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Dear Reader,

It has been a busy few months for us at ABB Power Systems and Power Products. We’ve celebrated some major contract wins and achievement of significant milestones at our current projects. What is most exciting about this is the wide variety, scope and geographical spread of our projects in the UK. We were particularly proud that ABB has been appointed by E.ON to deliver the power infrastructure to connect the Rampion Offshore Wind Farm. A key factor in the project was ABB’s work to minimise the impact of the onshore substation.

Building on this, Statnett and National Grid have appointed ABB as a major supplier for the NSN Link Interconnector that will link the national grids of Norway and the UK (see page 5).

In June, our Power Quality business entered a new phase when it moved into a brand new facility in Bromborough. The move is particularly exciting as the new site will enable the team to offer higher levels of customer service and create new opportunities.

In terms of major project milestones, we have made progress in the very north of Scotland. With the help of the local supply chain, we have broken ground on the power conversion centre that will feed tidal power from the MeyGen tidal stream project into the grid. The potential for predictable renewable energy means that it is a project of international interest. (See page 18 for details).

Electrical power and its price is never far from the public consciousness and so it is important to offer new opportunities and new technologies to enable distribution network operators to pass on financial savings to their customers. ABB’s Technology Strategy Manager, Peter Jones, and Head of Regulatory Affairs and Technology Colin Green introduce innovations with this aim on page 14. In the coming months we are looking forward to introducing you to some further exciting new technology innovations, such as eco-efficient switchgear in which the greenhouse gas SF6 is replaced by a new insulating gas mixture.

We hope you will enjoy learning more about some of our current high profile projects as well as ABB’s latest products and technologies in this edition of ffwd.
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Connah’s Quay, ABB’s largest ever UK substation project, has achieved a major milestone with the successful completion and energisation of the gas insulated switchgear (GIS) building, which has now been taken under National Grid rules.

The existing Deeside air insulated switchgear (AIS) substation, dating back to the 1960s, has reached the end of its asset life. It was decided that the optimum replacement solution was to construct a new gas insulated switchgear (GIS) substation offline and transfer circuits over on a staged basis.

The project scope includes the construction of a new 24-bay GIS substation, with 20 bays licensed for National Grid and four for customer connections. Central to the project is the huge indoor GIS building – longer than a football pitch – that houses ABB’s well proven ELK switchgear. The project is also integrating three new 400/132 kV 240 MVA grid transformers together with an existing refurbished unit.

In addition to the main substation protection and control systems in the GIS building, ABB has also supplied four portable relay rooms (PRRs) to facilitate the customer connections.

The substation compound is being finished off with National Grid’s highest specification ISS (integrated security systems) such as high security fencing, lighting and cameras.

Once all the circuits have been migrated over from the old AIS substation the ABB team will move on to clear the site. But rather than the usual demolition operation, the existing equipment will be dismantled, with around half of it going into storage for use by National Grid as strategic spares.

“The Connah’s Quay key project has provided multiple challenges. Not only in the sheer size of the exercise, but also in dealing with multiple stakeholders such as National Grid, International Power, SP Energy Networks, EirGrid, E.ON and Local Authorities,” says Neil Coates, ABB Lead Project Manager. “Furthermore, being on the banks of the River Dee we are close to an SSSI (site of special scientific interest) and badger sets. So it is a tribute to the way that everyone has worked together as an effective team that the project is well on target while we have also established an exceptional safety record.”
NSN Link to interconnect Nordic and British energy markets

ABB has won a major order from Statnett, the state-owned network operator in Norway, and National Grid to supply HVDC Light® technology for the North Sea Network (NSN) Link. The link will interconnect the power grids of the United Kingdom and Norway and will increase security of power supply for both countries and support the integration of more renewable wind and hydroelectric power into their networks.

The NSN link will have the capacity to transmit 1,400 MW of power passing through Norwegian and British waters. The 730 kilometre link will be the world’s longest subsea power interconnection, and is expected to enter commercial operation in 2021.

When wind power generation is high and electricity demand low in the UK, power will flow via the link to Norway, allowing it to conserve water in its reservoirs. When demand is high in the UK but the wind isn’t blowing, electricity from Norway’s hydroelectric plants will flow to the UK.

ABB will supply high-voltage direct current (HVDC) converter stations at both ends of the North Sea Network (NSN) Link between Norway and the UK. This is the latest example of how ABB is facilitating critical transmission links to create additional transmission capacity for trading of electricity to enhance energy security and boost renewables. ABB was recently also awarded the NordLink project, a 1,400 megawatt (MW) interconnection rated at ±525 kilovolt (kV) to connect Norway and Germany.

“We are very pleased to be working with Statnett and National Grid to support the integration of the European energy market,” said ABB Chief Executive Officer Ulrich Spiesshofer. “HVDC is a core technology pioneered by ABB and a key business focus in our Next Level strategy. This success also underlines that our Power Systems division is making solid progress on its return to profitable and sustainable growth.”

As part of the order, ABB will design, engineer, supply and commission two ±525 kV, 1,400 MW converter stations, using its Voltage Source Converter (VSC) technology, called HVDC Light®. One station will be situated in Blyth, UK and one in Kvilldal, Norway.

RoSPA Gold Medal success

ABB’s Power Systems and Power Service have been awarded RoSPA Gold Medal awards for 2015. RoSPA (The Royal Society for the Prevention of Accidents) presented the awards at an event in Birmingham on 15 July.

RoSPA awards its Gold Medals only to organisations that have achieved more than five consecutive Gold Awards, which recognise very high levels of performance. To win a Gold Award, organisations must demonstrate well-developed occupational health and safety management systems and culture, outstanding control of risk and very low levels of error, harm and loss.

ABB Power Service has won eight consecutive Gold Awards and Power Systems has won a total of six consecutive awards, making them both Gold Medal Award winners.

Both ABB businesses ensure that health and safety is at the top of the agenda and have the processes and systems in place to manage, monitor and promote good health and safety practice.

Stephen Trotter, Managing Director of ABB’s Power Systems Division in the UK said: “We are rightly proud that ABB has been recognised with RoSPA Gold Medal Awards for 2015 and the success is thanks to the ongoing effort and commitment from every employee in Power Service and Power Systems.”
ABB has won a significant order to provide substations and related power infrastructure for the Rampion Offshore Wind Farm. The contract includes power infrastructure for the offshore platform as well as the onshore substation to efficiently integrate the new wind farm into the UK grid. ABB is also extending an existing substation that will receive the wind power. The wind farm is scheduled for completion in 2018.

The 400 Megawatt (MW) project is being built by E.ON, in partnership with the UK Green Investment Bank plc (GIB). The wind farm will be situated off the Sussex coast between Worthing and Brighton and will include 116 turbines, with the nearest located 13 kilometres from shore. When complete, the wind farm will have the capability to generate electricity for around 300,000 homes and reduce CO2 emissions by up to 600,000 tonnes a year.

As part of the order scope, ABB is responsible for the turnkey delivery of the onshore substation, including high-voltage air-insulated switchgear (AIS), gas-insulated switchgear (GIS), transformers and substation automation as well as control and protection systems.

The onshore substation will also be equipped with four STATCOM (static compensator) units to ensure grid stability. These will provide reactive power compensation by detecting and instantly compensating for voltage fluctuations associated with the intermittent nature of wind energy. ABB will also supply medium-voltage switchgear, power transformers and protection and control systems for the offshore platform as well as two new switchgear bays with control and protection equipment for the National Grid’s nearby substation at Bolney, receiving power from the new wind farm. The solution ensures that stringent grid code standards are met.
In August, ABB achieved an important project milestone in the DolWin2 project when it installed the DolWin beta platform, which will connect offshore wind farms in the North Sea’s DolWin cluster with the German grid. The station will convert electricity generated by the wind farms from alternating current into high-voltage direct current (HVDC) for efficient and reliable transmission to the mainland. ABB is delivering the offshore wind connection on a turnkey basis on behalf of transmission system operator TenneT.

The 320 kV converter station has a power transmission capacity of 916 MW, making it the world’s most powerful offshore converter platform. The complete platform including substructure weighs around 23,000 tons and is around 100 metres long, 70 metres wide and 100 metres tall.

“Putting such a huge platform in place is one of the most delicate operations in the delivery of an offshore power link, requiring intensive pre-planning and cooperation between the stakeholders involved and we are pleased that this important project landmark has gone smoothly,” said Claudio Facchin, President, ABB Power Systems division.

Watch a video of DolWin beta being moved into position on ABB’s YouTube channel: ABB installs world’s most powerful offshore converter.

Cable system for Walney Extension Wind Farm

ABB has won a major order from DONG Energy, the Danish integrated energy company, to supply the high-voltage cable system that will bring power from the Walney Extension wind park off the northwest coast of England to more than a million people in the United Kingdom.

The Walney Extension will provide additional generation potential of 660 MW on top of the existing offshore wind farm’s 367 MW. When completed, both offshore wind farms will be capable of providing clean electricity to over 800,000 households.

Walney will be one of Europe’s biggest wind farms when the new extension is ready.

ABB will design, manufacture, supply and commission the 220 kilovolt (kV) alternating current (AC) extruded cable system. The link includes more than 157 kilometres of submarine cable to connect the two wind farm platforms to each other and to shore, as well as 24 kilometres of underground cable for the grid connection.

ABB will supply more than 157 km of AC submarine cable
Milestones achieved at Pen y Cymoedd

New grid connection for wind energy project takes shape in South Wales
Adrian Williams, ABB’s Project Manager at Pen y Cymoedd writes about how his team has recently achieved two major milestones.

Vattenfall has appointed ABB to build the grid connection for the Pen y Cymoedd Wind Energy Project, which will be the largest onshore wind farm in England and Wales when it enters operation in 2016. The project involves the construction of two new substations linked by 9.2 km underground cable connections.

The first of our milestones was the successful delivery to Rhigos of the two power transformers that will step up the voltage of the power generated by the wind farm from 132 kV to 400 kV so that it can be injected into the UK’s national grid.

The transformers were delivered on two subsequent Sunday mornings in April and their large size meant that we needed to organise special transportation including police escorts and traffic restrictions to make sure they were safely delivered to site.

Because they are so heavy, we stripped the transformers down to their minimum weight to simplify transportation. When they arrived on site, we needed to move them into their final position, install some additional equipment and fill them with oil, which will insulate the electrical parts inside them during their lifetime. Work is complete on both transformers including testing down to the interface points.

The other big achievement is that we have completed excavation work for the ducts that will carry the cable as it runs down a steep slope from the mountain-top substation. We’ve been excavating this stretch of the cable route since mid March and to complete the work, we’ve used an excavator that has been tethered with a large steel rope to avoid the heavy machine slipping down the slope. It’s been quite a task.

What’s next is to press on with the mechanical and electrical installation work. We’ve already started this at the Rhigos and Pen y Cymoedd substations, where we are starting to install switchgear, which is the name for the big industrial switches that will control the power from the wind farm.

The cable route that will link the two substations is also taking shape. We’ve installed more than half of the cable and we’re now in the process of jointing the sections of cable to ensure the electrical connection between Pen y Cymoedd and Rhigos substations.
First substation now energised for Great Western electrification programme

In 2014, ABB and UK Power Networks Services joined forces in a consortium to deliver a turnkey project for the creation of the new autotransformer feeder substations (25-0-25 kV) to deliver trackside power for Network Rail’s Great Western Route Modernisation (GWRM) programme. Worth in the order of £100 million split circa 50:50, the project is a critical element in the electrification of the Great Western railway to make travel more reliable, greener and smoother for passengers, as well as quieter for people living near the railway.
Between 2015 and 2017, the GWEP programme will see the delivery of 33 trackside feeder substations along a route that serves major towns and cities across southern England and Wales. Summer 2015 saw the project reach a major milestone with the successful energisation of the first of these substations.

The feeder substations are based on ABB’s unique modular Structure Mounted Outdoor Switchgear (SMOS) Light concept, which is designed to help railway infrastructure owners reduce the time required for construction, testing and commissioning by as much as 30 per cent. The substations also deploy ABB’s state-of-the-art eco-efficient power distribution switchgear, supporting Network Rail’s policy of reducing its environmental impact. They receive power from National Grid who provide the 400 kV connection and the associated cabling to the National Grid trackside disconnector compound.

The turnkey feeder substation solution also incorporates ABB’s advanced protection and control concept, which was developed to suit Network Rail’s own Rationalised Autotransformer Scheme (RATS). This highly sophisticated method of deploying the global IEC 61850 open communications standard helps achieve a cost-efficient substation solution. The protection and control cubicles and accessories are installed in a containerised building that is fully factory assembled and tested, constituting a near plug and play solution. The first substation is scheduled for commissioning in 2015 and the project is expected to be completed in 2017.

Stephen Trotter, Managing Director for ABB’s Power Systems Division in the UK said “The successful energisation of the first autotransformer substation is a very significant milestone in the electrification of the Great Western route. Achieving this exactly on schedule is a tribute to both ABB’s state-of-the-art technology SMOS Light technology and the effective consortium that we have established with UK Power Networks Services. Our focus is now on rolling out the remaining 33 substation sites”.

Supporting Hitachi Rail Europe’s push into the UK rail market

The SMOS Light concept is also gaining in popularity with other rail projects across the UK. Most recently, it has been specified along with an 8 MVA 132/25 kV autotransformer to power the 1.1 km test track at Hitachi Rail Europe’s flagship manufacturing facility at Newton Aycliffe in northeast England.
NordLink

A landmark project enabling a more interconnected Europe

NordLink is a pioneering HVDC project connecting the grids of Statnett in Norway and TenneT in Germany. It will use the first full bipole VSC-HVDC converter rated at ±525 kilovolts (kV) and 1,400 megawatts (MW).
ABB has recently been awarded an order for the two HVDC converter stations and the German sector of the HVDC cable system for the NordLink. At a length of 623 km, it will be Europe’s longest interconnector, enabling power flow between Norway, with its vast amount of flexible hydropower, and Germany with an ever-increasing amount of intermittent wind and solar power.

The HVDC system will join two of Europe’s main power grids, the continental ENTSOE grid and the Nordic grid. These two grids have an installed capacity of close to 600 gigawatts (GW) and 100 GW respectively; however, the increasing share of renewable power calls for more trading capacity.

Over the last four decades, several links have been installed to increase the power transfer capacity between the grid in Norway, Sweden, Finland and Western Denmark, known as the Nordpool region, and Europe’s continental grid.

The NordLink Interconnector is the first connection between Norway and Germany, and with its rated power of 1,400 MW at the receiving end in Germany, it is the most powerful and the longest HVDC link in Europe.

NordLink is the second VSC-HVDC interconnector between these two regions. In early 2015, the Skagerrak 4 VSC-HVDC link was commissioned. The use of VSC technology makes it possible to stabilize voltage and power quality on the AC side of the converter. ABB has extensive experience in this area using HVDC Light technology and now has 23 such projects on its reference list.

Three good reasons to use VSC-HVDC technology to connect Norway and Germany

Firstly, the HVDC converters have the ability to connect two non-synchronized grids, thereby linking the frequency of the two separate electrical zones represented by the Nordic and continental grids.

Secondly, the HVDC connection makes it possible to transmit electricity over long distances with minimum losses. In fact, it is not even possible to transport alternating current (AC) over long distances subsea due to capacitive losses.

Finally, the VSC-HVDC converter stations have full STATCOM (Static Synchronous Compensator) functionality to support the AC network at the Norwegian and German point of common coupling.

VSC-HVDC converter stations

The NordLink interconnection consists of a bipole configuration between Tonstad in Norway and Wilster in Germany. The converter bipole is rated at ±525 kV with a bipolar power of 1,400 MW at the AC connection at the receiving end.

The system is designed to operate in the following modes:
- Bipolar mode
- Monopolar metallic return mode
- Reduced DC voltage operation
- STATCOM mode
- Black Start/Islanded mode

The normal mode of operation is bipolar with balanced voltage between the two poles. The interconnector will not be equipped with electrodes or return conductor. However, monopolar metallic return operation is possible by utilizing the conductor of the other pole as the return path. Each converter is also capable of operating as a STATCOM, independent of the converter in the other pole. The reactive power capability allows NordLink to support the AC networks with reactive power in case of disturbances.

The VSC-HVDC system allows for fully independent control of both the active and the reactive power flow within the operating range of the system. The active power can be continuously controlled from full power export to full power import.

The converter is based on ABB’s HVDC Light technology, with IGBT-based (insulated-gate bipolar transistor) converter cells arranged in series, known as a multilevel configuration. ABB has been able to offer a converter design with station losses below 1 percent.

Submarine and underground cable system

The planned transmission system to connect the two HVDC converter stations is 623 km in total, consisting of 54 km of underground cable route in Germany, 516 km of submarine cable route and finally 53 km of overhead line in Norway. ABB will deliver and install the mass impregnated (MI) cables for the underground portion in Germany as well as a 154 km long submarine route from the German coast.

The submarine cable in the German sector will be buried in the sea floor at water depths of 25 metres or less. The two cables will be installed in a bundled configuration which results in a narrow installation corridor as well as a negligible or nonexistent influence on magnetic marine compasses.

The cable installation in shallow waters near the shore is a particular challenge that requires dedicated laying vessels, rather different from those suitable for the open sea.

The design of the submarine cables includes a copper conductor, an impregnated paper insulation system and double steel wire armor. The outer diameter of the cable is approximately 15 centimetres.

The cable will be unloaded in several different shipments at ABB’s high-voltage cable plant in Karlskrona, Sweden and the separate lengths will subsequently be jointed together at sea.

The underground cable is rather similar to the submarine cable with the exception of the lack of wire armouring. The route includes crossing of the Kiel Canal, which will be achieved by use of a horizontal directional drill (HDD) 25 metres below the channel’s floor. Most of the underground cable will subsequently be installed by cable pulling into an open trench.
Innovation: smarter ways to reduce network costs

ABB’s Head of Regulatory Affairs and Technology Colin Green and Peter Jones, ABB Technology Strategy Manager explain how some important innovations are helping to reduce the cost of replacing and operating assets on electricity networks. The emphasis is on making existing network assets work smarter, rather than putting more copper into the ground.

The UK’s power distribution networks are entering a period of profound change with an ageing asset base requiring investment to maintain reliability whilst avoiding additional cost to electricity customers. Network Operators are increasingly being asked to facilitate the integration of green energy, whilst making it affordable. This is paving the way for innovative technologies that can help existing networks work smarter, freeing up capacity without the need for major capital investment.

Is-limiter – protecting against fault currents
An excellent example of how innovative technology can make a significant impact is ABB’s Is-limiter which is being deployed as part of Electricity North West’s ‘Respond’ project. Normal substation circuit-breakers cannot provide extremely fast protection against fault currents, as they are too slow to respond and then operate. In contrast, the Is-limiter can detect and limit a fault current at its first inception – in less than a millisecond – this ensures that the maximum instantaneous current is limited to a safe level that will not cause damage to substation equipment.

The Respond project (enwl.co.uk/respond) is supported by Ofgem’s Low Carbon Networks Fund (LCN Fund), which supports innovative new technologies. It is interesting to note that during the initial project evaluation Ofgem raised a question on the size of benefit that could arise from installing an Is-limiter to only protect HV (high voltage) cables for through fault withstand. Electricity North West has estimated the length of HV cable at risk from increased fault level and calculated their replacement cost, and then compared this against the installation cost of an Is-limiter to derive a net benefit. It is expected that by 2050 the net benefit of using an Is-limiter instead of the traditional approach of replacing the cable will deliver savings of £161 million at the Electricity North West scale and £619 million at the GB scale.

Line voltage regulator
Managing predictable voltage levels along distribution feeders to stay within safe and statutory levels has typically been achieved by a standardised design approach however increasing levels of dynamic, intermittent
energy from renewable resources can result in instability and frequent variation of voltage levels in the distribution network, which can pose a risk to electrical equipment if beyond the maximum allowable level set by regulators. At the International Conference and Exhibition on Electricity Distribution (CIRED) earlier this year, ABB launched a cost effective innovation with its line voltage regulator (LVR) product family that is designed to help manage these variations and adjust the voltage accordingly, without the more expensive requirement to reinforce the network. Supplied in a street cabinet for LV applications the regulator can be placed anywhere along the feeder to optimise the voltage.

The medium voltage regulator is available for ratings up to 8 MVA (Mega Volt Ampere)

The ABB line voltage regulator allows the voltage to be adjusted by up to +/-10 percent. It incorporates “booster/feeder” technology based on a dry-type transformer operating in combination with an air insulated tap-changer. It is available in a low voltage (LV) version, the same size as normal street furniture such as fibre optic cabinets, rated up to 250 kVA and a medium voltage (MV) version, about the size of a garage, rated up to 8 MVA. Both versions are designed for quick installation and have low energy losses.

The LVR was developed in conjunction with Germany’s “Networks of the future/Smart Country” initiative. It has worked with the German utility RWE AG to test it on distribution grids in Germany, as well as separately in Switzerland where since 2014 it has been successfully smoothing out the typical voltage fluctuations generated by a solar power station in a rural area.

STATCOMs come of age

Western Power Distribution recently published the Close Down report on its LCN funded Low Carbon Hub for East Lincolnshire project. This project was designed to test a variety of new and innovative techniques for the cost effective integration of significant amounts of low carbon generation on to electricity distribution networks, in an effort to avoid the costs and other issues that would normally be associated with more conventional methods of network reinforcement

The technologies evaluated were: 33 kV active network ring; Network enhancements; Dynamic system ratings; Dynamic voltage control; FACTS (Flexible AC Transmission System) Device.

A key learning point that emerged is that the FACTS device, a STATCOM, is very effective at controlling voltage, especially during network outages to remain within statutory limits. On relatively weak networks, at the ends of feeders, or at relatively long electrical distances from the voltage controlling substation, it is particularly effective. Where there are both voltage rise and drop issues, Statcoms will increasingly be used as opposed to traditional reinforcement, in key distribution locations as a cost effective method to improve voltage control and to accelerate further generation connections. Dynamic control of voltage on distribution networks promises to reduce the costs of network operation in the future.
Taking transformer intelligence to the next level

ABB’s smart, sensor-based technology enables utility and industrial customers to optimize and manage their power transformer assets from 11 kV all the way up to 400 kV, enhancing performance, reducing costs and extending lifetime.
ABB’s new Transformer Intelligence™ concept is an innovative sensor based monitoring solution for transformer assets. Making transformers more intelligent enables condition-based maintenance and reduces operating costs. At the same time, the improved insights it delivers help enhance performance, reduce failure risks and extend lifetime.

The ABB solution is based on the next generation of the CoreTec™ online monitoring system that keeps a close watch on a transformer’s mission-critical functions and performs a complete evaluation of its operating conditions. It can also simulate future service conditions and forecast their impact on transformer lifetime, enabling predictive maintenance.

The CoreTec system is modular and expandable to suit the transformer operator’s current and future requirements. It is also maintenance free for up to 15 years, thanks to robust and proven components.

With its compact size and minimized cabling, CoreTec is easy and fast to install on both new and retrofit applications since only a few sensors are required. And CoreTec can be installed on any type and brand of transformer. No specific hardware or software is needed. The unit is easy to operate and displays a large number of operational parameters via a user-friendly web interface.

CoreTec offers the capability to include over 30 parameters including: Load and peak load, top and bottom oil temperature, gas and moisture in the transformer oil, tap changer position and IEC 61850 communication.

A particular advantage of CoreTec is that the predictive loading capacity that offers improved control and greater assurance of the load capability of the transformer. If the overload capacity function is employed then it is possible to safely operate an air cooled transformer at an overload of between 10 to 30 percent.

CoreSense™ – the perfect sensor for CoreTec

Traditional transformer condition analysis techniques such as laboratory Dissolved Gas Analysis (DGA) is a very effective method for detecting incipient transformer faults. The drawback is that it can only provide intermittent information relating to the time that the oil sample was taken. That is why ABB has developed the new CoreSense™ sensor to provide real time transformer intelligence, online and all the time.

CoreSense continuously monitors hydrogen levels in transformer oil to provide an early warning for most incipient transformer faults. In addition to hydrogen, CoreSense can also continuously monitor moisture levels. Moisture can compromise the insulating properties of oil and accelerate the aging of transformers. ABB has vast transformer experience to recommend corrective actions based on hydrogen and moisture readings obtained from CoreSense. It is possible to provide transformer intelligence on a single transformer or on a whole fleet of transformers in a centralized dashboard based on the inputs from individual sensors.

CoreSense is easy to install and use. Thanks to its innovative thermal pump design that uses no moving parts it can be connected to the transformer at any location including the drain valve. The thermal pump induces convection currents by heating the oil, thus causing fresh oil to be pulled in. This solution eliminates the need of having any moving parts, such as a mechanical pump that can be prone to failure. The sensor can be installed on any transformer – new or old, regardless of brand, type or location.

CoreSense is designed for 15 years of maintenance free operation. This is the result of its heavy duty industrial grade design with an all metal enclosure and no moving parts. The solid-state sensing elements in CoreSense do not drift over time. So there is less maintenance, no consumables and many years of trouble free operation.

CoreSense features

- Online monitoring of hydrogen in transformer oil
- Solid-state hydrogen sensor (no membrane)
- Online monitoring of moisture in transformer oil
- Active oil sampling/circulation with no moving parts
- Easy to download data in .csv format for offline analysis
- Two user-configurable alarm levels for both hydrogen and moisture
- Easy to interpret alarms and LEDs
- Large number of communication protocols and options
- 4-20 mA inputs allow connection from external sensors (i.e. load, ambient temperature or oil temperature)
- Sensor configuration and administration: streamlined and intuitive web interface

A complement to laboratory analysis

CoreSense is not intended to replace offline laboratory transformer oil analysis, but rather to complement it. ABB works with a leading test laboratory to provide TCA (Transformer Condition Assessment) that offers a comprehensive assessment of the dielectric and mechanical state of the transformer including: – Routine tests for moisture, acidity and dielectric breakdown

- PCB levels
- DGA (Dissolved Gas Analysis)
- Furan analysis
Breaking ground on the MeyGen tidal stream project

On July 29, Scotland’s Energy and Tourism Minister Fergus Ewing commented on progress at the MeyGen construction site in Caithness in the far north of Scotland, where ABB is delivering the onshore grid connection for a tidal energy project on behalf of Atlantis Resources Limited. MeyGen is Europe’s largest tidal energy project.

His comments coincide with several construction milestones, including completion of horizontal drilling to create boreholes for cables that will carry power ashore, as well as a ground-breaking ceremony to mark the start of ABB’s construction of the Power Conversion Centre.

Fergus Ewing said: “This is an exciting, first-of-a-kind project and these milestones mark a significant step forward in the onshore construction works, which has created vital employment for the area. The eyes of the global marine industry are on this Scots energy project.

“I am heartened to see the involvement of home-grown companies including John Gunn & Sons Ltd and Leask Marine, and very much hope there will be further opportunities for the Scottish supply chain.”

The ground-breaking event at Ness of Quoys near Wick was attended by Ian Funnell, ABB’s UK Managing Director as well as MeyGen’s CEO Dan Pearson and representatives from Highlands and Islands Enterprise.

Ian Funnell said: “ABB’s participation in the MeyGen project positions us at the forefront of the emerging tidal energy sector. During the project, ABB will contribute its knowledge and experience of delivering grid connections in remote environments for the renewable energy sector.”

Stuart Grattage, ABB General Manager T&D Infrastructure & Grid Integration Solu-
Renewables

Breaking ground at the Ness of Quoys site (l-r): ABB’s Chris Davidson, MeyGen CEO Dan Pearson, Norma Hogan and Claire Conway of Highlands and Islands Enterprise, and ABB’s Ian Funnell, Stuart Grattage and Grant Massie

...tions in the UK, (second from right in the group photograph) said: “ABB is proud to contribute to the MeyGen project and to help develop Scotland’s leadership in tidal energy. Not only are we coordinating from our Scottish engineering office in East Kilbride but we have also appointed local contractors wherever possible to support the Scottish supply chain.”

ABB is delivering the grid connection for the first 6 megawatt (MW) demonstration phase, which will include four submerged turbines in the Inner Pentland Firth, with first power expected to be delivered in 2016.

ABB is responsible for the onshore power conversion and grid connection systems that will feed the electricity safely and reliably into the local distribution grid. During the project, ABB will design, engineer, supply and commission the power conversion equipment, switchgear and transformer, as well as delivering associated civil engineering and cabling to connect MeyGen with the grid.

To boost the Scottish supply chain ABB has engaged local contractors and suppliers to deliver its part of the project, including civil engineering contractor John Gunn & Sons Ltd, HRI architects and marine contractor Leask Marine.

During the project ABB is taking measures to protect the environment in and around the site and to minimise the impact on its neighbours. The Power Conversion Centre building has been designed to blend into the surrounding countryside and will feature water, waste and cooling systems that minimise its environmental impact.

The initial phase of MeyGen has the potential to generate up to 86 MW of electricity, enough power for around 42,000 homes, potentially catering to the needs of almost 40 percent of households in the Highlands. Within a decade, MeyGen intends to deploy up to 398 MW of offshore tidal stream turbines in the Pentland Firth to supply clean and renewable electricity for 175,000 homes.
Exciting new phase for Power Quality

ABB’s UK Power Quality business has embarked on an exciting new phase in its history after leaving Ellesmere Port for a brand new, purpose-built facility at Bromborough.

Located on Bromborough’s Riverview Business Park on the Wirral, the 18,500ft² facility offers plenty of space to meet the ABB’s ambitious future growth plans for the development, manufacture and supply of power quality solutions for customers across the UK. Improving power quality can help customers save energy, among many other benefits. In fact at Bromborough ABB can truly demonstrate that energy efficiency begins at home. Not only is the building extremely well insulated, it also features roof mounted solar panels to help meet its own electricity demands.

The new facility provides additional space to support the Qcap and other products.

The move is designed to take the Power Quality business to the next level, as John Edwards General manager of HV products UK explains. “For some time we realised there is a wealth of growth opportunities in the power quality sector, but the limitations of the ageing facility had begun to act as a brake on our ambitions. This move to Bromborough has given us a brilliant opportunity to reinvigorate the business.

“The new purpose-built facility offers the additional space we need to launch exciting new products such as Qcap and to maintain and develop our existing range of products and services to provide even better customer service, especially in terms of speed of response.

“In the slightly longer term it will provide the flexibility and capability for us to explore new options and grow. These include undertaking special customer project development work and the assembly and construction of larger projects to support the manufacturing capabilities of the ABB facility in Jumet, Belgium.”

“This is a very exciting move to a new purpose built facility. The team is really excited about this new chapter in our history,” adds factory manager Stephen Williams.

Why improve power quality?

ABB’s power factor correction (PFC) and harmonic filtering solutions help improve the quality of electrical supplies for commercial and industry customers by:

- Saving electricity costs and reducing CO2 emissions
- Freeing up capacity for new equipment
- Eliminating harmonics that cause unexpected breakdowns and premature equipment failure.
Power factor correction releases extra load capacity for industrial customers

Power factor (PF) is essentially a measure of how effectively electrical power is being used. The closer to 1 this figure it actually is, the more effective the usage. ABB has recently helped two industrial customers to improve their PF – freeing capacity for new loads without major investment in new infrastructure.

An extra 400 A for Thompsons of York
Thompsons of York is one of the largest animal feed compounders in the North of England. In Spring 2013, Simpson & Wood, the York-based electrical contractors, had become concerned that the existing power supply might not be able to support the increased production loads needed to meet the growing demand for the company’s products. Initially, it seemed that a major investment in new power infrastructure might be required. But aside from the huge cost and timescale issues, there was also very limited space for new equipment. Simpson & Wood decided to explore options for improving the efficiency of the existing site network and called in ABB’s specialist power quality consultancy service.

ABB’s first step was to carry out surveys at three key areas – the main switchboard, the secondary switchboard and blending shed which established that they were operating at a significantly low PF. The verdict was that suitable power factor correction equipment (PFC) would significantly improve efficiency in these areas, freeing up more than enough load to support the increased production levels.

In Summer 2013, ABB installed sophisticated Advance automatic capacitor banks in the three key areas surveyed. In total, this has saved 317 kVA, releasing 421 A of capacity. Not only has this enabled the existing power network to meet the demands of increased site production, it has also resulted in decreased electricity bills for Thompson of York by reducing reactive power charges. The anticipated payback is less than four years.

Helping the Water Hydraulics Co. Ltd takes the pressure of its electricity supply
The Water Hydraulics Co Ltd of Hull is experiencing a major surge in interest in its environmentally friendly and less costly alternative to oil-based systems and was planning to expand its production facilities. There was however a major challenge. The site’s power supply – rated at a nominal 160 kVA, which is equivalent to 215 A maximum load – was already close to capacity. So the company was facing an investment of around £150 k to construct additional power infrastructure combined with the disruption involved in digging up local roads.

SC Humber Ltd, ABB’s power quality installation partner for northeast England, suggested that before any decision was taken a site survey should be carried out to check the site’s PF.

ABB’s specialist engineers quickly established that the site was operating at a power factor of 0.57 with an 85 kW load. The indication was that the normal load was 149 kVA with a current of 205 A. So there was a margin of just 10 A before the mains incoming fuses, rated at 215 A, would blow. In fact, working so close to the load limit was influencing the day to day running of the site, as operators had to stagger the starting of high-load equipment, such as compressors, in case the high inrush currents caused a trip.

ABB has recommended the installation of 100 kVar of power factor correction equipment based on its sophisticated Advance automatic capacitor banks. This will restore the PF at the Hull site to 0.95 with a maximum load of 124 A, effectively freeing up a margin of 81 A for the new facility.
Introducing Substation LifeStretch™

Jeremy Wright, ABB Operations Manager for Substation Service, outlines ABB’s methodology for delivering the right action at the right time.

Age, environmental impact and operational patterns all contribute to the gradual deterioration of substation equipment. Additional factors include quality of the maintenance programme, the expertise of operators and service personnel and spare parts availability. The general result is that after 30-40 years in service there is an inevitable decline in the reliability of a substation.

When the substation lifecycle reaches the design limits, it is time to make a decision about its future. There are many possible technical solutions available to help preserve and even enhance substation reliability. ABB has developed Substation LifeStretch methodology to address this challenge. The aim is to help our customers select the optimal solution for their ageing substation according to their specific conditions and requirements.

Substation LifeStretch is based on a collaboration process that allows customers to:

- Evaluate the existing level of substation reliability based on condition assessment of the equipment and reliability statistics
- Identify different technical alternatives based on the current substation condition and their specific needs
- Compare the potential solutions according to multi-objective criteria focused on their decision making process.

Substation LifeStretch methodology

LifeStretch methodology is based on a structured collaboration process involving customer stakeholders and ABB’s substation specialists that leads to better understanding of a customer’s needs. This enables the ABB team to design the potential technical solutions and provide a comprehensive analysis of the benefits and disadvantages of each of them.
**Substation risk analysis**
The first step towards the identification of an optimal solution for extending the substation life or functionality is to understand the existing risk involved in the system.

The risk model for the current substation status enables ABB to identify the substation components having a high impact on the system reliability.

**Requirements analysis**
Before initiating the risk analysis of the installation it is necessary to collect all the relevant information that will allow ABB to assess the substation’s current condition. The preliminary information collected is used to prepare the substation model, it includes substation configuration and component information (single line diagram, list of components, maintenance programme etc.).

**Substation Assessment**
ABB has been using our substation assessment methodology to understand customer needs since the 1980s. It is based on the combined experience of more than 100 years of development, manufacturing and delivery of leading-edge electrical infrastructure and on extensive customer feedback.

The risk assessment involves a detailed visual inspection of all the components and subsystems that influence substation performance:
- Transformers and tap changers
- HV equipment – eg, circuit breakers, disconnecting switches, instrument transformers and surge arresters
- MV switchgear
- Protection and control system
- Station auxiliary equipment
- Infrastructure eg, steel structures, foundations, fencing and grounding
- Health and safety
- Environment

The importance of each substation component is determined by how its failure would impact overall substation reliability. The calculated risk for each substation component then depends on its assessed condition and importance.

This process enables ABB to develop a comprehensive overview of the substation risk based on the analysis of the operation and maintenance documentation, thorough condition assessment and detailed reliability analysis.

**Definition of alternatives**
Taking into consideration the asset’s current status and substation reliability analysis, the LifeStretch team defines the potential technical solutions focused on mitigating the identified risk and fulfilling specific customer requirements.

The solutions will address various tangible and intangible objectives, such as:
- Outage frequency and duration
- Mean Time Between Failure (MTBF)
- Initial capital investment
- Operation and maintenance cost
- Cost of power interruption
- Life cycle cost for a defined period of time
- Health and safety
- Environmental impact, aesthetics, flexibility, etc.

Along with the specific requirements, the review of alternative solutions also considers:
- Existing condition of the substation components
- Current and required level of reliability
- Technology of the existing installation and proposed alternative solutions (AIS/GIS/Hybrid)
- Health, safety, aesthetic and environmental aspects
- Operation and maintenance aspects such as related outage duration and maintenance costs
- Existing installation and proposed solution footprint
- Integration of control and protection system

The final decision is made only after completing the reliability and economic analysis of the proposed LifeStretch substation alternatives. Other important aspects that should be considered in the review of the alternative solutions are:
- Maintenance strategy and planned duration of outages
- Operation configuration and procedures
- Spare parts availability
- Logistics regarding corrective maintenance urgent requests

**LifeStretch result analysis**
Once the system modelling phase is finished, the ABB service team will perform the calculation for the identified technical alternatives. The results of the analysis are presented in a comprehensive report that provides a solid technical background for the decision making process.

**Selecting the optimal solution**
After performing reliability and economic analysis for each of the proposed substation LifeStretch alternatives, a final decision will be made to select an optimal solution.

There is rarely a perfect solution matching all needs. This means that the choice of the substation life extension solution is normally a compromise decision. ABB’s Substation LifeStretch process is designed to help customers evaluate all the alternatives.

Once the investment choice is decided, ABB will propose an action plan based on the LifeStretch team conclusions.

**Summary**
ABB understands that no one knows their own assets better than our customers. That’s why the Substation LifeStretch methodology has been developed as a collaboration process to select an optimal substation life extension solution. This enables our customers to:
- Include their operational and maintenance experience in the analysis
- Understand the risk associated with each substation component
- Be actively involved in the definition of the risk mitigation alternatives
- Design tailor-made criteria to compare the risk mitigation alternatives

The outcome of the Substation LifeStretch collaboration process is a solid comparative analysis that enables customers to quantify and draw their own conclusions – helping them make a fully informed investment decision.
New horizons in service

Karl Young, ABB Global Product Manager HV Service, outlines two important new developments – Computed Radiography and the Life Cycle Management (LCM) programme

Computed Radiography – the time and money saving switchgear inspection tool

The importance of switchgear in electrical networks requires utilities and industry to carry out regular inspections to avoid the risk of unexpected malfunctions and loss of supply. At the same time, detailed knowledge of its internal condition helps the effective planning of maintenance and replacement schedules. Previously, the only sure way to make these vital checks was to take the switchgear apart. And when dealing with breakers filled with SF6 there is the added complication that they must be degassed and the SF6 collected and stored for refilling or recycling.

Now, with ABB’s radiographic inspection service, it is possible to see inside equipment without having to disassemble it, reducing outages from days to hours. In many cases switchgear can remain live and even in service whilst the inspection takes place.

The X-ray setup is assembled around the equipment, eliminating the need to disassemble or move it. The plate is normally attached to the switchgear and a reference object is arranged in the same plane to provide scale. To protect workers from radiation, the area is evacuated during the exposure. After exposure, the screen is scanned and subsequently cleaned for reuse. No latent radiation remains after the process, all equipment and areas are completely safe for immediate access.

ABB can perform computed radiography on both our own equipment and on that supplied by other OEM and legacy manufacturers. Most importantly, we have the expertise to evaluate the images and provide the appropriate service advice.

Combined with operational diagnostics (such as timing tests and dynamic resistance measurements), computed radiography provides a low-cost yet effective way of obtaining detailed information on the condition of equipment. This helps to predict the remaining number of operating cycles before intervention is required.

Experts can use such radiographic images to measure parts that are subject to wear such as comparing uneven ablation on electrical contacts. As well as wear problems, we can also reveal manufacturing or installation defects. Whole fleet assessments can be undertaken to provide a wide-angle view of a particular asset type, these assessments can include identification of latent defects.

Computed radiography can be applied to most high voltage equipment, providing a previously unseen picture, which with the right interpretation, can significantly reduce unnecessary maintenance and costs for our customers.
Life Cycle Management (LCM) for High Voltage (HV) switchgear

ABB’s life cycle service for HV switchgear is designed to provide customers with a clear view of their existing assets and to improve operational effectiveness through sharing expertise and knowledge. For each product ABB has defined a Product Life Cycle Management model – from initial development to aftersales service – aimed at providing proactive services for maximizing availability and performance.

The model divides the product’s life cycle into four phases: active, classic, limited and obsolete. Each phase has different implications for the customer in terms of services provided.

LCM reflects ABB’s commitment to effectively and efficiently manage and innovate our HV products and related services throughout the entire product life cycle.

Key benefits
- Total transparency of the product life cycle
- Enables efficient product support and maintenance for improved reliability
- Adds functionality to the initial product by upgrading or retrofitting
- Provides a smooth transition to new technology at the end of the product life
- Sets out a life cycle management plan to prolong equipment life and avoid premature failure
- Assists with the development of life cycle planning and budgeting.

Active phase
The active phase starts when the product is launched. In the active phase the customer benefits from different warranty options and other services such as training and technical support for optimum performance.

Complete life cycle services from spare parts and preventive and predictive maintenance and customer support agreements are also provided. The active phase of a product ends when its volume production ceases because a new active product is coming on line.

Twelve months before the status changes, ABB issues an announcement of the life cycle phase change.

Classic phase
Our customers continue to benefit from complete life cycle services throughout the classic phase. The classic phase is closely aligned with ABB’s research and development work to provide continuing support for products while developing future switchgear generations. In the classic phase upgrades may be provided to guarantee that the product continues to operate at its peak performance.

Even though a product is no longer actively marketed in the classic phase, complete products remain available for purchase for plant extensions. Accessories and spare parts are further available.

Limited phase
In the limited phase, services gradually become obsolete. Technical support (field service, phone support, etc.) continues, but may diminish over time as the installed base decreases.

Spare parts are available as long as components and materials can be obtained. In addition to the annual life cycle status reviews, ABB issues a life cycle phase change announcement, half a year before the product becomes obsolete. This is the last opportunity to transfer to new technology before product services end.

Obsolete phase
A product or solution is transferred to the obsolete phase when it is no longer possible to provide services at reasonable cost, or when ABB can no longer support the product technically, or the old technology is not available.

Obsolete products are no longer manufactured as a complete product; only some component spares, retrofit and/or upgrading solutions are available.

Throughout the classic phase, ABB reviews the availability of services. Should there be any change in the availability of services, ABB issues a life cycle announcement to ensure that customers are always kept fully informed.
Introducing FOX615
The utility hybrid multiservice platform

The latest addition to ABB’s FOX family of communications devices is the FOX615 hybrid multiplexer designed specifically to help power utilities bridge the gap between circuit and packet-switched technologies. It allows direct connection of all utility-specific applications without external converter boxes, enhancing flexibility and future proofing infrastructure investment.

In the face of growing competition and market deregulation, electrical utilities face pressure to minimise the total cost of assets. There are also pressures to encapsulate data, voice, protection and SCADA (supervisory control and data acquisition) communications. As operators migrate to TDM (time-division multiplexing) and packet-switched technologies, modular devices like the FOX615 can help meet utilities’ current requirements while future proofing their infrastructure investment.

The FOX615 multiplexer is a utility-grade communication product, capable of operating in electromagnetically polluted environments and across broad temperature ranges (–25°C to 60°C). Very high MTBF (mean time between failure) figures and exhaustive redundancy options ensure system availability. For a maintenance-free system, FOX615 is also available in a fanless version.

The multiplexer can help to optimise capital expenditure (CAPEX) by enabling an extendible multi-service communication network. Furthermore, less equipment in the system means lower operational expenditure (OPEX) through less operational and maintenance work.

FOX615 provides the perfect combination of traditional TDM (PDH/SDH – Plesiochronous Digital Hierarchy/Synchronous Digital Hierarchy) technology and sophisticated Packet Switched features. It can be easily integrated into existing PDH/SDH infrastructure, enabling step-wise migration to new packet-switched networks and investment protection.

Preserving freedom of choice
In contrast to many other solutions, FOX615 views PDH/SDH and Ethernet/IP as complementary technologies, providing a perfect solution for the installed base based on applications requiring TDM interfaces as well as new packet-switched based applications. Supporting both TDM and packet-switched technologies in a single device enables the user to set up an SDH network that fulfils all performance requirements, such as teleprotection, and to migrate to packet-switched solutions at a later stage without the need to exchange equipment. Full migration can be done when the necessary quality of service has been proven.

The ABB solution gives customers complete freedom of choice of when and how to migrate, and does not enforce migration by non-availability of certain technologies or as a portfolio decision prompted by the requirements of other markets.

In addition, the integrated access and transport multiplexer function significantly lowers OPEX and space requirements; only a single platform with sparse wiring needs to be installed and maintained.

Integrated access and transport also makes the management of the communication network easier since all alarms report directly to a single network management system. This ensures easy fault detection and the fastest reaction times.

Applications for electrical utilities
FOX615 is a multi-service multiplexer, which allows direct connection of all utility-specific applications to the multiplexer without external converter boxes. This includes direct connection of distance- and differential- protection relays. A specific interface for protection command signals complying with the IEC teleprotection standard IEC 60834-1, including specific functionality such as channel supervision, event recorder or fast protection switching, is available.

For optical interconnection to the protection relay an IEEE C37.94 optical interface is available. This enables an all-optical interconnection to be made from relay to relay using the FOX615 multiplexer, reducing the use of fibres and providing enhanced availability through redundant channel routing. FOX615 enables real multi-service networks to be established with protection functions included as an integrated service.
TROPOS
Wireless Mesh Radio

Effective replacement and operation of the electricity networks assets in the future will require a significant increase in data and control systems. Condition monitoring, and more widespread electrical measurement and control, promises to release significant value from the operating costs of electricity networks. The challenge will be how to cost effectively gather high volumes of data upon a resilient and secure data infrastructure.

Tropos networks are based on a fully distributed mesh architecture. With no centralized controller, the Tropos mesh architecture eliminates single-points-of-failure, performance bottlenecks and unnecessary network traffic. The architecture’s distributed intelligence dynamically selects the optimal end-to-end paths through the network by evaluating multiple RF links, channels and bands. The Tropos mesh architecture is self-organizing, simplifying deployment of new networks and enabling ease in expanding existing ones.

Designed to deliver superior capacity, resiliency, security and scalability, Tropos’ mesh architecture utilizes decentralized distributed intelligence that enables each Tropos mesh router to make intelligent coordinated routing and airtime management decisions in real time, maximizing bandwidth and system performance.

Tropos lends itself well to high density asset locations such as cities and large towns and “as well as offering secure and resilient communications to utilities” is increasingly drawing interest from large cities and municipalities as a method to provide further added value services to city dwellers in the form of free broadband services, such as has been provided to the city of Venice.
Enabling digital substations

The concept of a digital substation has long been an insubstantial thing – an ideal vision of all-knowing substations networked into an intelligent grid. But recent developments by ABB have clarified exactly what makes a substation ‘digital, and why this desirable.

Digital signalling offers excellent reliability and capacity, and has been in use in power infrastructure for decades. Most existing electricity grids employ digital fibreoptic networks for the reliable and efficient transport of operation and supervision data from automation systems in substations – and even power line networks carry tele-protection signals these days. But only now are the advantages of standardized digital messaging starting to extend into the deeper substation environment.

IEC 61850

Without standards, the adoption of digital messaging for intra-substation communication was piecemeal and fragmented, with mutually incompatible signalling creating an assortment of messaging within vertical silos. ABB has long championed industry adoption of the IEC 61850 standard for communications networks and systems for power utility automation.

IEC 61850 specifies how the functionality of substation devices should be described – how they should communicate with each other, what they should communicate and how fast that communication should be. All of this is critical to realizing the benefits of a truly digital substation.

At the substation level, things are generally digital, even in relatively old installations. SCADA (supervisory control and data acquisition) systems usually demand digital information and ABB has been providing fibre-optic ‘backbones’ for more than two decades.

Between the station level and the bays, fibres can carry digital data – but to become a true digital substation the IEC 61850 standard has to extend even further.

Deep digital

The world beyond the bays is still predominately analogue. The conventional primary equipment, like current and voltage transformers, is connected back to intelligent electronic devices (IEDs) using parallel copper wires carrying analogue voltage signals. The IEDs receiving this data perform first-level analysis and often provide the gateway into a digital world.

To properly earn the title of ‘digital substation’ the transition to digital must take place as soon as the data is gathered. Through permanent system supervision, digital equipment reduces the need for manual intervention and the adoption of the all-digital process bus allows sensitive equipment to be relocated into the bays. The digital equipment that has to be located out in the yard must be easy to find, and every bit as robust and reliable as the analogue equipment it is replacing or interfacing with.

FOCS

Robustness and reliability requirements apply to new technologies such as ABB’s fibre-optic current sensor (FOCS) that monitors direct current running through a high-voltage line without having to involve a current transformer (CT) to step down the current to a measurable value.

Eliminating the CT also eliminates the risk of open CT circuits, in which life-threatening voltages can occur, and so increases safety. The optical CT takes up a lot less space than its analogue equivalent. ABB has also integrated it into a disconnecting circuit breaker (DCB) to combine the functions of circuit breaker, current transformer and disconnector in one device – halving the size of a new substation.
The FOCS is one of a range of nonconventional instrument transformers (NCITs) that can make things entirely digital. NCITs have to be every bit as reliable as the equipment being replaced – and they are. Over the past decade ABB has supplied more than 300 NCITs (combined current and voltage sensors fitted into gas-insulated switchgear) for use in Queensland, Australia, and the utility has yet to see a single failure in the primary sensor. Extensive use of NCITs makes a substation simpler, cheaper, smaller and more efficient.

Not everything can be digital – analogue data will continue to arrive from conventional current and voltage transformers, for example. But there is no reason for wholesale replacement when a standalone merging unit can perform the transition to digital right beside the existing instrument transformer. Fibre optics can then replace the copper cables connecting the primary equipment to the protection and control IEDs.

**Process bus**

Every bit of copper in a substation is a potential risk. For example, where current is incorrectly disconnected, such as with an open secondary current transformer, arcing may occur as dangerously high voltages build and a copper line can suddenly carry high voltage, putting workers and equipment at risk. Less copper brings greater safety.

The digital substation dispenses with copper by using the digital process bus, which might use fibre optics or a wireless network, such as ABB’s Tropos technology. Just the removal of copper can, in some circumstances, justify the switch to digital. Going digital can cut the quantity of copper in a substation by 80 percent – a substantial cost saving and, more importantly, a significant safety enhancement.

The process bus also adds flexibility: Digital devices can speak directly to each other. For this, IEC 61850 defines the GOOSE (generic object-orientated substation events) protocol for fast transmission of binary data. Part 9-2 of the standard describes the transmission of sampled values over Ethernet. These principles ensure the timely delivery of high-priority data via otherwise unpredictable Ethernet links. ABB’s ASF range of Ethernet switches fully supports this critical aspect of substation messaging.

**Flexible solutions**

A fully digital substation is smaller, more reliable, has a reduced life-cycle cost and is simpler to maintain and extend than an analogue one. It also offers increased safety and improved efficiency.

Not every substation needs to be catapulted into a wholesale digital world – it depends on the substation size and type, and whether it is a new station or a retrofit of the secondary system. Different approaches and solutions are required. ABB’s extensive IEC 61850 experience and portfolio of NCITs, merging units, protection and control IEDs as well as station automation solutions are easing utilities into the digital world. Flexible solutions allow utilities to set their own pace on their way toward the digital substation.
ABB recently completed a challenging project to replace the first two power transformers in an electricity distribution substation below ground adjacent to London’s Hyde Park. UK Power Networks ordered two new 15/19 MVA 66/11 kV ABB transformers to replace two existing units that were reaching the end of their service life, helping to ensure security of supply for this busy area of the capital. The second replacement unit will be installed below ground in the near future.

The substation housing the unit that was replaced is located beneath the car park and gardens of a prestigious high rise apartment block in Bayswater, on the northern edge of Hyde Park. In fact, cooling of the two substation transformers is achieved via two chimneys which form an integral part of the apartment block’s construction with air exhausted at roof level. There was no direct access to the transformers for removal and replacement. The only possibility was to excavate the car park above the substation to extract the transformer vertically. This was a demanding task in itself due to the low permissible ground loading combined with the limited space at ground level. A workable solution was identified in combination with JB Rawcliffe, the specialists in moving indivisible and abnormal loads. So after the civil contractors had opened up the underground space, an hydraulic ‘Megalift’ system was constructed around the opening, with special bridging mats placed down to support the system over the hatches on the site’s strong points.

The old transformer, weighing 40 tonnes, was then lifted by the system from its position eight metres below ground to the surface and loaded directly onto a trailer for onward transport. The new ABB transformer, which thanks to modern developments in transformer technology weighs only 27 tonnes, was then installed using the same system in reverse.

The new transformer came from ABB’s world class transformer factory in Mon-selice, Italy that specializes in small power transformers. It offers more effective cooling thanks to the use of a forced cooling system and also features low noise technology that is setting new industry benchmarks for transformer noise emissions, making it especially suitable for installation in noise sensitive residential areas.
ABB is putting innovative transformer and switchgear technology to good use for UK Power Networks, the distribution network operator (DNO) for London, the South East and East of England

Powering the Thames Tideway Tunnel

Three ABB containerised 11 kV switchboard units will support the Thames Tideway Tunnel project to upgrade London’s sewerage system. Based on ABB’s compact UniGear 500R switchgear, they will be installed at three tunnel drive sites where the 15 MVA capacity required during the construction phase will exceed the existing network capacity.

The project is the first installation of ABB’s UniGear 500R switchgear on the UK Power Networks distribution network.

London’s sewerage system was designed by Sir Joseph Bazalgette in the 1850s, for a population of four million people. While the Victorian sewers are still in excellent working condition, they are struggling to cope with the demands of the city’s growth. Now, even just a small amount of rain can cause them to overflow, pouring sewage into the tidal River Thames from Combined Sewage Overflow (CSO) discharge points all along the river.

A decade of study has concluded that the most timely and cost-effective solution to the CSOs discharge problem is a 25 kilometre interception, storage and transfer tunnel running up to 65 metres below the river – the Thames Tideway Tunnel. It will be 7.2 metres in diameter and have a capacity of 1.6 million cubic metres.

UK Power Networks is enhancing its electrical power supply connections to support the Thames Tideway Tunnel project. For the drive sites at Chambers Wharf, Kirtling Street and Norman Road, its has specified ABB’s containerised switchgear solution based on the UniGear 500R range of compact medium voltage switchgear.

ABB is supplying two containers of five panels each and one container with eight panels, they will be fitted with ABB’s IEC 61850 enabled Relion® REF615 feeder protection relays. The containerized approach is enabling ABB to provide UK Power Networks with a fast track switchboard solution that is factory assembled and delivered virtually ready to ‘plug and play’, with only low cost site foundations required. As an added benefit, when the construction work is completed, in around five years time, the containers could be relocated to other projects.
Fast response service for surge arresters

High voltage surge arresters are the first line of protection for critical, high value network assets against the damage that can be caused by transient over-voltages, resulting either from external sources, such as lightning or internal switching events. This crucial role means that customers often require their surge arresters for delivery within short lead times, especially when replacing existing equipment damaged by lighting strikes. ABB has responded by developing a specialised fast response service.

ABB surge arresters are generally connected in parallel with the equipment to be protected to divert the surge current. The active elements (ZnO blocks) are manufactured using a highly non-linear ceramic resistor material, composed primarily of zinc oxide mixed with other metal oxides and sintered together.

Strong focus on quality at all stages, from raw material through to finished product, ensures that ABB surge arresters survive the designed stresses with ease and with good margins. Different dimensions are available to create a large variety of standard arresters as well as client-specific solutions for protection levels and energy capability.

A correctly selected arrester can divert surges almost endlessly, provided the energy to be dissipated is within the capability of the arrester. In the event that an arrester is required to dissipate more energy than it is capable of, it will sacrifice itself by failing short-circuit. Most commonly, arresters are connected phase-to-ground and the resultant earthfault will immediately collapse the voltage on that phase, thereby protecting other equipment on the same phase. The upstream protection will initiate a breaker trip to clear the fault, and the failed arrester can then be replaced.

Surge arrester housings have traditionally been made of porcelain – ABB’s EXLIM range. However, today there is a strong trend, and often even a preference, towards the use of silicone insulators for arresters at all system voltages – ABB’s PEXLIM range. There are a number of reasons why silicone is seen as an attractive alternative to porcelain, including potentially better short-circuit capability with increased safety for other equipment and personnel if correctly designed.
Surge arrester applications
- Protection of AIS and GIS substation equipment
- HVDC protection
- Protection of series capacitor banks
- Protection of cables
- Protection of transmission lines
- Polluted areas and areas with high seismic activities

The ABB difference
ABB offers a range of surge arresters approved by National Grid for applications from 66 kV up to 400 kV. However, the most popular model is the 132 kV PEXLIM Q model that is rated for 10 kA and high energy requirement/lightning intensity.

ABB’s fast response service has been developed to meet the needs of customers who require a supply only service, often for only a few items. Customers tell us that the main difference they experience when dealing with ABB is that they get a personal service from experienced sales engineers who help make the whole specification and pricing process straightforward and fast – with a quotation generally provided within an hour from the initial enquiry.

Loose products range
The surge protectors are part of ABB’s extensive range of loose products that includes vital components such as breakers, disconnectors, current and voltage transformers.

For more information please contact:
Donald Thompson, 01925 741 230 donald.thompson@gb.abb.com.

Distributor partnership for delivery ex-stock

Normally, the lead time for surge arresters is up to 10 weeks. However, ABB recognises that for some customers that is simply too long to wait. A distributor partnership has been established with Cable Services Ltd who can supply the most popular surge arrester models direct from stock.
STATCOM cracks the renewables grid code

ABB offers a complete service – from system studies to delivery of STATCOM solutions – to help renewable energy OEMs and operators to meet the relevant Grid Code and Distribution Code requirements for the grid connection of their projects.

As renewable energy sources continue to increase their share in the global energy mix, there are several issues that need to be addressed when connecting them to the grid. For consumers it is important that their power is available with a stable voltage and frequency. To make sure that this is the case, grid operators issue requirements for connecting power generating equipment to the grid. Collectively these requirements are known as the Grid Code.

Typical requirements imposed by grid operators is that generators should be able to meet the relevant Grid Code for their country in terms of steady state reactive power supply; voltage control and dynamic reactive power supply. In addition, there may also be a need to filter harmonic requirements. These requirements necessitate the deployment of devices that can control reactive power. A static var compensator (SVC) is such a device which forms part of ABB’s extensive FACTS (Flexible Alternating Current Transmission Systems) portfolio. The term var is derived from the unit of measurement for reactive power, VAr or volt-ampere reactive.

Systems studies
As the emphasis on ensuring grid compliance grows, many renewable energy developers, and especially wind farms are calling on the services of ABB’s Power Consulting team to carry out detailed system studies during the project design and development phase. Globally, this team is a key element within ABB’s Power Systems services and solutions portfolio, providing advanced technical expertise to electrical utilities, system operators, independent power producers and industrial electricity users. The expert team offers new approaches and solutions in the areas of power quality and grid code compliance. Not only can they help to identify a potential problem before it arises, they can also propose the most effective solutions based on a unique combination of technical and economic perspectives.

In many cases, the system studies will indicate that an SVC capable of delivering a set level of MVar is required. An SVC can be implemented in different ways. For a growing number of wind farms, ABB has deployed dynamic reactive power compensation based on voltage source inverter technology. This type of SVC is usually referred to as a
STATCOM (static compensator). Compared with other technologies the STATCOM has a number of benefits: a smaller footprint, a smaller parallel capacitor bank, faster dynamic performance, active filtering of harmonic currents, and more.

PCS 100 STATCOM
An important development for ABB has been the PCS 100 STATCOM. This is a low voltage STATCOM rated at 5 MVAr. It offers a key advantage in the form of its modular construction, which makes the platform very reliable: If one of the power modules fails, the system will not trip, but will continue to operate at reduced capacity. The PCS 100 can also be provided in a fully containerised system which also includes the switchgear and ancillary equipment. And, in a new development the container can also incorporate a dry type transformer to create a fully self-contained system.

The containerised approach offers a number of benefits to OEMs and developers: First is ease of installation and commissioning as all the STATCOM equipment is installed and tested at the factory and delivered as a turnkey package; Second, the container provides effective protection which is crucial since the equipment is usually deployed in remote locations where it is exposed to extreme weather conditions; Third, the installation is flexible so it can be relocated as customer needs change.

STATCOM range
ABB’s PCS 100 STATCOM technology ranges from 100 kVAR to 10 MVAR and offers power factor control, voltage regulation and high- and low-voltage ride through support. The STATCOM system has overload up to 260 percent for three seconds, and higher overload requirements can be met by adding extra modules while offering advanced capability for flicker mitigation.
ABB and its staff continued to support Macmillan Cancer Support in 2015 and the Power Systems division held a major event on 25 September for the ‘World’s biggest coffee morning’ this year that was bigger and better than ever before.

Previously the event took the form of a coffee morning that focused on the 450 employees based at Stone but this year it extended into the afternoon and members of the local community were invited onto site, including local businesses and school children.

At the time of writing, plans for the coffee morning included local MP Bill Cash saying a few words to open the event, which included stalls representing local food businesses and crafts. Planned entertainment was in the form of a dog show and an art exhibition by local schoolchildren, as well as a presentation from Staffordshire Fire Service. Plus, Stafford Radio planned to broadcast live from the site.

ABB aims to work with the local communities where it operates and where possible to make a difference to people’s lives. Many customers and governments work with ABB as it behaves in a responsible and ethical way and because it respects the needs of individuals, society and the environment.

Macmillan Cancer Support has been one of ABB’s chosen charities since 2000 and since then the firm and its employees across the UK have raised more than £800,000 for the charity.

Ian Funnell, ABB UK Managing Director, said: “Macmillan Cancer Support is a very popular charity with ABB’s staff as living with cancer can touch so many lives. The fund raising activities are a great way to have some fun at work, they are excellent for team building and encouraging different areas of our business to work together, and of course they support a very worthwhile cause. The £800,000 raised to date is an outstanding achievement and one that as a company we can all be very proud of. Our challenge now is to raise even more.”

Ian Funnell, Managing Director, Jayne Bingham, Joyce Rock and Trisha Ward, Communications Director, presenting funds raised in 2014 to Gillian Wilson, Fundraising Manager for Macmillan Cancer Support in Cheshire & Merseyside.
Social responsibility

Reaching out to Highland Disability Sport

Because ABB is delivering a number of high profile projects in northern Scotland, it has reached out to work with community organisation Highland Disability Sport.

Around 10 willing volunteers from ABB will support Highland Disability Sport’s ‘Come and Try’ day in late October. The event in Inverness will give 10 – 18 year olds with intellectual disabilities the opportunity to try their hand at a number of sports. Highland Disability Sports expects that up to 70 children and young adults will participate in the day, which could be start of a budding career and competition.

The charity is an excellent fit with ABB’s long tradition of working with education and healthcare organisations. Not only is it based close to high profile ABB projects such as the Caithness Moray HVDC Link and MeyGen but it is also an affiliated member of one of ABB’s chosen UK charities, Special Olympics GB.

Highland Disability Sport sent a squad known as ‘Team Highland’ to the Special Olympics GB Summer Games in Bath in 2013. A total of 52 athletes and 28 coaches represented six sports at the Games, including 10 athletes who participated in the bowling event, which was supported by volunteers from ABB.

Stephen Trotter, Managing Director for the Power Systems business in the UK said: “By supporting Highland Disability Sport, ABB will help young people with intellectual and learning disabilities gain the opportunity to develop physical fitness and confidence, participate in a shared experience and build friendships. As a support of Special Olympics GB, it’s natural that ABB should work with one of its affiliate organisations in Inverness as we are delivering major projects nearby.”
Aviemore safety conference

Delegates from ABB and its partners gathered in June in Aviemore for a one-day conference on safety.

The event focused on behavioural safety and emphasised the “Don’t look the other way” initiative that ABB is spearheading. A series of interactive sessions brought safety and safe driving to life and scenarios helped delegates gain deeper insight and work through how they will apply safety principles in practice.

It also included a detailed session on driver safety, which will help attendees counter the risks associated with the large geographical spread of ABB’s sites within the UK.

Delegates came from a wide range of roles, ranging from operations and site works through to senior managers. By working together to assess their own risks and attitudes to safety, the event aimed to create a sense of collaboration.

The culmination of the event was that each attendee made three personal safety commitments to take back into the workplace.

Ian Funnell, ABB’s UK Managing Director, said: “Hosting the Safety Conference demonstrated our safety leadership and commitment to collaboration and trust.

Feedback was extremely positive from employees, customers and partners alike. Our customer and partners are now looking to replicate the event in their own businesses, which is a great endorsement for the event.”

Health & Safety Week October 12 to 16

ABB is planning a week of special awareness and training activities to help its staff and supply chain partners identify and eliminate unsafe behaviour and conditions. Different activities will bring attention to specific areas of operation, for example working at height or driving.

Speaking about the week, Stephen Trotter, Managing Director of the Power Systems business in the UK said: “Ultimately the aim is to further enhance ABB’s ongoing commitment to ensure that everyone who works for and with ABB goes home safely to their families every night.”
IET Innovation Awards

ABB is looking forward to the IET Innovation Awards on 18 November 2015 at The Brewery in London. The prestigious event is the IET’s annual showcase of the very best of innovations in science, engineering and technology and it is celebrated by a wide selection of industries.

ABB sponsors the sustainability category, which recognises projects, processes, products and initiatives that are both innovative in nature and sustainable from a resource perspective.

Last year’s winner of the Sustainability award was Sure Chill technology, which had created a refrigerator that works with intermittent or erratic power to maintain a constant 4 °C temperature. Sure Chill’s innovation is based on the physical property of water, which is at its heaviest at four degrees. The chilling compartment is surrounded by water. When power is switched on, ice forms above the compartment and water at four degrees collects around the compartment but when the ice melts and the water warms, the four degree water remains around the compartment. This property keeps the compartment’s temperature constant.

The chiller has potential to help store food and vaccines in parts of the world where access to electrical power is limited. Since winning the ABB-sponsored award, Sure Chill’s executive team have met with Bill Gates in his philanthropic role heading the Bill and Melinda Gates Foundation, which is helping the world’s poorest people lift themselves out of hunger and poverty.
ABB took the opportunity to reach out to more than 160 experts in substation automation at the PAC (Protection, Automation and Control) World Conference in Glasgow in late June and early July 2015. The conference attracted delegates from Transmission Network Operators, Distribution Network Operators, generating companies and major industrial firms.

Below: Portable relay rooms speed up installation and commissioning

At the event, ABB shared its latest knowledge on transportable commissioning and digital substations by presenting five white papers and two poster sessions.

Danny Lyonette, ABB’s Business Development Manager for Power Systems Automation and Control said: “The conference was a great opportunity to talk about the impact of Ofgem’s RIIO (Revenue = Incentives + Innovation + Outputs) model and the latest ABB technologies such as Relion relays, intelligent transmission substations and remote terminal units.”