3 surge arresters
- Equipotential bonding by means of 16 mm² copper conductors to earth bar only – no bonding to air terminals

The primary protection goal is to prevent damage to the structure (fire) and injury or death to persons resulting from a direct lightning strike. The PV system must be protected from direct lightning strikes, this means that the PV system must be installed within the protected volume formed by the external lightning protection system. The protected volume is created by the installation of air termination rods and the rolling sphere or angle of protection methods are used to calculate the height and placement of the air terminals.

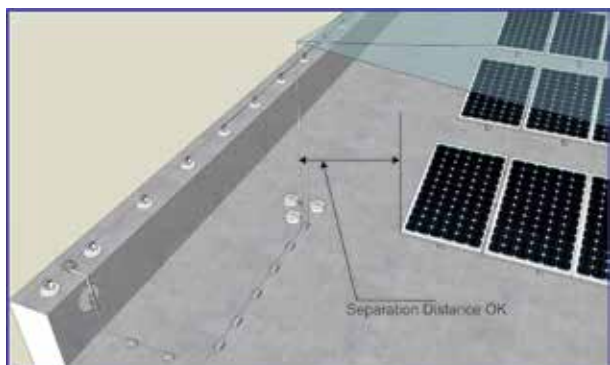
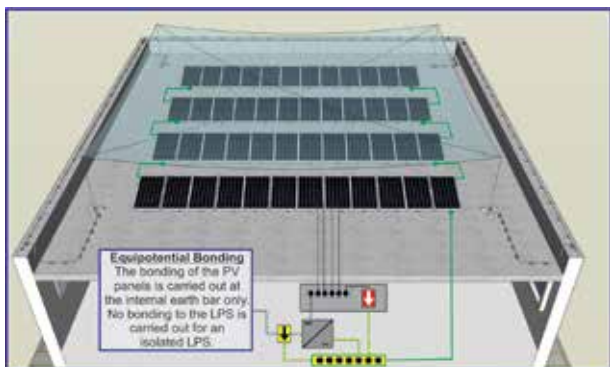
The establishment of the correct separation distance prevents partial lightning currents from entering the building and electronic equipment via the PV system’s cabling. Protection of inverters and data systems is done by means of Class 2 surge arresters and not Class 1 lightning arresters. The overall costs of the LPS is therefore reduced and the installation is as per the preferred method of protection.

- The energy released by a lightning discharge is one of the most frequent causes of fire.
- The installation of PV modules on buildings does not increase the risk of a lightning strike.
- Measures to protect the sensitive electronic system components from failure due to lightning flashes and surges are necessary.

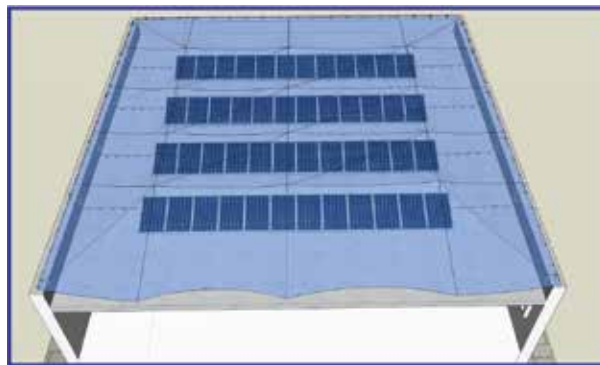
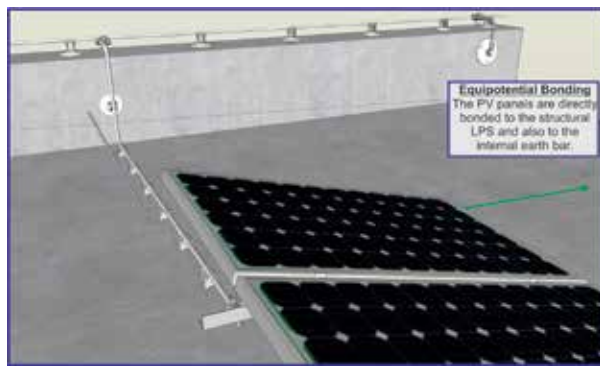
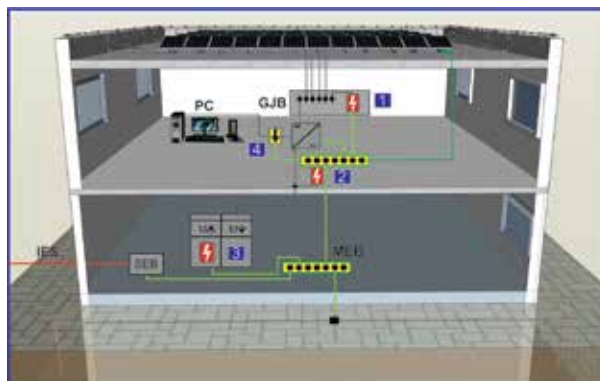


take note

Isolated LPS



Non-isolated LPS



Structures with external lightning protection and insufficient separation distances

Lightning protection systems where adequate separation distances cannot be maintained, should be protected as follows:

- LPS in accordance with lightning protection level
- Surge protection by means of Class 1 lightning arresters and Class 2 and 3 surge arresters
- Equipotential bonding by means of 16 mm² copper conductors or 50 mm² aluminium conductors

When the correct separation distances cannot be established the PV systems are vulnerable to partial lightning currents, therefore the protection of inverters and data systems is done by means of Class 1 lightning arresters and not Class 2 surge arresters. In accordance with Supplement 5 of IEC 62305-3 [2] all of the PV lines entering the building from the outside (i.e. roof) must be protected by means of Class 1 lightning current arresters.

In many cases, rooftop PV systems are installed on top of steel roofs, here the separation distances cannot be maintained due to the type of structure. In all cases where the separation distance cannot be maintained, then all of the metal components of the PV system must be bonded directly onto the external lightning protection. It is still imperative that an air termination system be installed to protect the PV system from direct lightning strikes in order to provide a controlled interception and dissipation of the lightning current.

Conclusion

Solar power generation systems are an integral part of today's electrical systems. They should be equipped with adequate structural lightning protection systems, lightning current arresters and surge arresters, thereby ensuring long-term faultless operation of these sources of electricity.

References

- [1] IEC 62305: 2010. Protection against lightning: Part 2. Risk Management.
- [2] IEC 62305: 2010. Protection against lightning: Part 3. Physical damage and life hazard.



Trevor Manas started his lightning protection career at Pontins in 1991 as an installation technician, learning the ropes by working on various sites and doing physical installations. Within two years, he was promoted to a sales engineer position, where he was involved in site assessments, soil resistivity surveys and compiling quotations. In 1996, Trevor was promoted to the position of director and was in charge of ensuring the company's compliance with the earthing and lightning protection codes of practice. In 1999, Trevor became the managing director of Pontins. In 2013, Pontins formed a partnership with DEHN Africa. Enquiries: Email trevor@pontins.co.za

Safe Energy Control Simplifies Surge Protection

Dipl.-Ing. (FH) Florian Lenzmeier, Phoenix Contact GmbH & Co

The Safe Energy Control (SEC) product range offers high performance and a long service life for lightning and surge voltage protection.

A basic prerequisite for optimal building protection is a universal concept that takes all measures necessary to protect against surge voltage into account. Whether a building is a small single-family home or a vast industrial complex is more or less irrelevant. The array of lightning and surge voltage protectors, structured in tiers, must be well-conceived and precisely implemented. While the use of a type 1 lightning protector varies according to a number of different environmental parameters, the use of type 2 and 3 surge protection is necessary in all cases.

Industrial building

The implementation of a surge protection concept demonstrates the advantages of the new Safe Energy Control (SEC) product range. The components from this series allow multi-level protection concepts for commonly used installations to be easily implemented. The example used describes the planning process on the basis of a simplified building concept. This scenario details the protection of an end appliance – in this case, an automated production system – in an industrial building. The machine and building's power infeed is supplied via a three-phase 230/ 400 V TN-S system. The various end devices in this industrial building are supplied with power through several sub-distributors. In addition, the building is equipped with an external Lightning Protection System (LPS).

Main distributor

Because of the external LPS, a corresponding interior LPS is also required. To meet this requirement, a type 1 lightning current arrester must be installed right where the power line enters the building. Be-

cause, in our example, there are already a PLC (Programmable Logic Controller) and various telecommunications equipment near the main distributor, the LT-SEC-T1+T2 lightning/surge voltage arrester combination has been selected here (see sidebar text 1). Since the main distributor is already protected by a main fuse (F1 = 315 gG), the lightning arrester requires no additional back-up fuse in this case. Type 1 arresters from the SEC range require no additional back-up fuse up to 315 A. In applications with higher rated current, either an additional back-up fuse or the FLT-SEC-Hybrid – a combination of a fully-enclosed spark gap and an integrated surge-current resistant back-up fuse – can be used.

Sub-distributor

Because the nearest floor or sub-distributor is located far away from the main distributor in this example, the use of a type 2 surge voltage protector is required. The VAL SEC surge voltage protector is a suitable choice. As with type 1 protectors from the SEC range, this device can be used in applications that are protected up to 315 A without an additional back-up fuse. Because the device is one of the slimmest surge voltage protection devices on the market, the installer saves both money and space. In our example, a three-phase TN-S network can be protected over less than three horizontal pitches – or less than 50 mm.

Protecting the end device

The type 3 surge voltage protector is installed right in front of the end device to be protected – in this case, the production system controller and robot arm. The PLT-SEC surge protector is being used. The main advantages of this device are its convenient installation and universal use. That is because type 3 products from the SEC range are equally suitable for use in ac and dc applications. An additional back-up fuse in single-branch configuration is unnecessary because all PLT-SEC devices come with pre-installed, built-in back-up fuses.

”

The 'Safe Energy Control' product range simplifies surge protection.



Simple selection

This simple example clearly demonstrates the advantages of the SEC range. Because it is not always easy to select the correct products for a given application in practice, this company offers customers a number of ways to learn more. The 'Foundations of Surge Protection' brochure provides a good introduction and a comprehensive overview. Starting with the way surge protectors work and going from there to explore various practical examples, all issues are clearly explained.

All-in-one lightning and surge voltage protection

The LT-SEC T1+T2 products combine

- The powerful spark gap that is free of secondary power supply currents and discharges direct lightning currents emanating from the lightning protection system or from power lines, guaranteeing low residual voltage
- The varistor arrester that effectively limits dynamic surge voltages thanks to its quick response characteristics
- Optimal energy distribution between the protection levels depending on the load occurring

Bibliography

[1] VDE 0185-305-3: 2006. Lightning protection – Part 3. Protection of physical structures and individuals.

- A basic prerequisite for optimal building protection is to ensure that every step has been taken to protect against surge voltage.
- The SEC product range described in this article offers outstanding lightning and surge protection.
- The product range allows multi-level protection for commonly used installations and easy implementation.



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DBN: 031 701 2701

PE: 041 364 0415

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Optimal surge protection for wind turbines with DFIG systems

2015 saw a huge boost for the wind industry, with annual installations surpassing 60 GW for the first time in history. At the end of last year, the new global total amounted to 432,9 GW, denoting a cumulative market growth of more than 17%.



This unprecedented growth has led to an increased concern around the lightning and surge protection of wind turbines, a concern that is addressed by the introduction of DEHNguard DG SE H 1000 VA FM surge protector, specifically designed to minimise the risk of failure resulting from surges when it comes to wind turbines with doubly-fed induction generator (DFIG) systems.

This powerful new arrester is rated for voltages up to 1 000V and discharges currents up to 40 kA (8/20 µs). Its module locking system ensures that neither shock nor vibration during transportation and use, or even an enormous force of discharge, can loosen the protection modules. The protection modules can also easily be replaced - without tools - by simply pressing the module release button.

DEHNguard SE H 1000 VA FM is ideally suited for wind turbines (with DFIG-Double Fed Induction Generator), however it can also be used for other applications with up to 100 V, such as, photovoltaic (PV) systems, railways systems, industrial plants and cable cars.

Enquiries: Kirk Risch. Tel. +27 11 704 1487 or email kirk.risch@dehn-africa.com

Installation testing protects appliances, wirelessly shares data

Growing concern for public safety and the increasing complexity of today's fixed electrical installations in domestic, commercial and industrial premises places extra responsibility on electrical test engineers who are charged with verifying conformity to South Africa's Certificate of Compliance (COC) safety standards.

South Africa's electrical contractors are well versed in the verification requirements of the COC, and that the audit should be carried out in the following sequence:

- Visual inspection
- Testing of the following:
 - * Continuity of protective conductors
 - * Insulation resistance
 - * Protection by separation of circuits
 - * Floor and wall resistance



- * Automatic disconnection of supply
- * Polarity
- * Functional performance

In addition to this the following tests are under consideration:

- Electric strength test;
- Voltage drop.

The basic requirements for test equipment used in installation testing consists of general requirements for test equipment, specific requirements for combined measuring equipment and the specific requirements for measuring/testing:

- Insulation resistance
- Loop impedance
- Resistance of the earth connection
- Resistance to earth
- RCD performance in TT and TN systems
- Phase sequence
- Insulation monitoring devices for IT systems

Available from **Comtest**, the Fluke 1660 Series Multifunction Installation Testers are measuring equipment which fully fulfil the requirements as described above, and the three different models in the series comply with specific parts of this norm. They are specifically designed to carry out the tests specified, and all local standards and regulations in the safest and most efficient way.

Enquiries: Comtest. Tel. +27 (0) 10 595 1821 or email sales@comtest.co.za

Introducing arc protection system to local market

DEHN Africa recently launched its DEHNshort arc fault protection system to the local market, with an intensive training session held at its Johannesburg office.

Overseen by Andreas Schumacher, Product Manager: Safety Equipment/ Arc Fault Protection from DEHN + SÖHNE, DEHN Africa sales engineer, Tatenda Gora, con-

ducted the training which was entitled: The Introduction of DEHNshort to South Africa - protection through detection for arc faults in low voltage switchgear assemblies.

The training session covered topics including a description of arc faults; the standards and norms of arc fault protection; an introduction to the DEHNshort

product and its application; as well as a demonstration of the new product offering. The comprehensive training was aimed both at DEHN Africa staff and partners as well as local clients.

Enquiries: Kirk Risch. Tel. +27 (0) 11 704 1487 or email kirk.risch@dehn-africa.com

Protecting children against lightning

Ugandan summer thunderstorms are practically a daily occurrence. The most dangerous by-product of these frequent storms is the approximately 70 lightning strikes per kilometre experienced within the country each year. Between 2012 and 2014, tragically more than 365 school children were killed due to lightning strikes.

In light of this, African Centres for Lightning and Electromagnetics Network (ACLENet.org), a Pan-African Network of Centres dedicated to reducing lightning related deaths, injuries and property damage, put in place a project called "Lightning Kills! Save a Life Africa" aimed at providing lightning protection equipment (including lightning rods, down conductors and grounding) to help safeguard African schools from

DEHN + SÖHNE subsidiary, DEHN Africa initially conducted a risk assessment, followed by the customised design plan of a lightning protection system (LPS) for a school based in Runyanya, Uganda. The school, which has a total of 700 pupils, is the first in the region to have rolled out a comprehensive LPS.

Within three days, **DEHN Africa** installed the external lightning protection system - including earthing systems, air-termination rods and down conductors - on each building within the school premises, including the chapel.

Kirk Risch, sales and marketing director at DEHN Africa, says: "This is the first of four similar school projects to be rolled out by DEHN Africa within the next few weeks. We have already sponsored the shipping of the required products and have trained our partner in Uganda, UltraTec World. UltraTec World assisted with the installation at Runyanya, and will complete the LPS installations at the

remaining three schools. "It is the serious intention of both DEHN + SÖHNE and DEHN Africa to prevent similar tragedies to the one that occurred in Western Uganda in 2011, where a number of children were seriously injured with others losing their lives during a thunderstorm. These projects present an ideal opportunity for us to give back to the communities in which we operate, helping to create a safer environment."

Enquiries: Kirk Risch. Tel. +27 (0) 11 704 1487 or email kirk.risch@dehn-africa.com



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Insurance Against Contamination

Joachim Zipp, WIKA

Pressure measurement in pharmaceutical processes for maintaining the sterile boundary.

They control the process pressure, serve as leak detection, they are used for the control of pumps, filters and cleaning processes and also for the monitoring of filling levels. Pressure measuring instruments in pharmaceutical processes must fulfil the widest variety of tasks. At the same time, they are subject, like any other instrumentation, to the highest safety criterion: For the protection of consumers, there must be no contamination risk to the end product arising from the measuring instruments and assemblies. As a result, the sterile boundary must be maintained within every phase of the process.

In the sensitive processes of the pharmaceutical industry the human risk factor must be reduced to a minimum. The plants operate almost fully automatically, with the control of the processes based on electronic instruments and systems. In the case of pressure measurement, we are talking about transmitters, programmable transmitters and switches.

In addition to reliable measured value registration and processing, the measuring instruments used should be robust, low-maintenance and easy to operate – not only for economic reasons. These characteristics also support the process safety in terms of the end product. Investigations have shown that the majority of damage to instruments that might lead to product contamination are due to incorrect handling. Other reasons are due to damage caused by corrosion or unforeseeable events such as an excessive pressure surge.

For applications in the pharmaceutical industry, in many respects, diaphragm seal solutions are used. The diaphragm seal system consists of a diaphragm seal made from stainless steel or other special material, the measuring instrument itself and the system fill fluid – glycerine or paraffin oil which conforms to the GMP guidelines. The diaphragm takes the pressure and transmits it hydraulically to the transmitter, programmable transmitter or switch. Thus the measuring instrument is permanently separated from the process and delivers an accurate measuring result, protected from influences.

Diaphragm seals offer a high operational flexibility. Using them, almost all instruments can be connected hygienically to a process. Thus the instrumentation is accurately custom-sized for the corresponding requirement. This is an advantage over measuring in-

struments with ceramic sensors, which, for example, are often only available with high-value transmitters that are therefore not suitable for all applications.

The primary reason for using ceramic sensors in sanitary applications is their high accuracy. The pressure measurement is made directly with a flush-mounted capacitive sensor without any system fill fluid which might, in the event of any damage, find its way into the process. In comparison to the metallic diaphragms of diaphragm seals, ceramic sensors are considered to have a higher resistance to shear forces or corrosion in the long term. Failure of a ceramic sensor would immediately be recognised to the operator by a loss of the signal. With a diaphragm seal system which has a damaged diaphragm, the measuring process still functions. The damaged seal goes undetected until a visual inspection is completed.

But a ceramic sensor is not immune to damage either. This can occur through hard water and steam hammer in the process or by an abrupt thermal cycling, such as during a sterilisation process. If the ceramic shatters, air and foreign matter from outside can enter the process via the ventilation and contaminate the sensor. By using diaphragm seals the process always remains sealed, even when a diaphragm is compromised, and thus the sterile boundary is maintained.

However, it can happen that products are contaminated even with a sealed process. Due to the measurement accuracy, the thickness of the seal's diaphragm is limited. Therefore, long-term overloading in the process can lead to deformations and, with that, to dead spaces. At these points, product particles can settle and, in turn, microbes can form. A similar effect can also not be excluded with ceramic sensors. The weak point here is the sealing between the sensor and the metallic process connection: In the first place, substances can diffuse into the seal, and can be released once again with the next process stage. Secondly, the seal can be overstrained with high temperature dynamics, and thus a gap can be opened up at the process connection – a point for potential deposits. If these remain undetected, they can be transferred to subsequent processes. This undetected cross-contamination usually has serious regulatory and economic consequences with costs in the millions.

Therefore, pharmaceutical companies strive to prevent such damage. In highly sensitive processes, for example, pressure measuring instruments are removed after each batch and checked for damage.

This adds costs to the manufacturing process. WIKA (further referred to as the company) has developed a special solution which ad-



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Pressure measuring instruments in pharmaceutical processes must fulfil the widest variety of tasks.

dresses these issues: A diaphragm seal system with a dual diaphragm and diaphragm monitoring removes the risks and the consequential damages as described. Using this patented system, the space between the two diaphragms is evacuated and the vacuum can be monitored with a measuring instrument.

The type of monitoring can be specified individually, depending on the sensitivity of the process. With regular on-site visual inspection, for example, it is sufficient to check a pressure gauge with green-red display, in other cases an optical or acoustic alarm in the control room may be required. When using media with a high risk potential, the operator can use a pressure switch which will immediately halt the process in the event of any damage.

Should the wetted diaphragm become damaged, the second diaphragm forms a reliable seal to the process and maintains the pressure monitoring until the damage has been rectified. Since a break within the system is detected and reported immediately, no microbes can get past the diaphragm undetected. Other options are available which can mechanically or electronically identify a failure in the diaphragm seal. If a seal is broken during maintenance or calibration the operator will immediately see this condition and will prevent a defective unit from being reinstalled. Furthermore, the 'alarm' is reported immediately in the event that the diaphragm is damaged. This prevents a defective instrument being installed in the process.

The safety function of this self-monitoring diaphragm seal system simultaneously optimises the protection of the non-process side: In the event of a damaged diaphragm, no dangerous substances can escape into the environment.

When a company uses such a device it shows due diligence that the system is monitored through an automated system and is not left to manual inspection of a seal area. In spite of the extremely high level of automation in pharmaceutical processes, not every measuring point absolutely has to be catered for electronically. For such cases, diaphragm pressure gauges with flush diaphragms are particularly worthwhile. These enable the measurement of low pressures and are exceptionally safe in overload as a result of their design. They keep the process sealed, even with pressure surges. Nevertheless, operators can also prepare themselves for the case of any possible damage to the diaphragm element. For such pressure gauges, the company also offers diaphragm monitoring, which will immediately indicate any rupture in the pressure element.

Diaphragm pressure gauges are suited mainly for mobile tanks, in which intermediate and end products are stored or transported to the next processing stage. They monitor, for example, the filling and the inert gas blanket. The dimensions of such containers are getting smaller and smaller, as the pharmaceutical industry is increasingly turning to the development and manufacture of individual medicines. Processes with small units and batches are the result. The measuring instruments for the corresponding tanks therefore have limited space available. This can quickly become tight for diaphragm pressure gauges: The lower the pressure to be measured, the larger must be

the diaphragm diameter and, with that, also the process connection.

To address this problem, the company has developed a new pressure gauge for small external areas: The model PG43SA-C measures in the low-pressure ranges with a proportionately much smaller diaphragm. This instrument combines the reduced connection size with a further specific feature that is particularly important for such measuring requirements on tanks: It is autoclavable. The pressure gauge can be sterilised with the vessel under saturated steam conditions at temperatures up to +134°C, without needing to be dismantled. The process thus remains sealed, also in the mobile phase, and the quality assurance is preserved.

Conclusion

The more critical the pharmaceutical process – for example, production of injection materials – the more important is the consistent maintenance of the sterile boundary in the manufacturing process. Risk prevention has, with the measurement technology used, an equally high requirement as accuracy and reliability of the process. The particular challenge is to merge the technical functionality and physical design features into an economical solution. For pharmaceutical processes are getting increasingly more efficient in view of the competitive situation – but without ever compromising safety.



- Pressure measuring instruments are subject to the highest safety criterion: The protection of consumers.
- Damage to instruments occurs for various reasons and could lead to product contamination.
- A special solution which addresses all the risks has been developed.

take note



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Hydrocarbon Dew Point – Critical Considerations for Natural Gas Turbine Installations: Part 2

Jack Herring, Michell Instruments, Inc

Part 1 of this discussion (published in *Electricity+Control*, December 2016) identified major factors that contribute to best practices for measuring the Hydrocarbon Dew Point (HCDP) of the natural gas fuel supply. Part 2 deals with current methods used for measuring.

There are three primary methods used in North America – Gas Chromatography (GC) with Equations of State (EOS), Manual Dew Point Analysis and Automatic Dew Point Analysis.

Gas Chromatography with Equations of State

GC analysis is primarily used to determine the BTU content of the gas sampled. With the recent interest in HCDP, Equations of State have been developed to predict the HCDP of the gas sample. HCDP is mainly influenced by C7 and above hydrocarbons.” Therefore, the traditional ‘C6 plus’ analysis provides insufficient data for a valid HCDP calculation [7]. Using a C6+ characterisation instead of a full characterisation containing all known components of the gas was found to change the computed dew point by as much 70°F, and invariably led to under-prediction of the dew point. Based on comparisons to date, however, the C9+ characterisation most often appears to predict measured dew points to within $\pm 25^\circ\text{F}$ [8]. ISO 23874 [9] states that the GC system requirements for analysis of higher hydrocarbons includes:

- Be capable of measuring alkenes up to and including dodecane
- Be capable of measuring individual alkenes at a concentration of 0,000 000 1 (0,1 ppm)
- Be able to distinguish and measure benzene, toluene, cyclohexane and methycyclohexane as individual components
- Measure all hydrocarbons in the range C5 to C12

GCs designed to meet these specifications are prohibitive in cost for most power plants. What currently is in place are generally C6+ and a few C9+ analysers on pipeline gas and in end user turbine installations primarily to check the BTU of the gas they are selling/buying. Many users are applying equations of state to provide additional data including a calculated HCDP. The table at the end of this paper sheds light on how the equations need the information that cannot be provided by the field GCs in the installed base. Even with a C9+ with a 60-30-10 split, the HCDP value is underestimated by nearly 29°F at

400 psig. With the JT cooling effect to reduce the pressure to 200 psig, this is pushing the superheat issue by another 14° to a total of 42,8°F.

Manual dew point analysis

The Bureau of Mines device has been used since the 1930s to provide manual dew point measurements and has been considered by many as the de facto standard in the industry. This device is used for ‘spot checking’ the dew point of a sample as extracted from a tap on the pipeline, from any location in a gas processing facility, or point of use. It allows a trained operator to detect the dew point visually and interpret that image as a HCDP or a WDP or a contaminated dew point. It requires patience and training to be able to operate this instrument properly. Since there is some subjectivity in the interpretation of the image involved, there will usually be some bias in the readings.

Automatic dew point analysis

Automatic dew point analysers have been in commercial use for over twenty years and independent laboratory testing has shown them to have very good accuracies to $\pm 1^\circ\text{F}$ when compared to the Bureau of Mines Manual Dew Point method. They can also provide the user with up to six measurement cycles per hour. An optical detector is chilled until a layer of condensate forms on that surface. Measuring the detector temperature when that occurs gives the HCDP

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Reliable accurate measurement instrumentation assists in controlling the operation of the turbine and protecting this asset.

- Gas Chromatography analysis is primarily used to determine the BTU content of the gas sampled.
- The Manual Dew Point analysis instrument (developed in the 1930s) is used for spot checking the dew point of a sample extracted from a tap on the pipeline from any location in a gas processing facility or point of use.
- Automatic Dew Point analysers (in use for more than 20 years) have very good accuracies compared with the Manual Dew Point method.

take note

BTU	– British Thermal Unit
EOS	– Equations of State
GC	– Gas Chromatography
HCDP	– Hydrocarbon Dew Point
JT	– Joule-Thompson
ROI	– Return on Investment
WDP	– Water Dew Point

Abbreviations/Acronyms

temperature. Automatic dew point analysers are not influenced by individual operators and include the entire spectrum of species in their analysis. They are available in field installable units that can be mounted very near the sample tap, providing a fast response to any change in the properties of the gas.

Best practices required for all measurement techniques

The general methods required to produce good accuracy begin with proper sampling. Proper sampling begins at the sample tap. The sample should be drawn upwards from a region sufficiently away from the inner walls and five diameters downstream of any components, elbows, valves and etc., which might modify the flow profile within the pipeline. This sample must be drawn off through heat traced tubing from the point of extraction through to the analyser. This is a critical issue since all surfaces contacting the sample gas must be maintained at a temperature higher than any dew point or the accuracy will suffer. Fast or speed loops should be used for maximum speed of response. Sample filtration must remove all particulates and liquid aerosols. This can sometimes be done as part of the sample extraction probe. Any required pressure reduction should be taken immediately before delivery to the measurement section of the analyser itself.

Additional best practices for GC analysis with EOS

GC best practices include using a C9+ GC as a start and then adding in data to C12 from periodic laboratory analysis to improve accuracy of the EOS calculations. These results should then be compared to actual manual dew point measurements to further enhance predictability. Using multiple EOS may also provide data comparison review over time that will determine the historical significance of one formula over another for a specific field or supplier. Keep in mind that field GC installations may not comply with all of the above general best practices and may produce less accurate results. GC samples are analysed at very low pressures compared to pipeline pressures and are predicting values at conditions far different from those of the actual measurement.

Additional best practices for manual dew point analysis

In addition to the general best practices above, the manual dew point method requires a well trained operator and patience. The optical device must be clean before starting any measurements. The sample pressure should be at the contract pressure or the approximate cricondenthem of the specific gas. The sample should be allowed to bleed through the device per the ASTM standard D 1142. Chilling the mirror down at $2^{\circ}\text{F}/\text{min}$ until a visible condensate forms on the optical surface is the procedure [10]. Once this image is identified as the HCDP, the thermometer should read the HCDP temperature. The mirror temperature should then be allowed to elevate slightly and then cooled again to 'home in' on the actual reading. These readings should be repeated a minimum of three times with reasonable agreement to qualify as being accurate.

Additional best practices for automatic dew point analysers

Reliable detection method

A reliable detector is a given for all instruments. Without the right sensor, discriminating a true HCDP has been tricky because the appearance of its condensate is often confused with other condensables. When hydrocarbons condense, they plate out as a shiny, transparent, somewhat iridescent condensate that is hard to distinguish from a mirrored surface. Repeatable discrimination of when the dew layer forms is a must, and new detectors are available with advanced sensitivity to reliably identify the HCDP eliminating the subjectivity of the manual visual method.

Close proximity to pipeline sample point

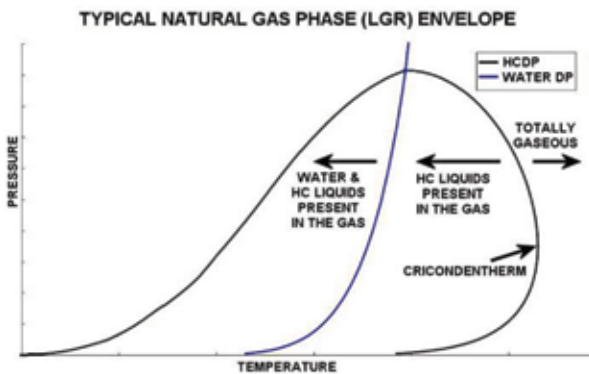
A unit that can be installed near the sample tap will produce faster information updates because there is less transportation time. Using a sample already piped to an instrument house may be convenient, but the resulting delay in the update may cause serious lag in reaction time for control purposes. Since each manufacturer has different operating temperature specifications, environmental conditions often dictate this choice.

Blocking in the sample during the measurement

A sample that is allowed to flow continuously creates an abnormal build up of the heavier hydrocarbons on the optical surface. These heavier molecules are the first to condense as the temperature is decreased. If the flow is continuous throughout the measurement cycle, these heavier components build up disproportionately to their representative concentrations found in the sample. This will always bias the readings higher and the bias can be significant. Blocking in the sample during the measurement cycle will eliminate this bias producing more accurate readings.

Controlling pressure to the cricondenthem

What is the derivation of the word cricondenthem? Critical condensation thermal curve – or 'phase envelope' is the curve described by the pressure and temperature relationship which shows where the phase of the gas sample changes. The cricondenthem is the point on this curve where pressure and temperature indicate that the maximum HCDP is to be found. Many tariffs are written with this point as the measuring point for the maximum allowable dew point in the contract. Tariffs written with the reference to the maximum HCDP at any pressure, are describing the same point. The cricondenthem pressure is not as critical as may be anticipated. Since the profile of this region of the curve is nearly vertical, even a variance of fifty to a hundred psi either way can be shown to produce very little change in the accuracy of the measurement. The expanded graph shows that a change of 100 psi in this sample will influence the HCDP a maximum of only



2°F. In contrast, missing just 1 ppmv of C10 component in the sample can change the HCDP by as much as 10°F! It is however, always good practice for the measurement to be performed at the contract pressure which is often the cricondentherm illustrated by the graph.

Heating the optical surface between measurements

Once the sample has been blocked in and the measurement is completed, it will need to be refreshed for each subsequent measurement. The condensate will usually evaporate as the gas flow is restarted through the measurement chamber during a recovery after a measurement. If the surface does not totally clear, and the measurement cycle begins with hydrocarbon residue already on the optical surface, the result will always be a bias toward a higher reading.

The sensing surface can be placed back into the measurement mode earlier by heating the optical surface which increases the evaporation rate of the condensate from the previous measurement. This heating cycle needs to be long enough to eliminate the condensate residue and prepare the sensor for the next measurement. A more consistent starting point for the measurement is achieved with the heating cycle. Without sensor heating the total cycle time can be three times that of the heated one and result in less reliability of the measurement.

Small internal volumes

When the volume of sample in the measuring chamber is reduced, it will speed the measurement and allow faster purging of the measurement chamber.

Frequent sampling

Many of the practices described will allow automatic dew point analysers to make more frequent measurements. Frequent measurement cycles provide for better response to changes in the gas conditions and allow control functions to be implemented in a more timely fashion.

Capability for harmonising with historical data

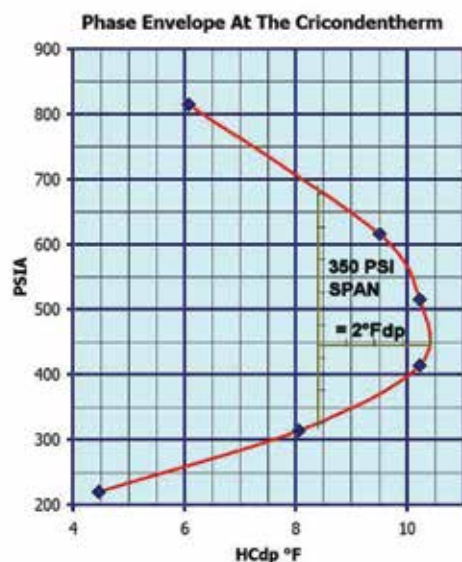
As HCDP research continues, new data has been incorporated into government regulations and commercial tariffs. Historically the definitions of HCDP have been slightly modified and standards have been rewritten to incorporate them. It is natural to assume that this trend will continue and as these changes come into effect, it is essential to have the ability to adjust the analyser to align with historical data or comply with newly refined standards.

Conclusion

Natural Gas Fired Turbine operation has become an efficient method for generating power and has found a niche in meeting peak demands. The investment in these plants is significant so they must be protected from damage. Turbine owners should consider the fuel requirements published by the manufacturer when contracting for natural gas. Once the contract is in place, accurate on-line instruments confirm that these contractual specifications are met. Reliable instrumentation becomes the only enforcement method available if contract quality is not being met. Installed cost is an important consideration in the choice of methods used to measure hydrocarbon dew point. But, even if the installed cost is slightly higher, choosing an accurate method can be shown to be a better value. Less expensive instrumentation techniques may under-report the dew point risking serious turbine damage. An inaccurate instrument choice can also add to the already high operational cost by over-reporting the dew point temperature which would the control system to heat the incoming gas more than necessary.

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Jack C Herring has been in the moisture/dew point measurement industry since 1979 and has published several articles on the subject. He co-authored the Moisture Measurement section of the 'Industrial Instruments & Controls Handbook' by McGraw Hill (1999).

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Two superbly engineered thermal imaging cameras

Fluke, represented locally by **Comtest**, is proud to introduce two new rugged and superbly engineered 640 x 480 thermal imaging cameras – the TiX580 and Ti480 – delivering four times the resolution power of previous cameras in these categories. Building on 65 years of manufacturing the world's top measurement tools, these cameras offer stunning image quality, while remaining surprisingly affordable. Users can now perform thermal imaging inspections with more confidence and faster results – all with the ruggedness and ease-of-use brand-loyal users have come to expect from Fluke.

The TiX580 features a 14,5 cm LCD touchscreen and a 240° rotating lens, that reveals the target, even when the user does not have the object in plain sight. The cameras use on-camera analytics for in-field analysis and offer 150% more viewing area than an industry standard 9 cm screen. The rotating lens allows users to easily navigate over, under and around objects and minimise outdoor glare.

Superior image quality

- Fluke's Professional Series TiX580 & Ti480 thermal imagers feature:
- MultiShar Focus: 100% focus for every object, near or far
- LaserSharp Auto Focus built-in laser distance meter: Calculates, displays distance from designated target with pinpoint accuracy)
- SuperResolution: 4 x pixel data (captures multiple images, combines to create 640 x 480 image)
- Pre-calibrated optional lenses: 2x and 4x telephoto and 25 micro/ macro allow for close-up or distance images

Enquiries: Tel. +27 (0) 10 595 1821 or email sales@comtest.co.za



Two new sensors with IO link interface

Randburg instrumentation specialist **ASSTech** now has introduced two new Jumo sensors with an IO link interface – the dTRANS p35 pressure sensor and the dTRANS T1000 temperature sensor. Both have a wide application range from tool machines to the food industry. The Jumo dTRANS p35 pressure sensor covers a measuring range from -1 to 600 bar. Its accuracy at an ambient temperature of +20°C is 0,5% of the measuring span and its long term stability is less than 0,2%. The dTRANS T1000 temperature sensor works with a tried and tested Pt1000 element sensor from Jumo. The measuring range is between -50 and +260°C. Both sensors have different switching functions such as switching point, adjustable functions hysteresis, switching delay or window function.

These sensors with IO link interface can be configured with identical software and offer a wide range of process connections. The PEKA process connection adapter system from Jumo enables the pressure sensor to also be used in the pharmaceutical and food industries such as beverage filling plants.

**Enquiries: Anastas Schnippenkotter.
Email info@asstech.co.za**



Capacitive sensors with IO-Link

At the SPS IPC Drives fair in Nuremberg, **Turck** presented BCT capacitive sensors with an IO-Link interface. IO-Link makes it easy to set the parameters of the capacitive switch in applications such as level control.

The internal process value of the sensor can be displayed in different damping states via FDT frameworks such as Pactware or the machine controller. This simplifies the teaching of the sensor in difficult applications and enables the diagnosis of the sensor or detects container contamination.

Alternatively, the BCT sensors can be set using teach buttons or teach cable, depending on the particular model. This last feature provides protection against unauthorised manipulation during operation.

The BCT Capacitive Sensors with IO-Link enables the user to carry out predictive maintenance. The sensor reports by IO-Link event if the temperature in the housing exceeds the critical value.

The state of the power supply is also monitored and reported. Using this feature the user can detect a possible wire break early on and can rectify the weak point before a fault brings the plant to a standstill.

The BCT Capacitive Sensor meets the requirements of protection type IP67 and is available as an M18 variant with a 5 mm standard switching distance and as an M30 variant with a 10 mm switching distance – measured for flush mounting.

If the sensors are mounted as non-flush devices the switching distance is increased by a further 50%. Both variants are available with or without teach buttons.

**Enquiries: RET Automation Controls.
Brandon Topham. Email
brandon.topham@retautomation.com**



New radar level sensor for water-supply and sewage systems



The VEGAPULS WL S 61 radar sensor is ideal for all simple applications in the water supply and sewage sectors. Featuring a wide range of mounting options, it is an especially cost-effective radar solution, because it can be readily integrated into existing infrastructure. Just as with the VEGAPULS WL 61, which has been available for several years and has a large installed base, the new VEGAPULS WL S 61 offers



a design optimised for use in the water supply and sewage sectors. Radar technology offers numerous advantages compared with ultrasonic sensors, which used to be standard in this sector; radar is independent of weather conditions such as strong sun, wind, fog or rain. In addition, no compensation is needed for variations in the signal transmission time due to air temperature fluctua-

tions. With an accuracy of ± 5 mm, the VEGAPULS WL S 61 covers a wide range of applications.

This sensor is particularly suitable for level and flow measurement in water treatment plants. Its excellent focusing enables its use in pumping stations and rainwater overflow basins, for flow measurement in open channels, and for level monitoring. The sensor's robust housing is wear and maintenance-free, and its high degree of protection, IP 68 (2 bar), also makes it suitable for applications where the sensor may be temporarily submerged. The unit complies with the latest LPR standard (Level Probing Radar), and is approved for open-air use without restrictions or special attachments.

An entirely new feature is Bluetooth wireless operation from a smartphone or tablet (and/or a PC with PACTware) when combined with a Bluetooth USB adapter; this makes commissioning and diagnosis even simpler. Corresponding display and signal processing units enable the display of measurements and provide the relay outputs needed, for example, to control a pump.

Enquiries: Chantal Groom. Tel 011 795 3249 or email Chantal.groom@vega.com

Knife gate valve – game changer

Afrivalve exceeded expectations with their robust C-Tech Knife Gate valve in 2016. The C-Tech Knife Gate valves, manufactured at eDART Surry Valve's manufacturing facilities in Jet Park, Gauteng, range in sizes from DN100-DN800. The DN750 size has proved extremely popular, with Afrivalve receiving major orders for the DN750 during 2016 which includes the supply of the C-Tech Knife Gate valve to a major mine in Africa. "Afrivalve's 100% in-house manufacturing allows us to manufacture the valves to the exact requirements of our customers, and further allows us to modify the valves to suit specific applications and overcome challenges that standard valves supply face. The valves are available in a wide range of materials to suit individual applications. We are constantly re-engineering our valves where we see that we can see a benefit to our clients. We manufacture our own range of manual, pneumatic and hydraulic actuators that are available with all required instrumentation" said Greg Hopton, Group Marketing Manager, Afrivalve.

Enquiries: Greg Hopton. Tel. +27 (0) 11 791 1411 or email greg@afrivalve.co.za



Greg Hopton,
Afrivalve.

New air release tester for oil analysis

Oil analysis, condition monitoring and reliability solutions are not static concepts or services. They evolve constantly over time to meet the ever-changing maintenance needs of industry as machinery and components are updated and redesigned. Condition monitoring specialist company WearCheck, based in South Africa and around the African continent, is dedicated to remaining at the forefront of the reliability solutions game, and invest regularly in new laboratory equipment and training for their scientists.

The latest addition to **WearCheck's** Pinetown laboratory is a brand new air release tester – a sophisticated instrument that measures the ability of an oil to release entrained air by pumping air through the oil sample at predetermined conditions. Laboratory manager Meshach Govender explains, "We record the time taken for the entrained air in the sample to reduce in volume to 0,2%. Entrained air that is not readily released from the oil can lead to spongy hydraulic action, inability to maintain oil pressure, incomplete oil films and the acceleration of oxidation of the oil.

"The new air release service was previously outsourced, and is now done in-house. This has reduced the turnaround time for sample results, and is of particular benefit to our customers with turbines and hydraulics, as well as gear oils to a lesser extent."

Enquiries: Email support@wearcheck.co.za



Senior laboratory assistant, Sheila Naidoo, of WearCheck operates the brand new air release instrument in which the condition monitoring specialist company recently invested, and which has made sample turnaround time faster.

Tilt sensor with shock compensation

Sensor specialist FSG presents new PE-MEMS.../GS70 series tilt angle sensors for monitoring the inclination of construction machinery and measuring tilt angles on ship platforms, working platforms or oil and gas rigs. The two-axis devices feature the proven MEMS technology (micro-electromechanical measuring systems) and ensure high-precision, redundant measurements. An additional gyroscope compensates mechanical shock. GS70 sensors gauge x-axis and y-axis angles in a measuring range of $\pm 60^\circ$ and achieve accuracies between $\pm 0,05^\circ$ and $\pm 0,3^\circ$ depending on angle range. The housing is made from passivated aluminium. The devices are designed for a temperature range between -40°C and $+80^\circ\text{C}$ and meet all technical safety requirements according to the IEC standards 61508 (SIL 2) and EN 13849 (PLD). GS70 sensors are available for cable connection with IP68 ingress protection or with a plug connector and IP67 ingress protection. A CAN bus interface supports CANopen and the CANopen safety protocol for signal output. **Mecosa** is the sole agent for FSG Fernsteuergeräte in South Africa.

Enquiries: Tel. +27 (0) 11 257 6100 or
email measure@mecosa.co.za



PE-MEMS.../GS70 series tilt angle sensors from FSG with shock compensation

Universal isolator – 400 calibrated measuring ranges

'When very good is good enough' – with this commendation, high-end manufacturer Knick presents its new BasicLine isolation amplifiers which allow for extensive use in economically sensitive large-volume installations thanks to an optimised price/performance ratio. The BL 570 isolator supports reliable current and voltage measurement as well as standard signal conversion.

The multi-talent is also suitable for measuring bipolar direct currents/voltages and enables individual adjustment of any measured voltage ranges between $\pm 20\text{ mV}$ and $\pm 200\text{ V}$. Currents up to 100 mA can be measured directly. Larger currents are picked up via an external shunt resistor. The BL 570 features more than 400 factory-calibrated switchable measuring ranges that cover most practical scenarios – readjustments are not necessary. Featuring an offset correction function, it can even convert signals with an offset into standard signals. Thanks to an integrated wide-range power supply the isolator can be operated both at 24 Vdc supplies and $100..230\text{ Vac}$ mains supplies globally. Strictly concentrating on basic functions, leaving all extras aside, Knick has tailored BasicLine devices to mechanical engineering companies that need precise and reliable yet cost-optimised isolators for large-scale applications. Notwithstanding the attractive price scheme, the devices feature Knick's characteristic high level of manufacturing quality and precision as well as complete galvanic isolation. **Mecosa** is the sole agent for Knick Elektronische Messgeräte in Southern Africa.

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Reducing Energy Consumption in Big Business and Industry

Heather McEwan, Rhino Lighting

South African case studies show how voltage optimisation systems are necessary for reducing energy consumption... and significantly increasing savings in big businesses such as Pick n Pay and Pretoria's Manhattan Hotel.

A new deal between South African energy efficiency specialists, Rhino Lighting and Powerstar SA, has signalled the rollout of a globally-patented Powerstar (referred to in this article as the company) range of voltage optimisation systems, which is aimed at reducing the energy consumption of big businesses and industry.

Manufactured at the company's international headquarters in Sheffield in the United Kingdom, the solutions being rolled out are designed to deliver significant, guaranteed energy savings. The range being rolled out nationally includes the latest innovation, Virtue – an energy storage system that can be integrated with any of the company's Max or HV Max voltage optimisation systems.

The range is unique in that it was designed to ensure that savings can be achieved, regardless of the type of energy load it is connected to. Savings can also be achieved on LEDs or VSD drives that have been installed to improve energy efficiency.

The patented designed voltage optimisation system returns the excess voltage in terms of negative power (back EMF) which is subtracted from the grid input power. Up to 80% of the total savings come from the negative power feedback (back EMF) while 20 to 30% comes from the improvement in equipment efficiencies.

Case study 1

- Guaranteed kW savings: 10,41%
- Annual kWh savings: 20,71%
- Annual kVA savings: 32,71%

Manhattan Hotel is a three-star New York themed hotel with a spa and; it is situated 250 m from the Pretoria Gautrain Station. The challenge for the hotel lay in the high level of incoming voltage to the hotel, which negatively impacted the lifespan of electromagnetic or induction motors and compressors in the hotel. The excessive voltage power quality was a cause for unplanned downtime, affecting productivity.

A voltage optimisation system was installed at the hotel to reduce the incoming voltage by 8%, bringing it in line with the 220/230 V required by most electrical appliances. In addition, as a true voltage optimisation system, the incoming power supply was cleaned and conditioned, providing suppression of harmonics and transients along with improving the power factor, therefore contributing to improvement in power quality.

Following the installation of the voltage optimisation system, an average of 30% less downtime due to poor power supply was recorded.

Case studies 2 and 3

2 Pick n Pay, Port Alfred

- Guaranteed kW savings: 7,2%
- Annual kWh savings: 7,8%
- Annual kVA savings: 10%

3 Pick n Pay, Grahamstown

- Guaranteed kW savings: 7,3%
- Annual kWh savings: 8,7%
- Annual kVA savings: 8,8%

Pick n Pay seeks to promote sustainable practices in every aspect of the business. The challenge for the two stores was to further lower their energy consumption, despite both incorporating various renewable energy generation solutions. Both stores operate seven days weekly and could not afford any downtime.

With average voltages of 238,5 V at the Port Alfred store and 234,4 V at the Grahamstown store, both suffered from excess voltage supply which was in turn causing high levels of energy consumption and increasing wear on electrical equipment. Through the installation of the voltage optimisation technology described in this article, issues

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Savings can be achieved on LEDs or VSD drives that have been installed to improve energy efficiency.

of over voltage were corrected and the incoming power supply was cleaned and conditioned to reduce wear on existing equipment. This extended the life expectancy of existing equipment and reduced maintenance costs. Following the installations, both stores are achieving energy savings which are greater than the guaranteed savings. The installation was completed with no disruption to the store operating hours and as a 'fit and forget' solution, the customer shopping experience was unaffected.

Case study 4

- Guaranteed kW savings: 10,2%
- Annual kWh savings: 13,6%
- Annual kVA savings: 19,5%

Continental Cars dealership in Port Elizabeth is one of the longest-serving independent BMW dealerships in South Africa. The challenge was to accurately evaluate the site load and voltage profile without impacting on the outstanding service and day-to-day operations of the showroom.

Following a thorough site evaluation, load analysis and voltage evaluation, the maximum site voltage was recorded as high as 248,8 V with the average voltage only marginally lower at 245,3 V. With a high but relatively stable incoming voltage, the installation of a 200 kVA voltage optimisation system has reduced the voltage by 25 V.

Following the installation the dealership is achieving a 3,4% higher than guaranteed savings, at 13,6%. With the over voltage corrected, Continental Cars are saving on electricity consumption, and also benefitting from reduced wear and tear on existing electrical equipment, culminating in reduced maintenance costs for the company.

Case study 5 – PE Alloy wheel company

- Guaranteed kW savings: 7,1%
- Annual kWh savings: 8,7%
- Annual kVA savings: 9,9%

The Port Elizabeth alloy wheel company is a family-owned business which was established in 1962. The company is a leader in the manufacturing of light alloy wheels. The company is headquartered in Europe but has multiple plants in South Africa, Europe and Australia.

As a technology-driven company, the PE alloy wheel company not only researches and develops next generation products, but it also looks at how it can make existing products more sustainable.

In addition to having high durability, all the aluminium used in its wheels is fully recyclable. The company monitors its energy usage and actively seeks ways to reduce energy consumption. The company decided to have its facility assessed and to introduce recommended energy saving solutions and carbon footprint reduction interventions.

Following a thorough site evaluation, load analysis and voltage monitoring, the Port Elizabeth plant was identified as a 'proof of concept' site within the company for an initial intervention.

The maximum voltage at the plant was 245,1 V, with the average voltage clocking in at 239,7 V. The installation of a 453 kVA LITE voltage optimisation system was recommended to reduce the plant voltage by 20 V, as the supply was high but stable.

With the incoming voltage reduced, cleaned and optimised, the plant is achieving an annual reduction in electricity consumption of 8,7%. The electrical equipment at the plant can now function at the optimum voltage, reducing wear and tear which in turn reduces maintenance costs and improves equipment longevity.



International Sales Director at Powerstar, Martin Stevens (far right), takes Rhino Group Managing Director, Brian van Niekerk, and Rhino Lighting Managing Director, Heather McEwan, through the company's plant in Sheffield. (Image: Supplied)

- New voltage optimisation systems reduce the energy consumption of big businesses and industry.
- In one example, the installation of this voltage optimisation system resulted in an average of 30% less downtime.
- In another example, installation of this system extended the life expectancy of equipment and reduced maintenance costs.



Heather McEwan is the Managing Director of Rhino Lighting (which is a sub-distributor of Powerstar SA).
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Flexible aero-derivative power generation solutions

The importance of renewable power generation technologies such as wind, solar and tidal cannot be questioned. But what happens when there is no wind or sun and there are low tides? **Siemens** aero-derivative gas turbine technology is a flexible, economical and efficient alternative to around-the-clock generation, be it for peaking, mid-merit or base load operation – writes Andreas Pistauer, Senior Vice President for Power and Gas Sales Sub-Saharan Africa at Siemens.

Siemens aero gas turbines are derived from turbojet/turbofan technologies, designed for civil and military aircraft, and are relatively new to the African power generation sector, which is accustomed to industrial gas turbines. Overall, Siemens aero gas turbines have a simple cycle efficiency that is typically 1~3% better than traditional industrial gas turbines.

The technology is a multi-spool design – where each spool rotates at its own optimal rpm for maximum efficiency across its operating range. Siemens aero gas turbines boast exceptionally high cycle capability, and can be started up in less than ten minutes (or less, if required) with no lockout timers after a shutdown (be it a normal or emergency shutdown). Electrical start-up is 500 kW, the equivalent of a small site back-up generator.



These features bring the power closer to the operator, which is able to respond instantaneously and follow load requirements, with no impact to the equipment's maintenance cycle and no increase to its maintenance costs.

How is a jet engine converted into a gas turbine?

The Siemens fleet of Rolls Royce aeroderivative products can be used as an example. The Aero Trent 800, which has more than 24-million flying hours in civil aviation applications, can be converted into the power plant specific Industrial Trent gas turbine, by simply replacing the fan with a two stage low-pressure compressor with matched flow capacity.

The Industrial Trent features three shafts (HP, IP, LP) that rotate independently and is environmentally friendly, as it is available in dry low emissions and wet low emissions cycle operation, and flexible maintenance solutions are available to ensure maximum return-on-investment.

Another important aspect of aero gas turbine technology is reliability and endurance under stress. The Industrial Trent requires no engine overhaul, as hollow shafts eliminate rotor bow and high nickel casings eliminate stress.

Titanium usage also reduces weight, thereby allowing for a higher power density. Operational expenditure is further reduced thanks to anti-friction bearings that require less lubrication. The ball bearing design is also lightweight with low oil flow and consumption.

Siemens aero gas turbines are therefore a low risk economic solution ideally suited to peak, mid-merit and base load applications, which can be used in open cycle, cogeneration and combined cycle power plants, with the key emphasis on having a power

plant which offers greater operational flexibility. Andreas Pistauer is the Senior Vice President for Power and Gas Sales Sub-Saharan Africa at Siemens.

Enquiries: Jennifer.naidoo@siemens.com



Andreas Pistauer, Siemens.

Growth opportunities in power generation

Promising solutions include chemical looping combustion and an integrated gasification combined cycle. The relatively high efficiencies and production rates of renewable energy sources are highlighting the need to make coal-based technologies clean and more effective. Coal-based power production accounts for approximately 41 percent of global electrical energy produced, and will continue to dominate the market for the next two decades. Government funding and private participation are already bringing promising coal-based power generation technologies to the forefront.

"Efficient oxygen carriers and combined cycle plant techniques are propelling the power generation market forward," said TechVision Research Analyst Guhan Sriram RV. "Within the next five years, the development of efficient materials for chemical looping combustion (CLC), along with improvements in reliability of integrated gasification combined cycle (IGCC) plants and carbon sequestration efficiencies, can be expected." Power Generation Technologies of the Future, analysis from Frost & Sullivan's TechVision Energy &

Utility subscription, offers continuous tracking and monitoring of both technology and product developments. The study also covers advancements, market and technology trends and predictions that will result in the creation of new markets, products and services, business models and even new industries within the energy and utility sector.

Beyond 2020, CLC will begin to take over as - similar to CO₂-based power generation technologies – it is approaching the commercialisation phase. Coal fired magnetohydrodynamic (MHD) is another promising technology; although it is still in the early stages of development.

"For now, IGCC will dominate clean power production," noted Sriram. "The technologies that IGCC are based on, like gasification and steam turbine based power production, are quite well established and any development in these technologies can be easily incorporated to IGCC to improve its performance."

Enquiries: **Samantha James. Email samantha.james@frost.com**

Looking forward to the challenge

Thierry Pimi was recently appointed as Managing Director of **Cummins Southern Africa**. Pimi is responsible for the leadership, operations and strategic direction for Cummins' distribution business South Africa, Swaziland, Lesotho, Namibia, Zambia, Zimbabwe, Botswana, Mozambique, Malawi and Madagascar.

Pimi is a professional mechanical engineer with over sixteen years' experience in the power generation, manufacturing and mining industries. He has held a number of senior management positions at Cummins in the United States of America and Senegal. He joined Cummins as Corporate Strategy Manager based at the company's head office in Columbus, USA in 2008. Thereafter he assumed the role of Mining Business Leader for Africa, also based in Columbus. For the last three years he has held the position of General Manager of Cummins North and West Africa Regional Operations; including overseeing the deployment and consolidation of company owned entities in Morocco, Senegal, Cote d'Ivoire and Ghana. Based in Dakar, Senegal, he has made a notable difference in a market which is considered to be one of the largest and fastest-growing business areas in Africa.

Commenting on his new role, he said: "I am ready to take up the challenge and work hard to further enhance the business, elevate the Cummins brand and get closer to our customers. My vision for Southern Africa is for us to exceed our customers' expectations through world class professionalism from a diverse and highly motivated team." A strong supporter of promoting local talent, the new managing director has unleashed diverse and capable teams across the regions in which he has worked, combining seasoned industry leaders with staff equipped with strong local market knowledge and solid regional business culture.



Thierry Pimi, Managing Director of Cummins Southern Africa.

Enquiries: Email
sal.govender@cummins.com

ETG welcomes 4 000th member

The EtherCAT Technology Group (ETG) has reached another membership milestone: In November, German supplier of advanced packaging solutions, KOCH Pac-Systeme GmbH, joined the organisation as member number 4 000. A tribute in honour of this landmark took place in the frame of this year's SPS IPC Drives show in Nuremberg, Germany. Jürgen Welker, Divisional Director of Control System and Service at KOCH, represented the company in Nuremberg to accept the official membership certificate with accompanying award. He explains the reason for joining the ETG as follows: "Beyond the high quality and efficiency, the individuality we gain differentiates our packaging solutions. We have benefitted from



the openness and flexibility of EtherCAT for quite some time, and have recently started to work with EtherCAT P as well. Therefore, official membership in the ETG was the next logical step for us."

Enquiries:
[Email c.hammel@ethercat.org](mailto:Email.c.hammel@ethercat.org)

Jürgen Welker, Divisional Director of Control System and Service at KOCH Pac-Systeme GmbH, and Martin Rostan, Executive Director EtherCAT Technology Group.

Bizz Buzz

South Africa's second Greenovate Awards

Growthpoint Properties, in association with the **Green Building Council South Africa (GBCSA)**, held the second Greenovate Awards with the University of Cape Town taking first place. In its second year, the awards programme is an initiative that inspires and encourages students of the built environment to discover, explore and invent ways to live more sustainably. Students needed to come up with ideas for any property-related project that makes the way we live greener and our environmental footprint lighter. The UCT team of Cédric Fournier and Priscilla Nthai, with supervisors Saul Nurick and Abby Street, were named the winners of the Greenovate Awards 2016. They focused on the perceptions of occupants in office buildings that contain green building features and initiatives. This team of outstanding young green innovators took home R30 000 in prize money.

Enquiries: Green Building Council of South Africa. Visit www.gbcsa.org.za

Electricity thieves responsible for deaths

Eskom requests the help of the public to bring to book the electricity thieves who are responsible for the deaths of 29 people and for the serious injuries suffered by 82 others in Kwazulu-Natal over the past three years as a result of illegal electricity connections and other forms of electricity theft. "Electricity theft remains one of the least reported crimes in South Africa despite the fact that an alarmingly high number of people, pets and livestock are killed every year as a result of illegal connections, improper house wiring, cable theft and low hanging conductors," said General Manager for Eskom in Kwazulu-Natal Monde Bala. "We wish to see all residents rising to the call to take an active stand against this crime by reporting suspected acts of electricity or cable theft to Operation Khanyisa. Tip-offs can be sent anonymously via SMS to 32211 (R1/SMS)," he said.

Enquiries: Visit www.eskom.co.za

Digitalisation set to develop Africa, not disrupt

Siemens has conducted an African Digitalisation Maturity Report to better determine a digitalisation benchmark across four countries namely South Africa, Nigeria, Kenya and Ethiopia as well as key vertical industries – transport, manufacturing and energy.

At a briefing held in Sandton, Johannesburg, on 7 December 2016, CEO Siemens Southern Africa, Sabine Dall'Omo, said that the four countries were selected as some of the fastest growing economies in Africa, as well as having made great strides in ICT (Information and Communications Technology) adoption.

"Africa's rapid urbanisation represents an immense opportunity for the extension of ICT and improvement of digital maturity to help urban hubs such as Johannesburg, Lagos, Nairobi and Addis Ababa cope with the influx of inhabitants.

"There is an opportunity for government as well as the private sector to roll out services for digital access and use, exactly as they do with traditional basic services infrastructure," said Dall'Omo.

For us, digitalisation means using new technologies like data analytics, the cloud and the Internet of Things to merge the virtual and real worlds. This enables us to offer our customers substantial productivity increases across their entire value chain, from design and engineering to sales, production and service. In concrete terms, this means faster time-to-market, greater flexibility and enhanced availability of our products and systems for our customers.

In Africa, the challenge lies in applying digitalisation in the context of various macro-economic factors such as regulation and infrastructure," said Dall'Omo. The report measures the extent to which each country has a business, legal and regulatory environment that supports and protects the development of digitalisation in key industries. This includes indicators such as the overall ease of doing business, the presence and regulation of ICT-related laws, the protection of intellectual property and evidence of ICT-related innovation and start-up activities.

Quality of infrastructure indicators include access to international bandwidth, mobile-network coverage, internet and mobile phone penetration and the costs of broadband and mobile-phone access.

Skills are another vital component of maturity. We believe that Digitalisation can bridge the blue and white collar worker, to create what is termed the 'grey collar' worker added Sabine.

"This implies humans and machines not competing for jobs, but rather working together and creating the need for a new type of talent. The challenge is whether or not government and industry are investing enough into the development of these skills."

Country Analysis

While the larger and more developed economies tend to be more digitally mature the analysis shows there are many indicators that can influence a country's ability to capitalise on digitalisation. If done correctly it can drive entrepreneurial competition in market.

While Ethiopian and Kenyan economies are of a similar size and are growing at similar rates, Kenya is ahead in terms of digital maturity. This is attributed to the country having far more extensive ICT infrastructure and mobile internet or 3G infrastructure to access and secondly because it is much more diverse and services-oriented economy, which typically drives the expansion of digital services.

Nigeria has a relatively undiversified trade profile beyond oil and is therefore highly reliant on imported technology, however it is benefitting from extensive investment in ICT, including 3G network coverage and is expanding into hardware manufacturing and software development.

South Africa with its relatively large and diverse economy and extensive and high quality mobile broadband infrastructure, remains the leader of the four countries in most areas.

Industry Analysis

The manufacturing, energy and transport industries showed varied levels of maturity and was reviewed based on the culture of innovation, digital operations and digital customer and offerings.

Manufacturing was the most mature. The adoption level of smart technologies that can accelerate the next industrial revolution globally termed Industry 4.0 remain at a foundation stage, however awareness of the significance and potential of this exponential technology is high. In the energy sector, it is noted that without stable electricity it is challenging to do anything digitally. Some of the main challenges facing the African power industry are related to unreliable generation capacity, costly transmission, limited skilled workforces and underdeveloped customer and billing management systems.

Digitalisation can assist in enabling decentralised power generation to work using alternate energy sources combined with intelligent grid management. In the transport sector, new ways of using existing infrastructure more efficiently are being enabled through digitalisation. The rail and road sectors need to move beyond electrification and automation to true digitalisation and focus on extending and integrating islands of excellence to solve the real mobility needs of citizens.

Key recommendations from the report to accelerate digitalisation include:

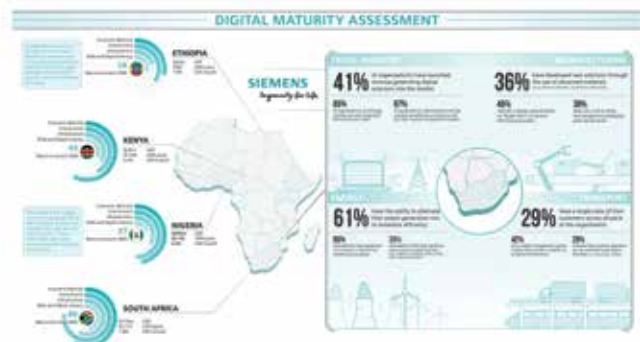
- In an African context, **disruptive technology** drives development rather than disruption. Developed economy solutions are not necessarily going to work in more under-developed economies. In Africa, especially, true innovation comes from necessity
- **Glocalised** digitalisation – conventional global views of digitalisation are being re-imagined for local-fit. Advanced technologies offer the opportunity to solve great socio-economic problems and should be considered in Africa's diverse and developing countries
- **Digital in Africa** is poised to happen in small isolated areas unless governments drive overarching policies to ensure consistency of standards.

The report is available upon request.

Enquiries: **Keshin Govender. Tel. +27 (0) 11 654 2412 or email keshin.govender@siemens.com or visit www.twitter.com/SiemensAfrica**



CEO Siemens Southern Africa, Sabine Dall'Omo.





African Digitalisation Maturity Report

On Wednesday, 7 December 2016, Siemens released the findings of the African Digitalisation Maturity Report at a breakfast in Sandton, Johannesburg. The report, produced by Siemens and Deloitte Digital, details levels and opportunities for digitalisation in the energy, manufacturing and transportation sectors. (See article on page 42)

Enquiries: Keshin Govender. Email Keshin.govender@siemens.com



Sabine Dall'Omo, CEO Siemens Southern Africa, hosted the event.



Klaus Helmrich, Member of the Managing Board of Siemens AG – a guest speaker at the event.

'Cost-effective technology through innovation'

Following the positive results and feedback from its inaugural Innovation Conference held in 2014, Omron South Africa staged this highly successful event again at The Venue in Melrose Arch, in Johannesburg on 27 October 2016. This is in line with the company's mission statement of 'creating inspired solutions for the future' through innovation and new technology. "Omron Electronics uses the bi-annual Innovation Conference as a platform to showcase and communicate new innovation for the industry we serve, and to demonstrate how these innovations provide solutions, improve processes, and challenge the status quo," Marketing Manager Laetitia de Jager comments.

Enquiries: Tel. +27 (0) 11 579 2600 or email info.sa@eu.omron.com



Evert Janse van Vuuren (Field Application Engineer Sysmac Motion), Rohan Wulff (Field Application Engineer Drive Motion) and Victor Marques (General Manager, Omron Electronics South Africa).



Marcel Kakese (Field Sales Engineer, SSA East/West) and Alexander Myokov (Manager, Emerging Markets).

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Africa Energy Indaba

21 – 22 February 2017

Sandton Convention Centre, Johannesburg

The Africa Energy Indaba will host the Sustainable Energy for All Initiative (SE4ALL) countries that will be showcasing their High Priority Renewable Energy Project Opportunities, identified at country level as the 'High Priority Projects' to provide energy to the respective country. The actual project owners (country government representatives) will be providing the full Investor Prospectus at the Africa Energy Indaba and showcasing the High Priority Project Opportunities to the private sector to consider for investment.

Enquiries: Email liz@energyindaba.co.za

Power & Electricity World Africa 2017

28 – 29 March 2017

Sandton Convention Centre, Johannesburg

Incorporates 'The Solar Show Africa' (meet with the right customers in the solar industry), 'The Water Show' (discover the latest services and innovation) and 'Energy Efficiency World' (bringing together buyers from across the energy spectrum).

Enquiries: Email Courtney.Harty@terrapinn.com

Domestic Use of Energy (DUE) Conference

'Energy efficiency in the home'

3 – 5 April 2017

Cape Town campus,

Cape Peninsula University of Technology (CPUT)

Prospective delegates may register for the conference by contacting. Delegates are also invited to present papers at the conference. Delegates who would like to present papers

should submit provisional titles of their presentations. Full papers are to be submitted before 30 January 2017. Brief abstracts of about 200 words may be submitted.

Enquiries: [Nadia Cassiem. Email cassiem@cpuc.ac.za](mailto:Nadia.Cassiem@cpuc.ac.za) or visit <http://energyuse.org.za/duel/>

Securex 2017

30 May – 01 June 2017

Gallagher Convention Centre,
Midrand, Johannesburg

Securex is Africa's leading security and fire exhibition. The exhibition enjoys the support of a number of industry associations, a fact that underlines the credibility of Securex as Africa's leading security and fire exhibition.

Enquiries: Email leighm@specialised.com

POWER-GEN & DistribuTECH Africa 2017

18 - 20 July 2017

Sandton Convention Centre, Johannesburg

Sustainable power generation and distribution in a constrained market is a top of mind issue across Africa. Seeking to share knowledge and catalyse development that helps address Africa's power challenges, PennWell Corporation, the organisers of POWER-GEN & DistribuTECH Africa, have issued a Call for Papers. The abstract submission deadline is 5 January 2017.

Enquiries: [Leigh Angelo. Email leigh@tradeprojects.co.za](mailto:Leigh.Angelo@tradeprojects.co.za)



Seeing the big picture

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In many small and compact mobile applications, the requirements on control tasks are increasing. Cost-optimised, modular mini controllers for mobile use are in demand. ifm offers ecomatmobileBasic consisting of the components BasicRelay, BasicController and BasicDisplay that are adapted to each other. This BasicController family is now complemented by the BasicController^{relay}.

Its special feature is made up of six protected power relay outputs with diagnostic capability for the supply of high-current consumers in mobile machines. In addition it has multifunctional digital and analogue inputs that can be configured via the application software. The BasicController^{relay} is freely programmable via the IEC61131-3-compatible CODESYS software.

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