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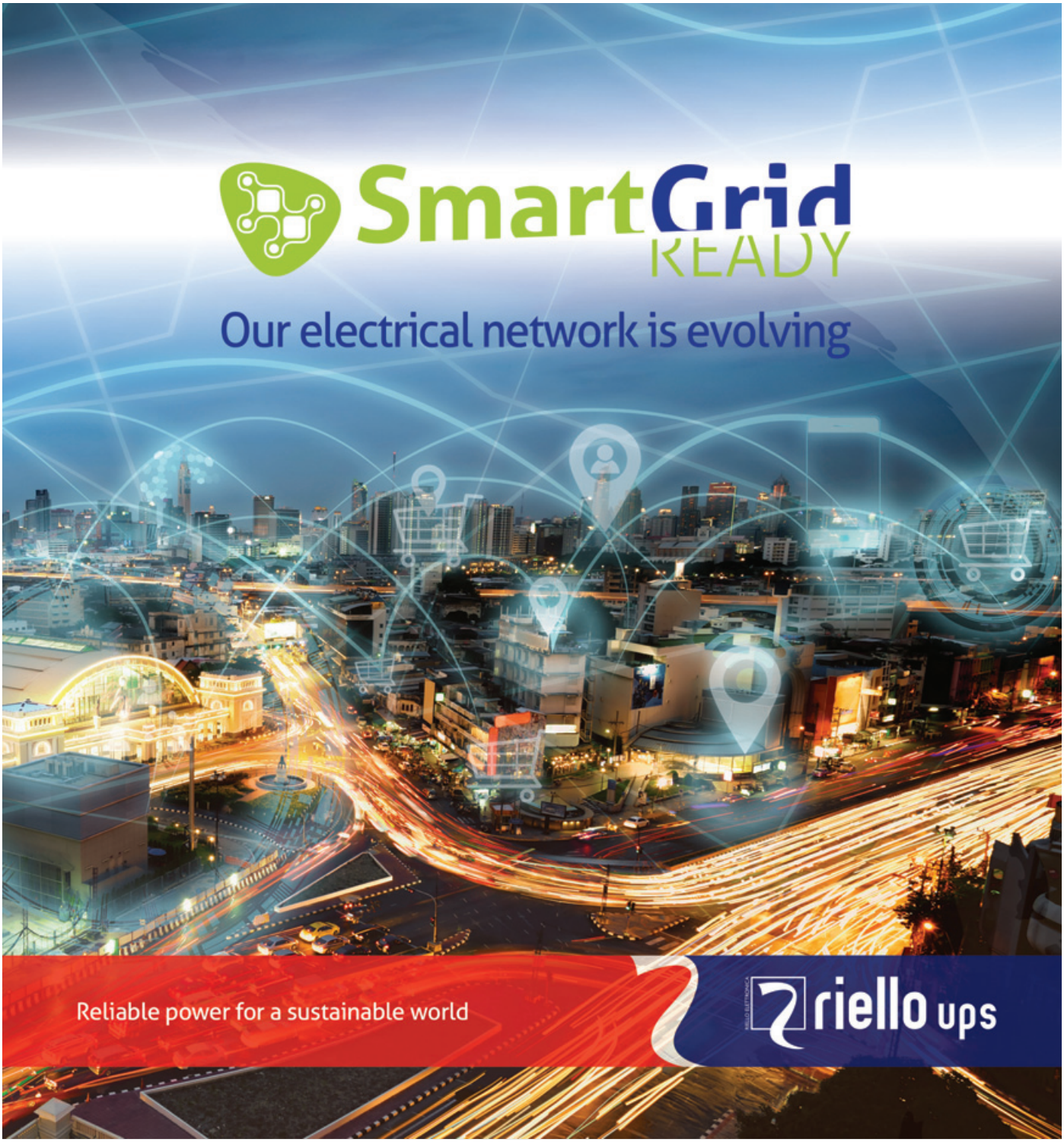

Cable management - Finding fault

Craig Collinson explores the methods and expertise required in specialist cable fault testing

Power Generation
Dr Jonathan Hiscock explains why tapchangers are so important in the power grid

Renewable Energy
Graham Wright dispels some common confusion surrounding heat pumps

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Feeling the pinch

Large firms are set to feel the pain of the Apprenticeship Levy this spring, when the first wave of levy payments will be wiped from their accounts unless they have invested them in training apprentices.

This is bad news, considering new research has revealed a whopping 80% of companies paying into the levy have yet to take on a single apprentice.

According to the ESFA, just 14% of the total funds paid by apprenticeship levy employers have been spent. Between April 2017 and December 2018, employers drew £480 million from digital apprenticeship service accounts, leaving more than £3 billion unspent.

Apprenticeship provider Develop Training Limited (DTL), whose customers include household names in construction and the utilities, says the deadline should focus attention on making the controversial initiative work.

Companies with payrolls above £3 million have been paying into the scheme since its launch in April 2017 and continue to do so monthly. They can get the money back if they invest it in apprenticeship programmes

with approved providers such as DTL, but there is a two-year deadline.

That means in April this year, levy payments dating back to the start of the scheme will go to the Treasury, and funds will continue to be funnelled away each month on the second anniversary of when they were paid in.

So, for example, the levy payments that companies made in September 2017 will no longer be available to invest in apprenticeship programmes from September 2019.

The levy was supposed to encourage firms to invest in apprenticeships, but confusion and concerns about costs meant the scheme initially had the opposite effect.

DTL hosted an Industry Skills Forum in late 2017 for leading figures in HR in construction and the utilities that highlighted wildly varying views on the levy, from companies that were embracing it to train new and existing employees to those who saw it as a tax.

Since then the government has tweaked the scheme significantly, reducing the amount of levy payments and allowing smaller companies to use levy money to help other organisations finance their own apprenticeship training, typically those in the big companies' supply chains.

Now, despite wider political and economic uncertainty, DTL hopes 2019 could still be the year that kick starts the faltering programme.

Whether by using levy-funded apprenticeships or by investing directly in learning and development, DTL is urging companies heading for the looming levy deadline to meet the challenge and ensure Britain has the workforce it needs to keep the country's infrastructure and building projects running into the future.

A perfect storm

It would seem things weren't looking great for engineering services in the final quarter of 2018, as a new study revealed a slowdown in growth, coupled with increased material and labour costs.

The latest sector-wide Building Engineering Business Survey from the ECA, BESA, SELECT and SNIPEF (sponsored by Scolmore) has unveiled that a quarter (26%) of businesses reported increased turnover, while another quarter (26%) said turnover had fallen, in Q4 2018, compared to the previous quarter.

Outlook for the first quarter of 2019 is also subdued. Three in four respondents (74%) said they expect their turnover to stay the same or fall compared to Q4 2019.

While nearly two thirds (61%) of engineering services organisations have seen their material costs rise in Q4 2018, compared to Q3, almost half (48%) of respondents reported increased labour costs during the final quarter of 2018.

ECA CEO Steve Bratt commented, "These latest figures indicate a squeeze on margins due to a downward trend in turnover and an upward trend in labour and material costs.

The current business climate is challenging, with firms facing the knock-on effects of Brexit uncertainty, more challenging contractual conditions and ongoing payment issues."

BESA CEO David Frise said, "There is a pattern emerging here. The latest forecasts from the CPA, which we recently shared with our members, indicate similar findings with a market forecast of just 0.3% growth in 2019 and material prices going up by 5.1%.

"The challenge for contractors across the sector is maintaining cash flow in a climate where payment issues still reign. It is in times like this that the work of organisations like BESA, ECA, SELECT and SNIPEF is even more vital than ever."

SELECT acting managing director Alan Wilson added, "Payment remains one of the industry's biggest issues. Often it starts at source, with clients delaying payments, which has a knock-on effect down the contractual chain. This is then compounded by delays in releasing retention sums.

"There has to be more transparency in the payment chain and national and devolved governments need to show leadership in making sure public bodies pay on time."

Payment and retentions remain a challenge. Almost three in four respondents (77%) said they are typically paid more than 30 days after a public sector project, and more than eight in ten (83%) are paid more than 30 days after a commercial project.

Almost two thirds (58%) said that up to 10% of their organisation's turnover was tied up in retentions in Q4 2018 – a 6% increase on Q3 2018.

The survey received 403 responses from companies across the multi-billion-pound industry, mainly regarding their performance in Q4 2018 (1 October to 31 December 2018), and expectations for Q1 2019.

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Top tips

Do you get tipped as a trade person? Research by Heat Insulation Ltd suggests that 51% of homeowners regularly tip tradespeople, whilst the other 49% refuse.

The people who are most likely to tip tradespeople are those aged between 45-64 and the least likely are 18-29 year olds, which on face-value may simply be down to disposable income.

However, when those aged 18-29 who said they would not tip were asked why, the vast majority said it is because tradespeople charge more than enough.

A total of 245 homeowners were surveyed across the UK and the survey was aimed at understanding whether people tip tradespeople.

The main reasons given for not tipping tradespeople:

1. It costs enough
2. The price is agreed before work commences
3. Good work should be expected and not rewarded

Ricky Swann, managing director of Heat Insulation Ltd, conducted the survey as he often hears of tradespeople on both sides, those being tipped and others saying they have never been tipped.

He said, "I've personally never heard of one of my staff being tipped, or they haven't told me! But I know they can get upset when they hear of other tradesmen getting tipped."

"It's quite a controversial subject and although it's nice to hear people get a tip as it often makes them happy, I don't honestly believe anyone should expect it. A job is quoted and that is what a customer should pay".

Creating a diverse, more inclusive industry

NAPIT has highlighted a range of initiatives it is undertaking to promote its longstanding commitment to Equality, Diversity and Inclusion (EDI), and has called for companies across the industry to take similar steps.

This year, NAPIT aims to promote these initiatives to encourage other companies across the board to join in and make the industry a more inclusive place to work.

As with many industries, the Building Services Industry has its stereotypes. It is common knowledge that the trades within the sector are male-dominated, with these careers largely targeted towards young males rather than young females at school and college.

NAPIT actively supports women in the electrical industry, but that's just one step to overcome when it comes to making the industry a more diverse place.

NAPIT's Equality and Diversity policy is firmly in place to ensure that no member, employee or customer is disadvantaged when doing business with them due to age, disability, gender, gender reassignment, pregnancy, race, religion or belief, sexual orientation, marriage or civil partnership.

Mike Andrews, NAPIT group chief executive said, "We are hoping to raise awareness and open people's minds to the benefits of equality and diversity practices so that they can take advantage of a greater mix of skills, experiences and ideas, as well as improved performance and profitability."

Addressing the UK skills crisis

To help address the growing crisis of skills shortages across the UK economy, JTL has established a new 'Trade Up' campaign, with the view to offer advice and guidance to businesses unsure about the apprenticeship process.

JTL's 'Trade Up' campaign has developed a range of support for small companies, to help build confidence in the apprenticeship scheme and the young people they could employ.

Jon Graham JTL's chief executive commented, "Many trades have an ageing workforce and are seeing some of those currently working in the UK returning home or looking to work elsewhere in Europe as a result of their concerns about Brexit.

"Whatever happens around Brexit, there will be a huge need for qualified tradespeople to undertake the vast amount of work required in the UK.

"There is frankly a 'head in the sand' approach to the skills shortages we have, which will get worse if we can't attract more talent from our pool of young people to these professions."

"There are no apprenticeships without employers – that's a fact, so we need to communicate more effectively that there are skills gaps looming that will hold this country back. We need to ensure that the trades can survive and thrive in the UK."

The impact of EV

Electric Nation has completed the world's largest EV smart charging trial, to help understand the impact that charging electric vehicles at home has on the local electricity network.

By the time the Electric Nation project ended in December 2018, data had been collected from more than 140,000 EV charging events. Analysis suggests that there is likely to be sufficient flexibility to manage charging away from peak electricity demand periods.

Initial findings show that on average, vehicles are plugged in for over 12 hours, but they are rarely charging for the full time. Other conclusions from the project suggest that the average charging event starts with the battery already more than 50% full and EV owners only charge their EVs three times a week.

The project monitored participants' charging habits to gather data on plug-in behaviour including frequency, length and amount of energy consumed.

The trial will help Western Power Distribution improve its understanding of the impact of EVs on its networks and how this impact could be reduced using smart chargers alongside customer incentive schemes.

Funded via Ofgem through its Network Innovation Allowance scheme, the project aims to provide local electricity network operators with the tools to be able to ensure that their networks can cope with this massive new challenge, while avoiding replacing cables and substations.

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GOSSAGE

"STANDS SCOTLAND WHERE IT DID?"

ScottishPower has been paid £107 million for switching off its wind turbines during a three-year delay in completing an undersea cable project which was supposed to solve that very problem.

The £1 billion Western Link from Ayrshire to North Wales was specifically designed to prevent so-called "constraint payments", by allowing more Scottish green electricity to reach consumers in England.

Previously, huge amounts of electricity from Scotland's wind farms became stuck in a bottleneck at the Border, resulting in operators being paid millions of pounds to shut down – and the cost being passed on to household bills.

The new high voltage link, a joint venture between SP Energy Networks and National Grid, was commissioned in 2012 and the project was supposed to be completed by December 2015.

However, a series of major problems delayed that completion for well over two years. The Western Link then operated at a reduced capacity until last May – when it was shut down again – before finally coming online on 16 October.

So throughout that period, ScottishPower shareholders were being paid for doing almost entirely nothing. Shame that these shareholders are now to be found mostly in Spain. However much it wraps itself in tartan, the fact remains that it is Iberdrola of Madrid, not ScottishPower of Glasgow, that benefits.

NO SAINT BERNARD

The new chairman of the UK's principal climate science denier campaign group, holds investments in a number of fossil fuel companies, including those building controversial oil and gas pipelines in Canada.

Labour peer Lord Bernard Donoughue, now 84, was handed the reins of the Global Warming Policy Foundation (GWPF) after former Chancellor Lord Nigel Lawson (87) stepped down last month.

The GWPF has provided a platform to opponents of action on climate change for almost 10 years. It consistently refuses to provide any details regarding who funds its work.

Donoughue was the senior policy advisor to Harold Wilson's government during the 1970s. In common with his predecessor, he has no scientific qualifications whatsoever.

Donoughue's 30 shareholdings include four investment funds that list BP and Shell in their top five holdings, while another fund has shares in ExxonMobil. The House of Lords' latest Register of Interests also shows another of his fund holdings invests heavily in oil and gas infrastructure in the US and Canada, including the controversial Kinder Morgan and Keystone XL pipelines.

All of which fossil fuel commercial interests will surely never cloud his judgement on the scientific veracity of global warming.

"FULL OF SOUND AND FURY, SIGNIFYING NOTHING"

Large electricity suppliers must triple the number of smart meters they are installing, in order to meet the 2020 rollout deadline, consumer group Which? has warned. Firms will need to install 30 smart meters a minute, every day, for the next twenty-two months to replace the 46 million existing meters. At present, large energy suppliers are only putting in just 9.7 meters a minute.

And, as the civil servant running the programme, Daron Walker, has admitted to the House of Commons Business Committee, the numbers installed over the past year actually dropped. Even so, his publicity mouthpiece, Smart Energy GB is still claiming that suppliers, "are working hard to offer all households smart meters as soon as possible".

As Alex Neill, managing director at Which?, tartly observes, "The smart meter rollout has been plagued by problems and been massively delayed, the benefits have been overstated, and the savings they could bring consumers are at risk."

She adds, "It is time for the Government to re-plan with industry and consumer groups, to ensure people get the maximum benefit at the minimum cost."

The National Audit Office agree. As have a whole slew of parliamentary reports. And a whole series of exposes of this debacle in the national press. But still this £14bn boondoggle continues.

Almost the only item of good news is that this month should be the last during which the vintage SMETS-1 meters will be permitted to be installed. Only four years later than Walker originally promised. And in the knowledge that practically all of the 12.5 million of these antiques already installed will require serious upgrading in future.

NO BRASS WHERE THERE IS MUCK

Vegans now not only have to watch what they eat and wear. But also where their electricity comes from. That venerable authority, The Vegan Society, has determined that only the owners of Forest Green Rovers, Ecotricity, are permitted to brand their product as truly "vegan".

In addition, The Vegan Society has decreed that purchasing electricity from any other eco-oriented supplier are verboten. It seems that their generation processes are not "animal free" and are thus completely unacceptable to true believers. Apparently, this is because by-products of the farming industry – such as (shock, horror) "manure" – are used in the generation of some of their electricity.

“It takes 20 years to build a reputation and 5 minutes to ruin it. If you think about that, you'll do things differently.”

Warren Buffett

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BEG launches new multi-sensors for DALI-2

Manufacturer BEG Lighting Controls has released its first range of DALI-2 multi-sensors for building management systems to the market. Paul Jones, BEG director, UK & Ireland, outlines the advantages of these new sensors compared with their original DALI counterparts and highlights why this new technology is set to be the future of lighting control.

DALI-2 is the new open protocol for bi-directional communication between lighting and control products. Being an open protocol, the standard, based on IEC 62386 international standard, is managed by the (DIIA) Digital Illumination Interface Alliance of which BEG is a member.

Compliance means that all member products will be tested to prove interoperability and will have additional functionality compared to the original DALI standard.

The new BEG DALI-2 range comprises a range of eight indoor and one outdoor multi-sensor detectors based on its most popular product styles, including the PD11 which is one of the thinnest detectors on the market today, with a surface thickness of less than 1mm.

The new BEG DALI-2 sensors and systems still use the same cabling and infrastructure layout as the traditional DALI.

The big advantages are increased functionality and interoperability, which means specifiers can quote DALI-2 safe in the knowledge they will be getting a competitively priced

> “The future is DALI-2 lighting control, from shops and offices to airports”

product, which is tested and approved to a known standard.

End users will benefit from excellent detection quality for movement and occupancy due to digital passive infrared sensor technology, and extremely reliable light measurement from the external light sensor. The future is DALI-2 lighting control, from shops and offices to airports.

The new DALI-2 standard means it is possible for sensor information, including movement, occupancy and light values, to be sent via the multi-master mode without cyclical queries. This information is standardised so that all BEG DALI-2 sensors can be used with all DALI-2 compatible controllers.

The main differences between standard DALI and DALI-2, is the inclusion of application controllers and inputs, which were not previously included in DALI.

The certification of DALI-2 has also been introduced to improve interoperability with devices now capable of being used together on the same DALI bus regardless of the manufacturer.

The range of BEG sensors cover a wide range of applications including offices, schools, hospitals, conference rooms, warehouses, loading ramps, underground car parks, gyms and halls. There are also more sophisticated sensors for the monitoring of corridors, public lavatories and archive rooms.

> “The big advantages are increased functionality and interoperability”

BEG has shown it is leading the way by becoming one of the first manufacturers to update its multi-sensors so that they meet the DALI-2 standard, which offers significant benefits over the original DALI.

The new DALI-2 multi-sensors offer electrical contractors and lighting designers a very sophisticated and fully adaptable lighting system for end users. We are pleased that BEG DALI-2 sensors are already being specified and installed into major projects in the UK.

www.beg-luxomat.com

Finding fault

Within any organisation, a defective electrical cable has the power to cause significant disruption to operations, making detecting and resolving these problems crucial – especially when high voltages are involved. Craig Collinson, operations director at Smith Brothers, explores the methods and expertise required in specialist cable fault testing.

As with many technical issues, it always seems to be the case that cable faults occur at the most inconvenient of times – when an interruption to the power supply is not just an annoyance but can also have significant financial implications.

For instance, an outage in the middle of a production line can create havoc for a manufacturer, whilst downtime for even a few hours can be very costly for a busy office. And of course, with any electrical infrastructure, safety is of paramount concern.

So, when it comes to identifying and fixing cable damage, acting fast to reduce risk and disruption is essential.

UNDERLYING ISSUES

A cable fault might occur as a result of a number of underlying problems – including water ingress, mechanical damage, poor materials, subpar jointing practice, partial discharge or age-related deterioration – many of which often aren't immediately apparent. Such issues can affect all types of electrical cable, no matter the age or voltage.

Arising from these complications, the most common are short circuit faults – which can be phase-to-phase or phase-to-earth – and open circuit faults, where a break in the cable occurs. A combination

> **Whilst the causes and catalysts behind cable faults are well-known, finding and repairing them is a complex process**

of the two can also take place and in many instances, the defect starts as a minor point of damage to the cable or joint. This is then exacerbated by a gradual ingress of water, causing a breakdown in insulation resistance to the point where flashover occurs – triggering the protective device and cutting off the mains supply.

In some instances, such faults clear once the protection has kicked in and are therefore known as transient faults. Although this may sound like a temporary glitch, it can be extremely disruptive. Detecting such intermittent problems is difficult – increasing the likelihood of issues recurring in the future and often leading to a permanent fault.

Where the outer casing of the cable has broken, this is classified as a sheath fault and – as with open and short circuit faults – can lead to a far greater issue if

water ingress occurs. However, if detected early enough, such external damage can be repaired, preventing possible cable failure in the future.

FINDING AND FIXING FAULTS

Whilst the causes and catalysts behind cable faults are well-known, finding and repairing them is a complex process that requires advanced equipment and technical expertise. Where there is suspected circuit damage, it's therefore vital to enlist an electrical cabling specialist to locate the fault, fix the problem and restore the power supply.

Following a call-out, engineers will review any protection that has been activated and conduct an insulation resistance test. Depending on the results of this initial assessment, they may attempt to re-energise the system entirely or in part, to re-establish mains supply where possible. They will then walk the length of the circuit route, inspecting the visible cabling, joints and terminations for signs of failure and additionally looking out for potential sites

of cable damage – including new structures or recent excavations, for example.

The next stage is to run preliminary tests to determine the characteristics of the fault. The observations from these are then used to inform which specialist equipment needs to be employed to locate it. Firstly, the general site of the fault is pre-located, then a more exact position pinpointed within this identified area, before excavations are conducted and further visual inspections carried out.

Portable TDRs (Time Domain Reflectometers) are usually employed at this stage for both open and short circuit faults. Combining advanced high voltage surge wave and arc reflection technology, this apparatus has a receiver that utilises acoustic and electromagnetic pinpointing, enabling the fault to be located within inches. Using such equipment, circuit lengths of up to three miles can be tested, making it invaluable for large-scale connections and infrastructure.

Although less technologically advanced, High Resistance Fault Locators are also widely used in the pre-location phase, for particularly difficult-to-find high resistance defects.

After the fault position has been identified, the necessary repairs to the cabling, joints and terminations are then carried out by the engineers. Once rectified, insulation resistance testing and continuity assessments can be conducted, to confirm all issues are resolved before the circuit is re-energised. VLF (very low frequency) testing is also often performed at this stage, to ensure any further cabling problems have been identified prior to the supply being restored.

> **Cable fault call-outs are often urgent, so a swift response is essential to minimise disruption**

SPEED AND SAFETY

Cable fault call-outs are often urgent, so a swift response is essential to minimise disruption – especially in industrial or manufacturing settings. After safety, the secondary priority is to get systems back up and running, so seeking assistance from specialist engineers with experience in the latest and fastest fault finding techniques is vital.

To prevent the need for such an emergency response, enlisting a contractor to conduct routine tests and carry out the necessary upkeep on cabling circuits is a good idea. Not only does proactive preventative maintenance mean that minor issues are spotted before they turn into larger problems, it can also be a cost-saving option for businesses in the long run – minimising possible downtime and removing the need for urgent call-outs, tests and repairs. ER

Recolight: Are you disposing of your waste electricals responsibly?

Incorrect disposal of hazardous waste could land contractors (and their customers) with prosecution, legal costs, reputational damage – and a fine.

Waste fluorescent tubes are regarded as hazardous, and it is illegal for a business to send hazardous waste to landfill. Electrical contractors and their customers have a duty of care to make sure their waste is disposed of correctly. This applies to all who:

- Produce or store waste.
- Collect and transport waste.
- Receive waste for recycling or disposal.

In the UK there is an increased awareness of the need to protect our environment. Business customers are increasingly adopting corporate social responsibility and environmental policies.

That frequently means they will want to be confident that their waste is being disposed of correctly. Contractors who can demonstrate that electrical and hazardous waste is being recycled can use this to their advantage to win new business.

But there is also a downside to not doing the right thing. There is a duty of care for all businesses to ensure that their waste is handed on to an organisation that is authorised to receive that waste. If a contractor disposes of that waste in an illegal fashion, both they, and their customer could be subject to enforcement action by the Environment Agency.

THE WEEE REGULATIONS AND HOW THEY AFFECT YOU

WEEE is Waste Electrical and Electronic Equipment. The WEEE Regulations were introduced back in 2007 to make sure that WEEE is treated properly and not sent to landfill. All fluorescent lighting, LEDs and light fittings are classed as WEEE.

The UK's four Environment Agencies, one for each UK nation, have reporting procedures in place for tracking, storing and moving WEEE.

TRACKING WEEE

The environment agencies require businesses to prepare consignment notes or waste transfer notes to track the movement of WEEE. These help make sure that the waste can be tracked responsibly from where it is produced through to its final destination. Copies of such notes must be kept for three years.

STORING WEEE

Storage exemptions enable low risk waste operations to be undertaken without complex permit controls. These are generally limited to small quantities of waste for use, or storage. Electrical contractors and wholesalers are typical of the type of companies that can benefit from storage exemptions.

All exemptions require you to store waste in secure containers with weatherproof covering.

MOVING WEEE

To move waste electricals, contractors need to register as a Waste Carrier with the agency in the county of their principal business. A tiered system for registrations as a waste carrier came into force in January 2014.

WASTE CRIME

The high profile that waste and recycling now has in the UK, means that the environment agencies have dramatically increased their monitoring of waste carriers. Spot checks on white vans are now a regular part of their routine and can result in cautions or prosecutions for companies that are not compliant.

ILLEGAL WEEE EXPORT IN THE NEWS

Recent press articles about the illegal export of electrical waste reinforce the importance of correctly managing WEEE. As a WEEE producer compliance scheme, Recolight ensures that the waste we manage is collected and treated responsibly within the UK, using authorised treatment plants. Recolight also organise regular, comprehensive audits of our contracted operators to verify compliance with the relevant UK Regulations and Recolight's own criteria.

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Implementing the IoT

Karl Walker, marketing development manager at Beckhoff, addresses some of the confusion surrounding the technology used in intelligent buildings and gives us some advice on the implementation of the Internet of Things.

When it comes to technology, if everything is operating as it should we just carry on as normal, forgetting how easy our lives are made 99% of the time thanks to modern innovations. However, when something goes wrong, we are quick to lament its failings, leading us to a subconscious trail of thought that makes us highlight the potential shortcomings of what could be a revolutionary new product, rather than consider the benefits it could bring.

If we consider some of the incredible technological advances from history, such as aviation, space travel, cars (both fuel-powered and electric), the internet and cloud technology, none are without their faults, but they pale into insignificance when compared to the ways in which we have profited from them.

> **“The IoT is starting to have a transformative effect on smart building automation and control”**

What is IoT?

The Internet of Things (IoT) is built on the idea that any object can connect to the internet. It is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators and connectivity which enables these objects to connect and exchange data.

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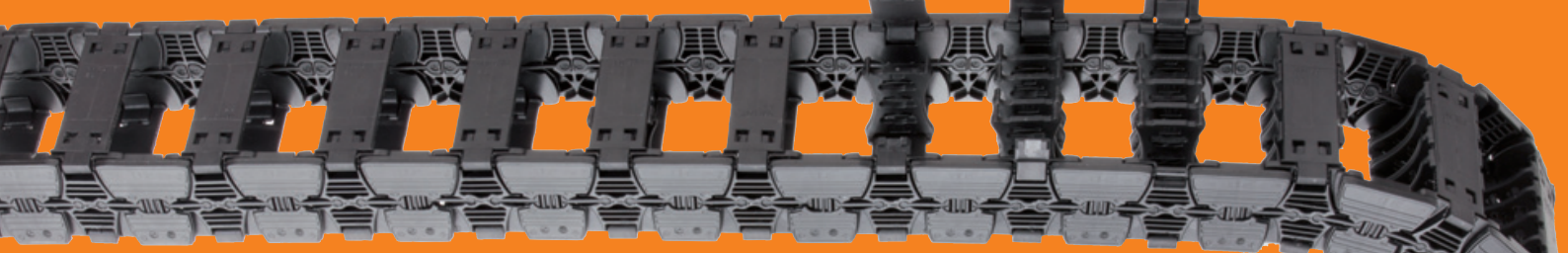

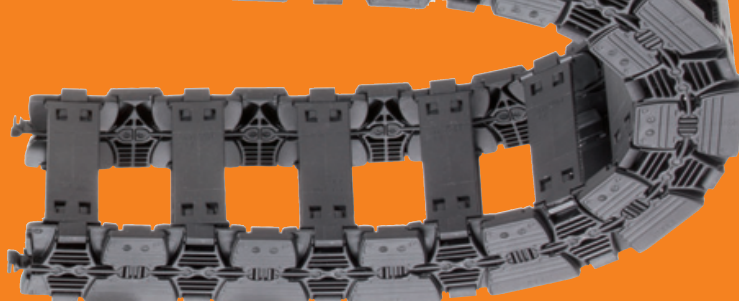

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This description has given rise to some rather wild theories about how technology is taking over the world and how we'll eventually be ruled by robots, and there have been some well publicised stories of where the IoT has gone "wrong".

A famous example from a few years ago is the story of the man who spent 11 hours trying to make a cup of tea using a Wi-Fi kettle. Stories like this do mean the IoT will continue to be met with some scepticism, but they often involve cases of poor implementation in consumer products and therefore cannot be used as a reason to lose sight of IoT's fantastic potential.

The whole idea of IoT is to facilitate the connection of disparate devices and allow them to exchange data using open, non-vendor specific protocols, and to make the data instantly available to the user(s) or other software applications.

What isn't IoT?

With so much smart technology about now it is too easy to assume that it is all part of the IoT. However, devices with built-in wireless connectivity that don't connect to a cloud-based service should not be classified as IoT devices. An example of this might be a wireless sensor that connects to a remote display device or datalogger. If its information is not made available to other devices it is not IoT!

Industry 4.0 is often mistaken for IoT. Industry 4.0 was a phrase coined in 2011 to encompass the revolution of automation and data exchange in manufacturing technologies via physical or cyber-physical systems, which aggregate raw data to higher-value contextual information to ensure interoperability of equipment, transparency of data across the plant and decentralised decision making. This does not necessarily involve IoT technologies and more commonly relies on industrial networks or 'fieldbuses'. However, more increasingly, the same outcomes are achieved via the implementation of IoT devices within the sub-systems.

There is no defined standard as to how IoT devices should communicate. IoT is not a 'fieldbus' like BACnet, DALI or Modbus. A smart lightbulb controlled by a wireless remote control is not IoT in itself. However, add a 'hub' (gateway), connected to the internet via a broadband router and now you have a potential IoT system. This relies on the manufacturer exposing their API to allow other applications and devices to control it.

> **"IoT is disrupting long established business models and offering significant new opportunities to improve the efficiency of buildings"**

IoT in buildings

The IoT is now starting to have a transformative effect on smart building automation and control. It is disrupting long established business models and offering significant new opportunities to improve the efficiency of buildings, raise employee productivity as well as stimulating the development of innovative services.

In tenanted buildings (domestic or commercial) there is a question about who takes ownership of IoT connections. If a smart building or home has been designed around a network structure then the landlord needs to own that structure in order to ensure smooth operation.

However, like energy suppliers, the tenant has the right to choose their provider. Changing a router to a new one provided by a new ISP could cause the smart devices to stop working (pending re-configuration). This raises the question about ownership; the most robust method would be for the landlord to own and maintain the system and provide a paid-for service to the tenant.

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How can IoT be implemented?

IoT's raison d'être is to connect devices and systems. The problem with most buildings stems from the fact that responsibilities for the implementation of mechanical and electrical systems are separated at the consultancy stage, then typically awarded as individual packages to different providers. Unless there is the overarching role of "master systems integrator", these systems are unlikely to be interconnected and will remain as individual silos of control.

The excellent standard, BS EN15232-1:2017, 'Energy Performance of Buildings. Impact of Building Automation, Controls and Building Management', highlights and quantifies how the convergence of all aspects of building control can result in significant energy savings, e.g. more than 50% for thermal energy usage in an office (Class A compliant vs. Class D).

A typical building control scenario: separate controllers for heating, cooling, ventilation and lighting require their own sensors (e.g. presence detection, temperature and humidity measurement) and (possibly) have limited communications functionality without the addition of additional hardware or a third-party gateway.

One solution to this usual piecemeal approach to building management systems would be to use a single controller for all aspects of building automation. This has the added bonus of only needing one set of input sensors whose data can be used by any function. With a single system it is very easy to interlock all control regimes, e.g. heating and cooling, lighting and shading, etc. Furthermore, it becomes significantly easier to publish all data directly to the cloud, from a single point, facilitating remote data capture, storage, analysis and management.

However, for a building with existing functional plant and control equipment (albeit unoptimised and perhaps not performing as one would hope), it might be unrealistic – or uneconomical - to take a "rip it out and start again" approach.

By using an overarching controller to aggregate operational data from all equipment, communication 'gateway' products or IoT software add-ons (such as MQTT data agents, if they are available for that equipment), it is highly likely that links can be established between these disparate pieces of plant and their data converged in a cloud platform.

Cloud based software could then be used to make sense of all this data and, combined with rules and algorithms and artificial intelligence or self-learning systems, control decisions can be made and new parameters sent to the relevant controllers to ensure optimum performance.

However, IoT is not the panacea to all control problems and there is no A to Z guide for its implementation. The reality is that it may not even be possible with some legacy equipment.

As with all problems, always have an outcome objective in mind, always look at building automation systems holistically, and – most importantly – ensure that the equipment you use is open, scalable, secure, and plays nicely with the IT world.

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Key Note Speaker

Jim Phillips

Jim is Vice-Chair of IEEE 1584 and International Chair of IEC TC78 Live Working. For over 35 years, he has been helping tens of thousands of people around the world understand electrical power system design, analysis and safety. Having taught over 2500 seminars during his career to people from all seven continents, he has developed a reputation for being one of the best trainers and public speakers in the industry. For more information about Jim, visit www.Brainfiller.com

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Renewable revolution: Rethinking the role of a UPS

Riello UPS general manager Leo Craig explains why our increased reliance on renewable energy offers mission-critical sites the perfect opportunity to rethink the role of their uninterruptible power supplies. It's time to turn a reactive, underutilised asset into a proactive, carbon-cutting money-maker.

WINDS (AND RAYS) OF CHANGE

It was a record-breaking 2018 for renewable energy in the UK, with sources such as solar and wind contributing a third of our total electricity. Indeed, renewable generation has increased by 95 TWh since 2005.

While these cleaner and greener power sources continue to grow, old-style coal, nuclear, and thermal power plants are slowly being phased out. Around 23 GW of thermal capacity has closed since 2010, with another 24 GW of coal and nuclear expected to go offline by 2025.

But this renewables revolution poses serious challenges for the electricity network. Compared to coal or nuclear, renewables are far more unpredictable – it goes without saying that you can't guarantee when the wind will blow or the sun shine. Our increasing dependence on these changeable low-carbon sources means maintaining a secure, stable supply and frequency becomes a tougher task.

The solution? A decentralised electricity grid with a wide range of power generators connected to the network, feeding in power or adjusting their energy use in real-time.

These smart grids help harness the untapped power of renewables through mechanisms such as battery storage and demand side response (DSR), which basically involves storing cheaper off-peak electricity and using it instead of expensive mains supply during periods of peak-demand.

And for mission-critical sites such as data centres, factories, and hospitals – often some of society's most energy-intensive environments – this opens up the possibility of using their backup power systems for a greater good.

DITCHING THE DOUBTS ABOUT ENERGY STORAGE

Despite its undoubted potential, battery storage is still looked upon with scepticism by such mission-critical settings. Even though if only 5% of our peak demand was met by DSR it'd be the equivalent of a costly new nuclear plant, for data centre operators, network administrators, and facilities managers big doubts still remain.

When 100% uptime is the priority, the perception remains that using a UPS system and its batteries for anything other than emergency backup power is an unnecessary risk.

But this simply isn't true. Rather than undermining system resilience, in reality, battery storage enhances reliability. And it opens up a whole new world of opportunities for IT managers to take advantage of.

An uninterruptible power supply is an essential part of any mission-critical site's infrastructure, ensuring a clean and

consistent flow of electricity and preventing the potentially catastrophic fallout from any mains failure.

More often than not though, a UPS system sits quietly in the background – an indispensable safety net, but it could so easily be described as an expensive, underutilised asset. How often is that backup power ever called upon?

Capitalising on battery storage transforms a UPS from the purely reactive into something truly dynamic. A 'virtual power plant' reducing energy bills, improving system resilience, and opening up new revenue streams. As we head into uncertain political and economic times, why would any site manager ignore these benefits?

WORKING IN A SMART GRID WORLD

While the more common sealed lead-acid (SLA) batteries can be used to store energy, premium lithium-ion (Li-ion) blocks tend to be far more effective. This is because they provide the same power density in less than half the space and weight, they have up to 50 times the cycle life, and they recharge much quicker.

In theory, this means more than twice the number of Li-ion cells can be installed in the same space, meaning you can retain enough autonomy for emergency backup, but also have the spare capacity for energy storage – the best of both worlds.

Admittedly Li-ion is still significantly more expensive than SLA. But the cost has fallen sharply, by 79% since 2010, and this trend is predicted to continue in the coming years.

And when you consider that Li-ion batteries will last for 10-15 years, during which time an SLA would probably need replacing three times, the total cost of ownership over a ten-year period is 10-40% less, more than balancing out the higher initial investment.

REAPING THE REWARDS – FIRM FREQUENCY RESPONSE (FFR)

Bear in mind that large data centres or factories typically require 30 GWh of electricity a year, which translates into a £3 million annual bill. While energy storage isn't purely the pursuit of this top end of power-hungry users, it's currently only commercially viable for organisations that use significant amounts of energy.

Across the UK though, there are thousands of sites with electricity costs in the £500,000-£1 million bracket that are more than suitable – data centres, utilities, hospitals, manufacturing plants, and more.

The National Grid offers such bodies a variety of incentives and mechanisms to encourage participation in DSR. There's something called Reserve Services, which aims to overcome any unexpected spikes in demand or drops in power generation. Short Term Operating Reserve (STOR) is probably the most common scheme. This gives guaranteed payments over two years for businesses to crank up power generation or reduce demand at 10 minutes notice, three times a week.

Another alternative is Frequency Response, which attempts to ensure a stable grid frequency within one hertz of 50Hz.

Firm Frequency Response (FFR) is only suitable for organisations that can meet the challenge of feeding in or turning down

> "Our increasing dependence on changeable low-carbon sources means maintaining a secure, stable supply and frequency becomes a tougher task"

> Capitalising on battery storage transforms a UPS from the purely reactive into something truly dynamic

demand by 1 MW within 10 or 30 seconds of a major event, such as a power station tripping out. But their rapid response, fast ramp times, and capacity to continually generate and absorb power make Li-ion UPS batteries ideally-suited to this task.

REDUCED ENERGY COSTS, ENHANCED RELIABILITY

Signing up to smart grids and energy storage obviously delivers a wide range of benefits, starting with lower electricity bills thanks to not having to call upon the mains supply during expensive peak times. Revenue from incentives such as FFR is welcome too.

But the rewards aren't simply financial. Think back to earlier... What's been the single biggest obstacle to participation in DSR? The thought that using UPS batteries for any other purpose apart from as an emergency backup would negatively impact on reliability.

In practice, one of the principal reasons why a UPS might not spring into action when required, is that there's been a battery failure. Because a comprehensive monitoring system for SLA cells comes at significant cost, many admins choose not to take up this option. And as SLA batteries are difficult to monitor, if they haven't been used for a while, can you truly know 100% that they'll be up to the task, if and when required?

Whereas for lithium-ion batteries, advanced monitoring is mandatory – each individual cell is closely examined to maintain balanced states of charge. The ongoing inspection and insight from the monitoring system boosts resilience and reduces the risk of battery failure when your backup is truly needed.

POWERING THE RENEWABLES REVOLUTION

Our increased emphasis on solar, wave, wind and other renewable sources can only be fully harnessed by mission-critical sites embracing battery storage. It offers facilities managers the chance to use their UPS systems as something more than just an ultimate insurance policy. Something that generates additional value.

Battery storage planning applications have soared by an incredible 1,653% in the last three years, with the UK Government's National Infrastructure Commission predicting more than 15 GWh capacity by 2030. Smart grid-ready UPS are ready to play their part in turning these lofty ambitions into reality.

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Building better

Pradyumna Pandit, VP of EcoBuilding UK and Ireland at Schneider Electric, explores the role intelligent buildings have to play in contributing to a smarter, more sustainable future.

The future belongs to smart cities. While it feels like we are far away from a reality without traffic jams, polluted air and power failures, change is happening fast. Global spending is projected to grow to £34.35bn by 2020, more than double the level of investment in smart cities in 2015.

Yet what is a smart city if not a collection of smart buildings? When we look at the cumulative impact of cities on the environment, buildings demand large quantities of energy and, often, waste it. Government and central planning can only do so much. Ultimately, it will take millions of businesses, upgrading and optimising their real estate in unison, to provide the smart cities future.

> **The Internet of Things (IoT) is at the heart of both a smart building and a smart city – without it, neither would be possible**

However, in addition to the many boons for the environment, smart buildings can also pay dividends for those who own and work in them. The potential for savings, innovation and optimisation within organisations is enormous. Smart buildings represent a substantial return on investment which businesses cannot afford to dismiss.

Smarter buildings = smarter cities

The Internet of Things (IoT) is at the heart of both a smart building and a smart city. Without it, neither would be

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possible. The power of the IoT lies in its ability to integrate the various and complex components and IT systems that comprise any modern building. It creates a cloud-based network where devices can communicate and collaborate.

Only through cross-system communication is real-time monitoring, optimisation and automation possible. When building systems can 'talk' with each other without the need for complex interfaces, the resilience of the infrastructure as a whole is strengthened. It provides access to a greater volume of intelligence, as well as a better use of building resources. Such a system augments an organisation's pursuit of greater energy efficiency, where the rapid collection of and reaction to massive amounts of information are essential.

For example, having IoT devices and sensors integrated with a heating, ventilation and air conditioning (HVAC) system, means that organisations can collect real-time data on all their products and services. Here, thousands of sensors are gathering data to be analysed while the system is communicating with the outside world. The data will include actionable data from outside the building itself, including electricity, utility and commodity prices. Then by understanding and organising this information, the system will enable organisations to take a fresh look at their current practices, generate business change and create efficiencies.

Of course, none of this would be feasible without the IoT's accommodation of automation. Tools that visualise and report utility bills, monitor assets, detect and diagnose system faults through benchmarking and analysis and enable fixes and optimisation are nothing new. However, most solutions have tended to demand a considerable amount of human involvement, reducing speed and overall effectiveness.

> **In the long term, the presence of a smart system saves energy and reduces waste, amounting to a substantial cost-saving**

The benefit of an IoT network where devices communicate with each other without the need for human intervention is that adjustments can be made on-the-fly and instantaneously, provided that the right software is in place. By taking advantage of the IoT to better manage the day-to-day running of a building or facility means that an organisation can reallocate its human capital to tasks where creativity and decision making are more important.

Waste not, want not

How then does this benefit an enterprise in practice? There are significant opportunities for greater efficiency and sustainability in an IoT-optimised environment. For example, consider an office that is minimally-staffed due to employees suddenly going out to lunch.

An occupancy sensor, integrated through the IoT to the building management system (BMS), will detect a reduction in the office's CO2 levels and set off an immediate chain of actions. It will communicate this data to the BMS, which will then switch off heating, ventilation and lighting systems and place the environment into a deep setback, low-power mode until the employees return.

Where this kind of system is absent, energy is wasted, emissions produced and money lost. Though relatively minor in isolation, the cost of, for example, leaving the air conditioning running on a cool day builds rapidly over time. Indeed, the energy efficiency potential of buildings stands at 82%. In the long term, the presence of a smart system saves energy and reduces waste, amounting to a substantial cost-saving.

Eagle-eyed efficiency

Smart buildings can also be a driver of superior maintenance. Proactive and predictive asset maintenance practices rely on the monitoring capabilities of an IoT-connected system. Taking care of equipment is cheaper and more effective when a building's devices are able to communicate with each other.

It is more difficult for failures and malfunctions to go unnoticed and unrepaired when a BMS can detect a fault and automatically schedule maintenance, all without human input. This cuts down on the number of equipment failures and instances of costly and unexpected repair work, helping to ensure that maintenance is scheduled for a time that is least disruptive and expensive to the business.

As the effects of climate change worsen and sustainability rises on the international agenda, our current cities are too large, too polluting and too inefficient to ignore. As they continue to grow, urban areas consume more than two-thirds of the world's energy and generate 70% of its emissions. If we are serious about tackling this, then we need to start at the bottom. More sustainable buildings that use less energy are our only recourse.

Yet sustainability does not have to be painful. The economic benefits of IoT adoption in factories, retail settings, work sites, offices and homes could total as much as $6.3 trillion by 2025.

Connected, intelligent equipment and systems have proven their ability to provide greater insight into performance and deliver a considerable, measurable return on investment. By forming the foundation of tomorrow's smart cities, they also have the potential to reduce energy waste and consumption on an impressive scale. Smart buildings are a smart decision, for people and the planet. ER

> **As they continue to grow, urban areas consume more than two-thirds of the world's energy and generate 70% of its emissions**

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Cloud-based cooling

Cooling units are playing an increasingly important role in Industry 4.0. Seamless communication between cooling units and associated cloud-based systems is opening up opportunities for new applications. Karl Lycett, Rittal's product manager for Climate Control, explores why IoT-capable devices such as the cooling units and chillers in the Rittal Blue e+ range are essential to these applications.

During the lifetime of an enclosure cooling unit, the costs incurred for energy, maintenance and service are usually much higher than the initial investment in the unit itself.

Optimisations carried out during maintenance can help reduce workload and thus lower costs, for example through predictive or needs-based maintenance. Needs-based maintenance, however, always requires information about the individual cooling units and the surrounding conditions.

A typical example is replacing a fan before a fault occurs, which otherwise – in the worst-case scenario – could cause not just the cooling unit, but the entire system to fail. If there is historic information available to plant operators about the fan's running time, the difference between its expected and actual speeds, and its power consumption, then it's possible to identify a gradually developing fault or an impending failure. This means that vital components can be replaced early on, increasing the overall system's availability.

Other information, such as energy consumption, the condition of individual components, ambient conditions, or even the level of soiling on the filter mat, can also provide useful data, and practical opportunities to optimise maintenance and energy efficiency.

It's not surprising, therefore, that seamless communication of information between systems is growing in importance. In a state-of-the-art factory, where data is easily available as and when required, the sight of maintenance technicians walking from one cooling unit to another, jotting down information with a clipboard and pen, is a thing of the past.

NETWORKING IS POSSIBLE NOW

Rittal equips its climate control solutions with a comprehensive range of communication options.

Using the new IoT Interface, Rittal units can communicate directly with superordinate systems and network with customers' in-house monitoring and energy management systems. As a result, data such as the internal/external temperature of enclosures, and the temperature of condensers and evaporators, can be continuously evaluated.

Added to which, the run times of compressors and fans is easily accessible, as is information on capacity utilisation, messages and unit settings. Plant operators can therefore identify potential malfunctions early on, improving the reliability and availability of their systems.

Numerous industrial protocols are supported, allowing climate control solutions to be integrated into IoT applications, which paves the way for smart service solutions. Additionally, information from the units can be used in cloud-based systems for a wide range of analyses.

PREDICTIVE MAINTENANCE AND DATA ANALYTICS

At last year's Hannover Messe, Rittal demonstrated the future of Industry 4.0 applications such as predictive maintenance and data analytics together with Siemens MindSphere and IBM Watson IoT.

Industry 4.0-capable Rittal units were integrated into Siemens MindSphere. This cloud-based, open IoT operating system enables

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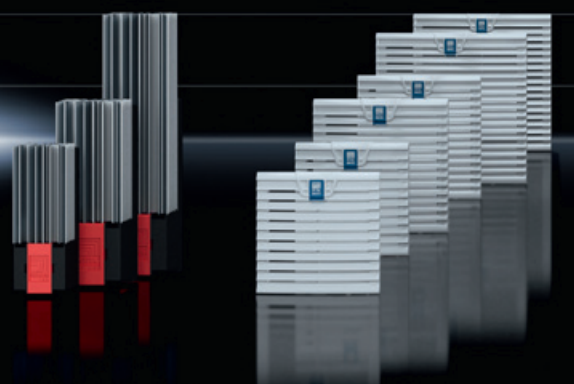
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> Needs-based maintenance is cheaper than carrying out maintenance work at fixed intervals and raises system availability

users to develop their own Industry 4.0 applications. Using Siemens MindSphere, the platform is scalable and can capture and analyse huge volumes of data – paving the way for smart-factory applications, for example, in predictive maintenance, energy data management and resource optimisation.

As I indicated at the beginning, needs-based maintenance is cheaper than carrying out maintenance work at fixed intervals, and raises system availability. Our solution also calculates the shortest routes between calls for service engineers, which eliminates wasted journeys at facilities with a large number of machines. And live data on each unit means staff can bring the right spare part with them straight away.

Rittal products also interoperate with the cloud-based data analytics system IBM Watson IoT. Watson's architecture is designed to process information rapidly and employs machine-learning algorithms to analyse ever-growing data volumes. Data analytics applications are used to make maintenance more efficient and achieve a high standard of operational reliability.

Again, customer benefits include improved machine availability and optimised maintenance costs. The solution's new technologies also make new business models - such as smart maintenance contracts - possible.

VISUALISED DATA IN THE COCKPIT

With the introduction of the Blue e+ cooling unit series, Rittal has set new standards for the energy efficiency of electrical enclosures.

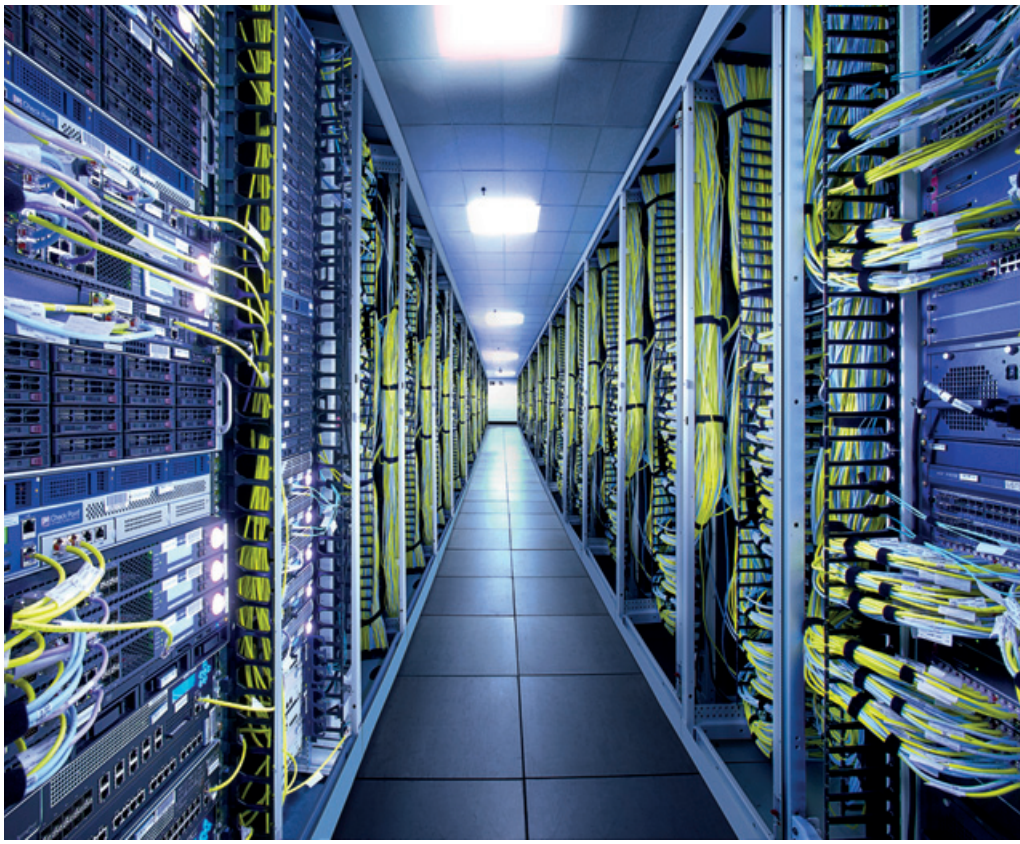
Thanks to diagnostic software, users can go a step further, and save more energy through the optimum operation of their cooling units. Comprehensive information is essential of course, and all the relevant data is provided by the new data cockpit in RiDiag III. All the information collected from the cooling unit's numerous sensors is clearly displayed and evaluated, including temperatures, the input voltages and currents at the compressor.

The EER (Energy Efficiency Ratio) display is particularly useful, allowing users to track how energy efficient the cooling unit is under specific environmental conditions and with specific settings. By analysing the data, users can optimise parameters, achieve additional efficiency improvements and hence lower costs.

What we've wanted to show in this article is how how the IoT Interface can be used, providing an insight into future Industry 4.0 applications and their potential benefits. All this stems from the seamless transmission of data from sensors inside the cooling units and chillers to the cloud.

Intelligent grid connections

Stephen Jones, ABB Power Grid's head of business development for the Distributed Energy Sector, explains what makes a grid connection intelligent – and how this can help data centre operators.



Growth in the data centre sector has been mind blowing. Ninety percent of all the data in the world today has been created in the last two years. Our personal and business lives are now more reliant than ever on timely and accurate data processing. And as machine-to-machine communication and the Industrial Internet of Things become more popular, our reliance on data centres is set for more exponential growth.

This poses a huge challenge for data centre operators. According to the 2018 annual survey from the think tank the Uptime Institute, many data centres are experiencing more outages due to growing complexity. In addition, they are under pressure to reduce energy consumption, which will both reduce energy bills and carbon dioxide emissions. As a result, data centre operators need to know that they can rely on always-on power from the grid.

This is where intelligent grid connections come in. They are systems that integrate all necessary hardware and software into a none comprehensive solution to assure high reliability, interoperability and real-time performance management of the data centre. As with the technology at the heart of the data centre itself, advanced digital technologies are essential for intelligent grid connections. In addition, they can be delivered quickly and effectively.

FAST-TRACK GRID CONNECTION

When planning to extend capacity or build a new site, many data centre operators face the challenge that grid connections often require long lead times.

At the root of this issue is that there is often high demand for new connections, for example from property developers, industry, renewable energy developers and other data centres. However, utility companies often have limited resources available to meet demand. As a result, their new connections teams are often booked well in advance.

In 1997, Ofgem recognised the need to offer an alternative, so brought competition to the market. Today, Lloyd's Register Group operates certified Independent Connection Providers (ICPs) under the National Electricity Registration Scheme (NERS) on behalf of the UK's distribution network operators.

> **Ninety percent of all the data in the world today has been created in the last two years**

ABB Power Grids is one of a select group of contractors that is accredited to deliver grid connections at voltages from 11 kV to 132 kV sub-transmission level. This gives us the capability to create new grid connections on a turnkey basis, only calling on the utility to provide the connection point.

ONE-STOP-SHOP

Working on this basis, we can consult, design, engineer and construct a complete substation, managing the entire project, including civil engineering, installation of substation equipment, commissioning and testing.

One example in the UK is at Telehouse's Docklands campus, where we delivered twin grid connections to two separate 132 kV distribution grids. By tapping in at this voltage level, Telehouse can avoid paying DUoS (distribution use of system) charges and by connecting to two separate grids, the operator gained a redundant supply. This

is helping it achieve its goal of 99.999% availability. In the case of an outage on one supply, the feed will switch seamlessly to the other feed.

With our Power Consulting Services, we can support data centre operators with reliability, operational and energy cost optimisation, power quality analysis and full electrical site audits.

This required installation of two 132/11 kV grid transformers and 132 kV ELK-04 gas insulated switchgear (GIS) as well as medium and low voltage switchgear and transformers. ABB created an indoor substation design on a small footprint to minimise the space required inside the building. Indoor substations also increase physical safety and security for the data centre operator.

DIGITAL SUBSTATION AND AUTOMATION

We also provided a SCADA interface to enable Telehouse's operating technicians to monitor the substation remotely.

Going beyond the SCADA system, digital substation and automation brings additional superior benefits: reduced footprint, less site works and commissioning, increased safety (from reduced electric hazards risks) and system reliability.

It's possible to apply the IEC61850 standard down to the primary assets, by digitising all control, measurement and condition monitoring information from the equipment to the control and protection panels. ABB Power Grids can deliver a state of the art fully integrated digital substation solution that includes the use of Digital CTs, VTs, I/Os and sensors.

BALANCING COST AND SPACE SAVINGS

Operators of city centre facilities want to house substations indoors or in very compact sites. As a result, they often order the most compact equipment available. For example, they typically opt for GIS switchgear, as Telehouse did for its Docklands campus.

Dry-type transformers are another option to minimise footprint. They are made with solid insulation that is compact, non-flammable, non-combustible and that has no chance of leakage. As a result, they are often used in indoor substations where there is little space for oil containment, perimeter clearance and fire-rated walls.

> **As machine-to-machine communication and the Industrial Internet of Things become more popular, our reliance on data centres is set for more exponential growth**

A recent development in dry-type transformers is that they are now rated at up to 72 kV, which makes them an option for some indoor data centre grid connections.

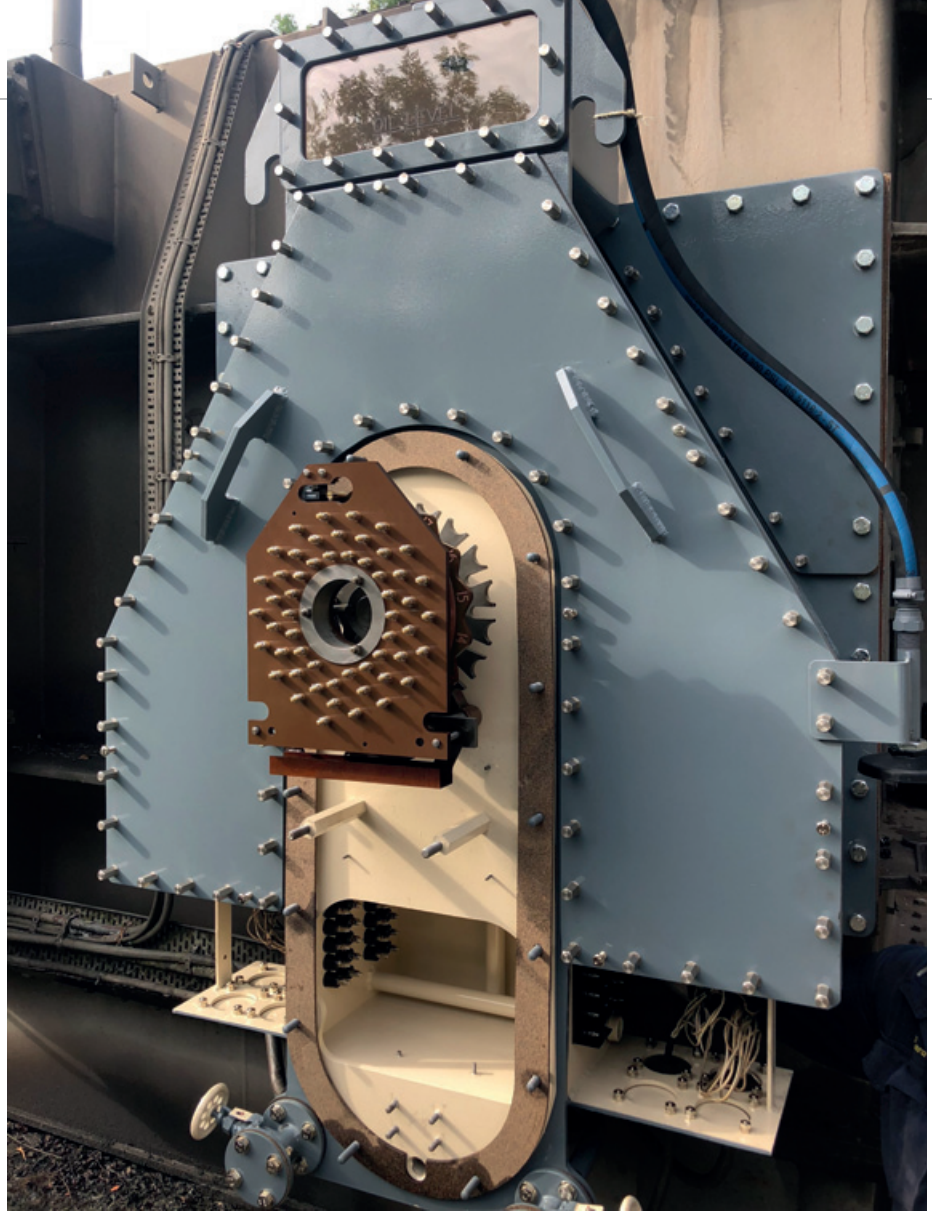
Operators of data centres in areas where land is abundant and low cost, may prefer to opt for a substation based on air insulated switchgear (AIS), although this requires a lot of space. Alternatively, they can opt for hybrid switchgear such as ABB PASS (plug and switch system) switchgear. This combines elements of both AIS and GIS in the same module, therefore is a compromise between compact and low-cost solutions.

While it is available in different configurations, the PASS M0H is particularly useful for data centre applications as it includes all the functions of a complete switchgear bay in an H configuration. This makes it suitable to control the flow between two incoming and two outgoing circuits.

FULL LIFECYCLE PHILOSOPHY FOR SERVICE SOLUTIONS

ABB Power Grids provides lifecycle services with service solutions spanning from rapid response and operational excellence, including high performing service level agreements, to performance improvements and lifecycle management.

Being experts in grid technology, we can help utilities and end users to expand and extend substations to meet growing power demand from data centre operators. The result is that data centre operators can plan their business growth with confidence. ER



Dr Jonathan Hiscock, managing director of Fundamentals Ltd gives us an insight into why tapchangers are so important in the power grid, how their performance can be enhanced, their reliability extended and what to expect if they're not properly maintained.

Tapchangers: The Fundamentals

WHY TAPCHANGERS?

The purpose of a tapchanger is to safely switch between the tapped windings of a power transformer in order to modify its output voltage. Tapchangers are critical for the performance of the grid. They are used to keep voltage levels within statutory limits; something network operators are obliged to do and which is an increasingly challenging task, as the dynamics of the grid changes with the realisation of the low carbon economy.

There are two generic types of tapchanger, on-load tapchangers (OLTC) and deenergised (also known as off-circuit) tapchangers (DETC). The main difference is the OLTC can be operated without interrupting the supply of power, whereas an off-circuit tapchanger must be deenergised and isolated from the energy network in order to be operated, which of course interrupts the supply of power.

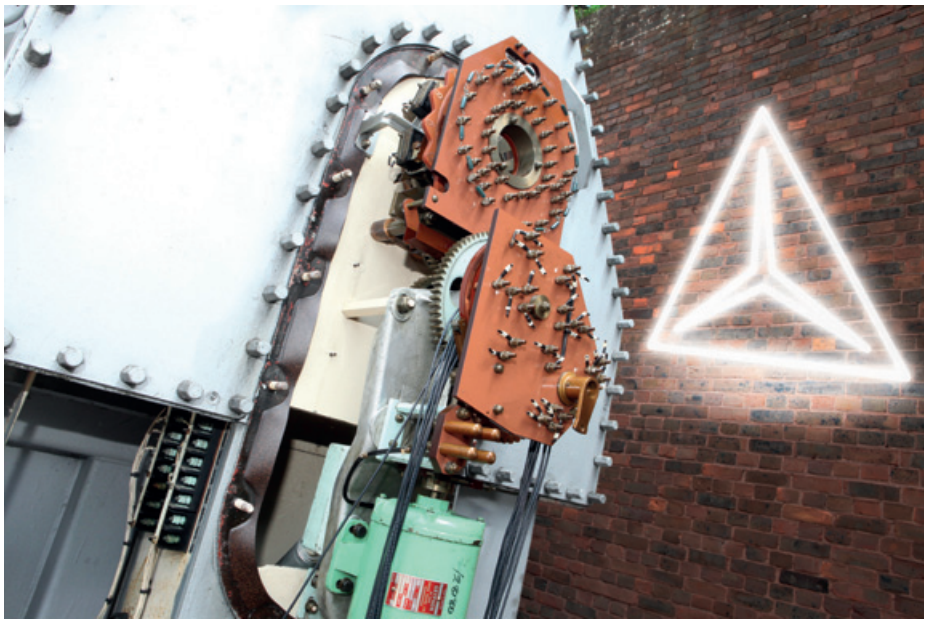
Most network power transformers are equipped with OLTCs since they commonly supply many customers and experience regular system voltage variations which need to be corrected. Off-circuit tapchangers are typically found on secondary or more local transformers, where fewer customers are supplied and voltage variations are more seldom.

ESSENTIAL SERVICING

The tapchanger is arguably one of the most vulnerable parts of the transformer since it is the only moving part, and like any mechanical device, requires regular maintenance to ensure optimum performance. OLTCs are in continuous use and experience arcing between contacts during every tapchanger operation. This causes degradation of insulating oil and contact wear which over time can compromise the integrity of the tapchanger.

A typical OLTC has a recommended service interval (time between maintenances) of ten years or less. It is critical to ensure that service requirements of OLTCs are observed in order to maintain the health of the transformer. Service of OLTCs is quite often overlooked or not done properly (an oil change is not maintenance!) which can increase the risk of failure.

Tapchanger failure can ultimately lead to total failure of the transformer itself which can be extremely costly. It is estimated that up to a third of transformer failures are caused by tapchanger failure. The cost of replacing a transformer is around two orders of magnitude higher than a scheduled tapchanger maintenance or repair, so it does not make much sense to try to save money by avoiding regular service.



Considering the typical service life of a tapchanger is less than ten years, (depending on the tapchanger specification) maintenance should be performed by the Original Equipment Manufacturer (OEM) in order to ensure technical updates are carried out and that all parts and accessories are produced and manufactured to original designs and specifications and fitted correctly.

COMMON ISSUES

Many tapchanger problems can be related to the external motor-drive mechanism and control scheme. These are often overlooked and can result in incomplete tapchanger operations and tapchanger 'run aways' (where tapchangers run to end positions) with extreme high or low voltage conditions. Typically, with these issues, control schemes are 'locked' in a fixed tap position, voltage control is disabled and grid performance compromised.

These aren't strictly failures, but they do lead to some down-time and extra repair costs and are ultimately caused by a lack of maintenance. Even where maintenance of the tapchanger has taken place, the drive mechanism and control scheme are often overlooked. Tapchanger drive mechanisms and control schemes can be upgraded and modernised to improve reliability before such issues arise and should be considered as part of tapchanger servicing.

IS SERVICING A DISRUPTIVE PROCESS?

Normal tapchanger service can tan take one to two days for a technician to complete, depending on the scope of the work. In order to work on a tapchanger, the transformer must be switched out and isolated. This does not normally disrupt power flows to customers since transformers are operated in parallel for security of supply, and load will be picked up by other transformers in service. However, servicing is disruptive in respect of the need to remove insulating oil and gain access to the internals of the tapchanger so that inspections, measurements and replacements of parts can take place.

Occasionally, a spare tapchanger, often referred to as a 'traveller', is kept on site where more extensive maintenance is required due to high amounts of tapchanger operations and/or heavy loads (e.g. arc furnace transformers). To minimise down-time, the spare tapchanger is fitted in place of the one to be serviced so operation can be resumed very quickly. The serviced tapchanger then becomes the spare, ready for the next outage.

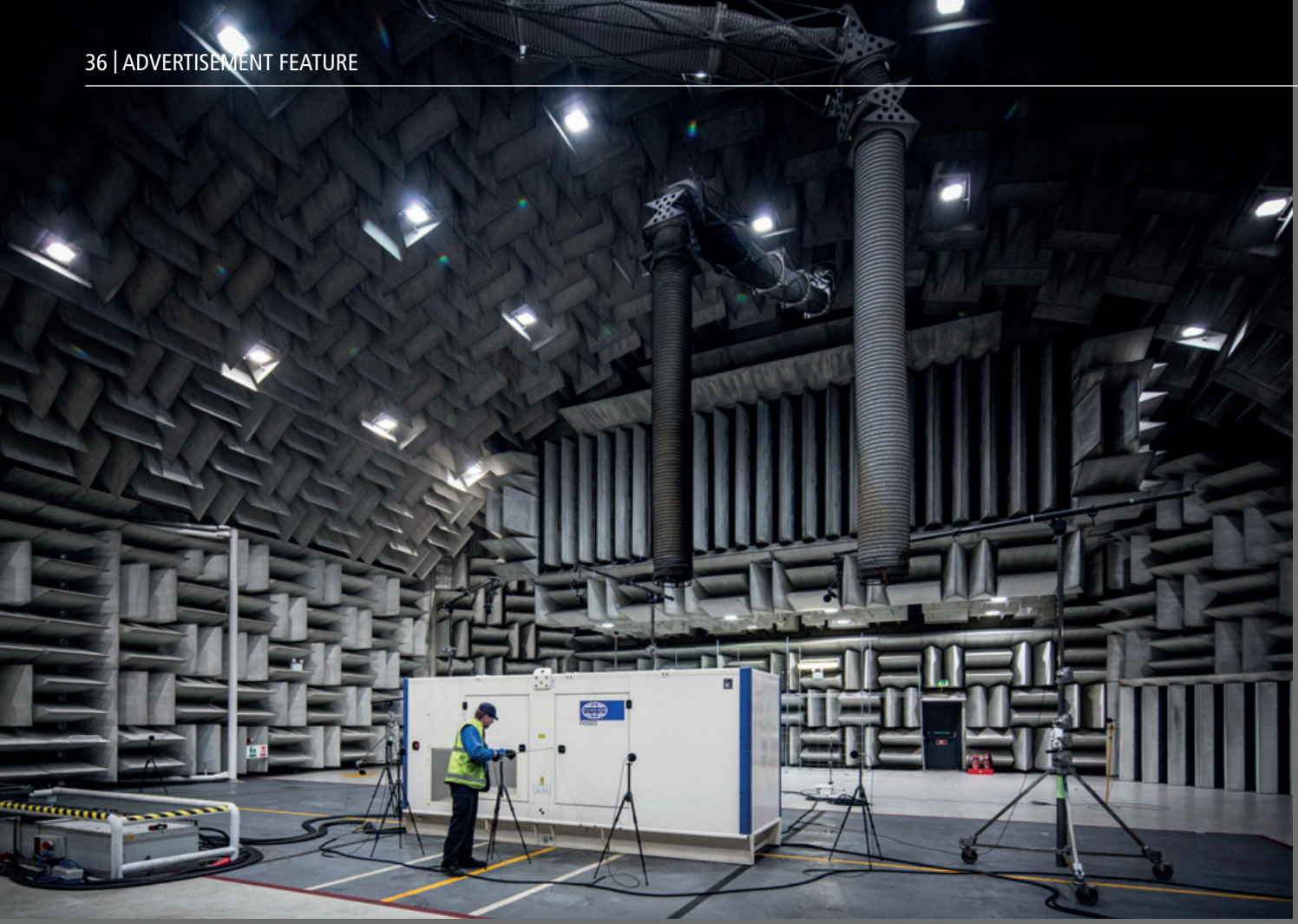
WARNING SIGNS

It is very difficult to determine the condition of the tapchanger without an internal inspection. However, with good records and regular maintenance tapchanger condition can be monitored. Even then, loading conditions can change due to the demands of the network which can lead to increased tapchanger duty.

The current drawn by the tapchanger-drive motor can give an indication to the mechanical integrity of the tapchanger and can therefore be monitored. However, it will not give any information about the type of problem which might exist. Dissolved Gas Analysis (DGA) is often used to detect gases which are indicators of internal faults in oil-filled transformers.

On-line DGA units can be fitted in order to continuously monitor transformer health. This can also be applied to tapchangers, but the various diverter/selector configurations need to be taken into account. The tapchanger diverter is the part which switches current and therefore expected to contain particular gases, whereas the tapchanger selector determines the transformer tapped winding connection and does not. Although absolute gas concentration levels will not give any particular health indication, the trending of the levels will indicate if problems are emerging and prompt an internal inspection. ER

> "Tapchangers are one of, if not the most vulnerable part of the transformer"



Generator sets: Evolving for a new generation

Paul Creighton, managing director of FG Wilson outlines the benefits of generator sets and although a tried and tested technology, explores how and why they have developed into what they are today.

As a way of providing guaranteed electric power, generator sets have been around for a long time and the simple economics of securing reliable power supply mean that they are a strong consideration for many people.

FG Wilson has been manufacturing generator sets for over 50 years, installing more than 640,000 worldwide since 1990. Paul Creighton is the newly-appointed managing director of FG Wilson, and with around 30 years of commercial and product background in the industry, he knows and understands the business very well, "When it comes to guaranteeing standby or emergency electrical power, in terms of cost, flexibility and responsiveness, for many people, the best option is a generator set."

Diesel engines are the most common prime mover for generator sets and the reasons have always been practical: compared with other engines, they are economical to run, easier to service and maintain, fuel is safer to both store and transport than petrol or gas, and engines are durable.

Because the engines operate at relatively low RPM in power generation applications, they can expect a long working life if well maintained, and in countries where usage is high, examples of generator sets with 30,000 operating hours are not uncommon.

The basic technology in a generator set today is well tried and tested. FG Wilson can point to a 70-year-old 50 kVA unit on display in one of its factories which wouldn't look out of place at a customer site today. However, as Paul notes, "What has changed is the efficiency of the generator sets you see now. The 70-year-old 50kVA generator set is about the same size as a 250 – 300 kVA generator set today."

That reduction in size, in other words the improvement in power density, means a corresponding reduction in both fuel consumption and in emissions from generator sets, with emissions further reduced by new engine technology.

FG Wilson engines are sourced from UK-based manufacturer Perkins, designed in the UK, and among the most modern and fuel-efficient engines available. All meet or surpass standards wherever the engines are being used.

Rightly, there's growing interest in renewable sources of energy. Paul remarks, "We're seeing this in many applications where a generator set may be running for four or five hours a day and customers are seeking to reduce operating costs by adding a renewable element."

"We're working with some global telecoms networks and for one of them, we're supplying hybrid generator sets with solar panels as part of the package. Thinking ahead, in countries where generator sets may be running for several hours a day, we can see solar panels, batteries, wind turbines and generator sets all linked and capable of powering settlements or customer applications."

"In countries where the mains supply is more secure and power outages are less common, energy storage is starting to become an option for some users. These are usually domestic or other light users of electricity, who may have enough electrical energy stored to see through short outages.

"However, where you have a facility which requires substantial electric power, like a data centre or hospital, current renewable and energy storage technology is not well enough developed to be a commercially viable option for standby power.

"For guaranteed continuity of power, you still need a generator set, but that might exist along with some renewable energy sources, so you could end up with a slightly smaller generator set installed or perhaps run on batteries for a very short outage."

For FG Wilson products today, the watchwords which design engineers live by are customer operational efficiency and keeping customer operating costs low. That means long service intervals, up to 1,000 hours on some of the popular small models with fewer parts consumed and fewer maintenance calls.

> "Every new FG Wilson design is thoroughly validated at the UK facility, including 500 hours of testing at full load power rating"

Reliability in service is also a big priority. Every new FG Wilson design is thoroughly validated at the UK facility, including 500 hours of testing at full load power rating, covering maximum cold load step and hot load step and further testing for vibration, engine/alternator cooling, electromagnetic compatibility, noise, water ingress and rating/transient performance.

Coming from an engineering background, Paul sees this as especially important. "We're a volume manufacturer and we take reliability extremely seriously. We know that thorough upfront design, testing and validation all lead to superior reliability throughout a product's lifetime and that this can really save customers a substantial amount of money over time. If you add to this the wide and efficient FG Wilson dealer network with fast delivery of parts, it really does make a difference."

The cold facts

Graham Wright of the Heat Pump Association dispels some common confusion surrounding heat pumps, and explains why this often underrated technology is becoming a favoured form of heating for the future.

In 2018 the UK continued to commit to more energy efficient building practices. This was underlined in May in a speech by Prime Minister Theresa May, which committed the UK to reduce its building energy usage by half.

Theresa May's reference to more energy efficient buildings and smart technologies was certainly welcomed by the Heat Pump Association (HPA) as heat pumps represent one of several environmentally friendly heating solutions for the long term.

This is a view shared by Claire Perry, Minister of State for Business, Energy and Industrial Strategy, who declared during a debate in Westminster Hall on 10th October 2018, that she would like to see people in rural areas being supported with technologies like heat pumps.

While we acknowledge that a major short-term shift to solely heat pumps would be neither practical nor sensible, it should not be denied that heat pump systems of all genres are capable of significantly reducing carbon emissions.

Misinformation inevitably has led to concerns in some quarters over whether heat pumps present a suitable option for enough properties for them to be considered a viable long-term heat source, but in my view the case for heat pumps, made a long time ago.

We need to ensure that our focus on delivering heat pumps to the domestic market is sustained as it has been in the commercial sector, with significant success and recognition in aspects of building design.

ENERGY OUTPUT

Heat pumps do work better in well insulated buildings, but the same can be said for all heating systems, in the sense that this means less energy output, wherever it is derived from, is required.

However, if a building needs heating to a particular level then it will need a finite amount of energy (kWh) each year to achieve that, regardless of the source of heat. Hence the most optimal method to provide that amount of energy will need to be sought.

You can find many examples of low energy, low running cost heat pump systems installed in thermally poor buildings, including Grade 1 listed buildings with no insulation and original leadlight glazing. A badly insulated building may require slightly higher flow temperatures than ideally desirable if existing heat emitters are to be re-used, which may reduce the efficiency slightly.

Take an old Victorian house with no insulation in the cavity and 50mm in the roof void. If the radiators have been selected using a crude rule of thumb it may be they are massively oversized when working at say a 70°C flow (typical of condensing boilers).

With no additional treatment of the building, they could provide enough heat output at a reduced temperature of say 55°C from a heat pump, but that is not the most ideal operating temperature for a heat pump.

However it's discovered (by checking all the radiator outputs at 45°C) that by increasing the size of all of the radiators requiring a flow of say between 45-55°C, the system

> Heat pumps represent one of several environmentally friendly heating solutions for the long term

can run at design conditions at a maximum flow temperature of 45°C and satisfy the heat demand. Hence by uprating certain radiators, the system is more efficient and this will result in lower running costs.

Of course by insulating the cavity, the overall heat demand will reduce and now the existing heat emitters may be sufficiently sized to provide the new demand at a lower flow temperature that suits heat pumps. This will have the added benefit of reducing the energy demand for heating and hence reduce fuel bills, regardless of the heating system employed.

Another false belief is that heat pumps only work with underfloor heating. In fact, this is a slight misapplication of a correct principle, the principle being that heat pumps work better with as low as possible delivery (load side flow) temperature.

Underfloor heating can work effectively at flow temperatures of 35-40°C if correctly designed, and the building can be effectively heated with a low temperature source. Natural or fan convector heat emitters will generally need to be quite larger than previously or run at slightly higher temperatures, resulting in small reductions in efficiency.

SEPARATING FACT FROM FICTION

While there is an element of truth in the belief that air sourced heat pumps aren't efficient in cold weather, stated alone it is misleading and therefore needs to be put into context. Heat pumps do work more efficiently in higher source temperatures and lower delivery (load side) temperatures, but the heat pump's performance must be assessed over a year.

This gives rise to 'seasonal' figures, whether Seasonal Coefficient of Performance (SCoP) or Seasonal Performance Factor (SPF). These seasonal figures either predict the performance over a typical year for a typical weather pattern, or actually measure the performance over a season.

I will emphasise here that SCoP and SPF are similar, but not necessarily exactly the same. This is further complicated by the fact that some standards (e.g. the EU RED) use them incorrectly or interchangeably.

In general, SCoP is the predicted seasonal efficiency of a piece of equipment, whilst SPF is the measured performance of a heat pump system, but which can include or exclude various components such as circulation pumps etc.

Although our damp oceanic climate requires higher than average defrost cycles than a drier environment would, the oceans around us to tend to keep the winter temperature higher than more land-based countries (e.g. central Europe) and this offsets much of the reduced efficiency from defrost cycles – something which may not be represented in standard tests from other European countries.

> It cannot be denied that heat pump systems of all genres are capable of significantly reducing carbon emissions

> It is crucial that the heating industry as a whole continues to develop technology for a greener future

WET THEORY

A question we're often asked at the HPA is whether your average garden pond is able to support a water sourced heat pump. Unfortunately for green conscious lovers of aquatic life, the short answer is no.

Any source needs to have sufficient heat capacity (in this case volume) to deliver the required amount of heat energy until the heat is replenished. A pond 4m in diameter and 0.5m deep is likely to hold just 37kWh of energy, meaning it could supply a heat pump of 8kW for just over 4.5 hours full load. And this is assuming that the heat is replenished in the pond by the next time heat is required.

While there is still work to do to give the wider public a better idea of how heat pumps work and their benefits, I hope this article has gone some way to clear up some of the confusion in the industry surrounding heat pump technology.

In the meantime, it is crucial that the heating industry as a whole continues to develop technology for a greener future and increase awareness with accurate information on the various technologies available.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A smart move

Smart Tech adoption is gathering pace. This is not only good news for retailers of all sizes and types, but also for the electricians and professional installers that can help facilitate the connected home. Liam La Cumbre, commercial director at Exertis explores how electricians can seize this opportunity and take the consumer on a smart tech journey.

Over the last two years, smart speakers, from the likes of Amazon with its Echo range and Google with its Home product, have seen an explosion in sales in pretty much a two-horse race.

A recent report from Consumer Intelligence Research Partners showed that sales of smart speakers in the US had reached 66 million units, virtually double in number since December 2017. In the UK, the number of smart speakers is set to grow by almost a third in 2019, after doubling this year according to eMarketer research. Total smart speaker usage will grow another 31.6% to 12.6 million people.

That forecast is understandable with prices continuing to fall and both Amazon and Google heavily marketing their respective products, the proliferation is set to continue with British households second only to the US in adoption. Analysts largely agree that awareness has grown considerably and there is a healthy appetite to invest in building a connected home.

The growth in the smart speaker market is important for two reasons. Firstly, they are often the introduction to consumers into the smart tech market and secondly, they help drive adoption of a wider range of smart home accessories and devices, becoming the hub to control a variety of products and appliances that are Alexa or Google enabled.

Smart tech adoption is a journey that should provide opportunities beyond a single purchase. Interestingly, Futuresource Consulting's Smart Home Devices and Appliances 2018 consumer survey revealed that 34% of UK households had at least one smart home device installed. So, there is clearly an appetite for smart tech in the home.

Of course, smart home gadgets that let you turn your lights on, control your heating or secure your property from your smartphone are appealing, but controlling a range of devices by simply using a voice command adds even more convenience to the home owner.

As more smart home manufacturers have seized on the smart speaker opportunity, by default the speakers have become the hub that is controlling anything from lights to security cameras. Adding a display, either already built-in to the speaker or connected to a TV, that lets you see who is at your front door or back gate from the comfort of your living room is even better.

Whilst voice has certainly contributed to breaking down certain barriers to adopting smart home technology, there are still other concerns to overcome. The major challenge for the whole industry is the education of the consumer on the products, their features and benefits of having smart technology in the home. It's the classic "If you don't know, you don't know scenario".

Retailers need to understand the benefits of the products they are selling – not easy when there are so many to choose from – and ensure that they fit within the customer's eco-system. Smart tech, if sold properly, has the potential to drive incremental demand as products can be added over time so that lights, switches and sockets, cameras, sensors and audio systems can be gradually introduced.

The electrical trade also has a great opportunity to both educate the consumer and increase their own value add service. There are increasingly more solutions that can be added to existing fixtures and fittings to upgrade them to become smart, improving the quality of life as well as protecting people's homes and reducing their bills with more efficient technology.

The opportunity can often be overlooked – but many upgrades are quite easy to deploy yet offer incremental sales. A simple, "Did you know that your kitchen light switch can be replaced with a Google or Alexa enabled switch?" The customer often needs to hear it from the experts to be convinced it can be done!

Whilst a certain number of smart tech products can be DIY installed, installation is often seen as a barrier and electricians and installers can therefore play a huge part in driving continued adoption. By ensuring that the products they install not only meet the expectations of the customer, but also meet the highest safety standards both in terms of security and privacy, electricians can become the homeowner's trusted adviser.

With so many me-too brands on the market that are less compliant but often cheaper, it's important to stick with established brands that have built reputations based on the quality of their products. A successful installation is very likely to result in repeat business for the electrician and many independent retailers retain good professional electricians to increase the value of their proposition. People like to buy from people they trust, and independent stores are often seen as pillars of the community.

Of course, new properties can be constructed to accommodate a fully functional connected home. Demand for smart tech to be incorporated in new homes will be driven by millennials who will expect the technology to be part of the specification. Analysts suggest these homes will sell faster and for more money.

But whilst, the light switch may not always be in the right place in an older dwelling, help is at hand with wireless technology. Friends of Hue push buttons have been developed, that enable switches to be freely positioned on the wall without the need for electrical wiring or installation. They can be placed almost anywhere – even on surfaces such as glass or wood. In addition, they don't need a battery. So, for those homeowners that don't want to disrupt their décor, it's a great solution. Indeed, we are starting to see more kinetic lighting controls – no wires, no batteries, no drilling, plastering or painting – extending the value and functionality of lighting for homeowners.

Whilst security, in terms of hacking and privacy, has been raised as a concern, the government has worked with industry partners to develop a Code of Practice aimed at device manufacturers and developers to improve security and consumer safety and a document for consumers with guidance on securing IoT devices in the home. This should help to allay fears.

Retailers come to Exertis because we entered this market at its infancy, we know retail because it's been one of our specialisms for over 30 years. We have an established portfolio of vendors with products across all of the key categories: lighting, heating, security, safety and voice. As a result, we have a great insight into the market and the opportunities for growth. Security remains a key category along with energy saving products. However, there is also an increasing demand for outdoor products, ranging from smart door bells and cameras to garden lighting.

The Plug In To Exertis event on May 16 at Silverstone Circuit will feature a fully fitted Smart Home. Further details at www.exertis.co.uk/plugin

> **"Awareness has grown considerably and there is a healthy appetite to invest in building a connected home"**

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Following the success of the inaugural 2018 Electrical Review Excellence Awards, we invite electrical manufacturers, contractors and project owners to enter the 2019 Awards.

The recipients of 2018 Awards included: Noriker Power battery storage facility - Entry by Vertiv; Indectron Shield House data centre - Entry by Sudlows; The Queens Hotel, Penzance - Entry by Chubb Fire & Security; Project Beagle, Ingenuity House - Entry by zencontrol ltd; Chertsey Water Treatment Works - Entry by Danfoss Drives and Heathrow Airport, Electric vehicle charger installation - Entry by R.L. Freemantle Electrical Ltd

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ESP LAUNCHES NEW TWO-WIRE FIRE ALARM SYSTEM

ESP is expanding its range of fire protection products with the launch of the new MAGDUO two-wire fire alarm system range.

Two-Wire fire alarm systems are based on standard conventional system technology, but unlike standard conventional four wired systems where the detectors, call points and alarm devices for each zone are wired on separate circuits, MAGDUO utilises intelligent two-wire technology.

This allows all devices to be wired on the same set of two-core zone cables back to the control panel - enabling it to use a single circuit per zone both for detection and to power the sounders. This advanced technology can reduce both installation and material costs.

ESP • 01527 515150
www.espuk.com

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Hybrid Power is a new business division of Energy Solutions (UK) offering bespoke hybrid solutions reducing emissions, reducing operational costs and cutting noise levels over traditional off grid power sources.

Energy Solutions claim to be the UK's leading supplier of standalone power systems supplying quality hybrid power systems to commercial and private customers wherever connection to the grid is not a viable option.

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VENT-AXIA LEADS THE WAY WITH QUIET LIVING

UK-based ventilation company Vent-Axia, has launched a range of acoustic solutions for its Sentinel Kinetic mechanical ventilation with heat recovery (MVHR) units. With the negative effect of noise on our health now recognised, the new Acoustic Top Box and Acoustic Enclosure have been designed to further reduce the already low noise levels of the MVHR units to improve the quality of life of inhabitants and reduce noise complaints in very noise sensitive applications.

Vent-Axia • 0844 856 0590
www.vent-axia.com

SCOLMORE EXPANDS IEC LOCK RANGE

Seven products have been added to Scolmore's IEC Lock range, which is designed to provide protection against accidental disconnection of computer equipment, servers and most network devices by way of a patented locking mechanism.

Four new moulded angled IEC Lock models have been introduced as a direct result of numerous customer requests for a smaller, more versatile version that can fit into tighter spaces.

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Vive from lighting control specialist Lutron Electronics is a simple, scalable, wireless lighting control system for new and existing commercial buildings. With installation times up to 70% faster than traditional wired systems, Vive reduces overall installation costs and minimises downtime and disruption.

This allows more users to easily realise their energy saving goals and manage their space with Vive's intuitive user interface. Vive is ideal for commercial office and educational spaces with options that specifically suit the unique needs of each space.

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COST EFFECTIVE CABLE ENTRY SYSTEM

Essex based Foremost Electronics has introduced the icotek EMC-KEL cable entry system which offers a cost-effective alternative to EMC cable glands as a means to divert and block conducted and field bound EMI disturbances. Industrial process technology demands increasing security against EMI disturbances in electrical facilities. Special emphasis is being placed on the derivation of electromagnetic interference where a distinction is made between conductive and field-bound disturbances.

Providing a large contact area of the cable shield from the source of the interference to a conductive enclosure wall, combined with shielding of the enclosure interior, generally offers a good solution for both types of interference.

Foremost Electronics • 01371 811171
www.4most.co.uk

ERA ACQUIRES Y-CAM TO ACCELERATE GROWTH IN SMART SECURITY MARKET

ERA has purchased British smart security pioneer Y-cam. The acquisition will make ERA one of the most advanced and capable providers of smart security solutions for the home.

Y-cam's proprietary cloud platform, alongside its range of award-winning security cameras, alarms and sensors, will bring ERA unrivalled expertise in the sector and substantial potential for further growth.

According to a recent GfK Global report, the UK is the fastest growing smart home market in Europe and smart security products have the second highest level of appeal after connected entertainment devices.

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NEW C.K GLOWORM - LIGHTING THE WAY FOR CABLE ROUTING SOLUTIONS

C.K is expanding its range with the exciting new C.K Gloworm Cable Router (4m), perfectly designed for running cables around tight corners, through insulation filled walls, underneath flooring and across ceilings.

The Gloworm's clever glow in the dark phosphorescent polymer construction, aids routing in low light conditions and easier navigation towards exit points. When charged under natural light, Gloworm provides an effective glow for up to 30 minutes.

Short tight runs can often be tricky, even when using traditional cable routing equipment such as rods and draw tapes, but the new C.K Gloworm retains a natural curvature for perfect routing around short tight bends. When the need arises, it can also be straightened out for any straight line runs.

C.K Tools • 01758 704704
www.carlkammerling.com

LED DOWNLIGHT IS FULLY FIRE RATED

TEGO by Megaman is a fully fire-rated, integrated LED downlight, tested to provide fire protection for 30, 60 and 90-minute ceiling constructions. Also featuring in-built colour change technology, dimming capability and an optional tilt bezel for the 5W version.

For indoor use, the product comes IP65 fixed and matte white as standard, but it can be altered to compliment any building interior with the use of an interchangeable twist and lock bezel, available in chromium and brushed nickel.

Megaman • 01707 386000
www.megamanuk.com

QUICK RELEASE TERMINALS FOR SAFE CONNECTION

JPR Electronics is offering a wide range of quick-release terminals manufactured by connector manufacturer Schützinger. Quick-release terminals provide the ideal connection in any situation where a safe and rapid connection must be created quickly between a conductor or cable and another device.

Typical applications for quick release terminals include instrumentation, burn-in, test and repair bays or any test applications in which cables, conductors or electrical devices need to undergo functional testing.

Wires are connected to the terminals by pressing on the head of the terminal post and inserting them between the connection jaws where the strong internal compression spring guarantees good contact. Versions are available with two apertures as well as shock-proof versions for applications operating above protective low voltage levels.

JPR Electronics • 01582 470000
www.jprelec.co.uk

RECOLIGHT RECYCLE LIGHT – AND MORE

Recolight offers free lamp recycling. If you collect over 1000 lamps each quarter, your container and collections are free too.

For smaller quantities, Recolight funds a network of collection points across the UK. Check the map on the Recolight website.
Recolight can offer this as a free service because it operates as a non-profit WEEE Compliance Scheme, funded by its Lighting Producer Members.

All Waste Electrical & Electronic Equipment, WEEE, is covered by the WEEE Regulations. It must be recycled responsibly. Recolight recycle more than light, with a service available for all WEEE and batteries too.

Recolight
WEEE? GOT IT.

Recolight • 020 8253 9750
www.recolight.co.uk

INTRODUCING THE C.K MAGMA PRO TOOL CASE PLUS

C.K has launched the C.K Magma Pro Tool Case Plus (MA2640), the ultimate bag to organise and protect tradesmen's tools. The C.K Magma Pro Tool Case Plus provides the latest vertical tool storage facility, which not only offers perfect organisation within the tool bag, with a place for every tool, but also helps prevent any tools being lost, which can be extremely costly.

This innovative tool case features over 60 vertical storage pockets and holders, offering easy access and the best organisation of valuable tools. The outer construction of the Pro Tool Case Plus offers superb strength and durability and includes heavy duty pierce protected zips, with a 100% water and crack proof base, all designed to keep tools safe and secure in transit, as well as deliver long lasting performance.

Measuring 450 x 290 x 340mm and weighing in at just 2.65 kg, this quality tool case has all it takes to be a hit with busy tradesmen who need easy to handle, reliable storage for their tool kit – RRP £82.45 ex VAT.

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www.carlkammerling.com

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And when you entrust your power project to us, you receive the full support of more than 300 skilled technicians who nurture your project from initial design and manufacture, right through to installation and commissioning.

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