Circuit breakers get smart

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Dear Reader,

There’s lots of news coming from ABB’s Power Products and Power Systems businesses in the UK as the country’s transmission owners and distribution network operators continue their programmes of work to strengthen the electricity grid.

Work to strengthen the AC transmission network ready for integrating renewable energy continues. I am pleased that ABB continues to play a central role as a supplier and has won a number of high profile contracts in this area, including the country’s first TCSC (Thyristor Controlled Series Compensation) equipment, which is due to be electrified in Cumbria in 2014 – see page 25 to find out more.

I was also excited to hear the news (on page 5) that two of ABB’s distribution transformers have passed new testing levels that have been introduced for equipment to be installed at the UK’s airports.

Staying at the forefront of substation technology is never far from my mind and, with this in mind, I’m fascinated by ABB’s newly launched approach that makes the most of high value sites by excavating to create underground substations. Summarised on page 8, the approach marries together experience of long-term substation operation with knowledge of how to deliver complex projects successfully.

Stephen Trotter
Division Head of ABB Power Systems UK & Ireland

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Making the most of natural resources

A major framework agreement awarded to a consortium made up of ABB and Balfour Beatty Engineering Services will increase the capacity of the transmission network in the north of Scotland, paving the way to make use of the region’s excellent natural resources for renewable electricity generation.

The five-year deal granted by the licensed Transmission Owner for the north of Scotland, Scottish Hydro Electric (SHE) Transmission plc, will cover projects at the region’s 275 kV (kilovolt) and 132 kV GIS and AIS substations.

Working out of a base at Kintore, Aberdeenshire, the consortium will be supported by ABB’s offices in East Kilbride and Stone, Staffordshire and the first projects will cover substations in Caithness, Orkney and Shetland.

“This framework agreement for SHE Transmission is a very important development that continues our drive to both expand and diversify ABB’s customer base across the UK utility sector,” said Jon Downs ABB’s Director for Utility Substations in the UK.

Automakers to reduce energy consumption

Network Rail will receive around 100 of ABB’s 25-0-25 kV trackside autotransformers as part of a three-year UK-wide framework agreement signed in December to support the UK’s rail electrification.

The autotransformers comply with Network Rail’s guidelines for 12 kiloamp (kA) infrastructure and have already established their reliability on Phases 1 and 3A of the West Coast Main Line. ABB has modified their design to reduce no load losses for low traffic areas, which will reduce the lifetime energy consumption by around 30 per cent.

A major autotransformer for Scotland

Scottish Power company SP Energy Networks has ordered one of ABB’s 400/275 kV autotransformers rated at 1,000 MVA to provide the grid connection for the new Wishaw substation in North Lanarkshire.

The autotransformer is due for delivery in February 2014 and will play a role in reinforcing the power transmission and distribution infrastructure in central and southern Scotland, where SP Energy Networks is the network owner and operator.

Steven Blanche, General Manager for ABB’s UK transformer business, said “Our success in winning this contract is down to competitive pricing allied to our proven technical capability and a reputation for on-time delivery.”
An upgrade at Eggborough

ABB has won a project to upgrade the Automatic Voltage Regulators (AVRs) at the coal-fired 2,000 MW (megawatt) Eggborough Power Station in East Yorkshire. The plant was built in the 1960s and the new contract is the latest project to improve environmental performance and replace major components with more efficient modern designs.

During the contract, ABB will use its wide expertise of retrofitting Excitation Systems, which was a deciding factor in Eggborough Power Limited’s decision to select ABB. Based on ABB’s latest excitation technology, the UNITROL® 6080 will significantly improve reliability.

Tony Rooney, ABB’s General Manager for Power Generation UK said: “This is the latest in a string of contract wins that confirms UNITROL as the excitation solution of choice for both new build and retrofit projects.”

Control upgrades at Dungeness ‘B’

EDF Energy has selected ABB to engineer improvements to the steam turbine control systems at Dungeness ‘B’ nuclear power station by summer 2013. The contract covers the steam turbine governors for Units 1 and 2 at the 1,040 MW power station in Kent and the project forms part of EDF Energy’s ongoing programme of upgrades at the site.

ABB’s expertise and extensive experience in control systems for power generation plant was a major factor in winning the contract, as was the capability to deliver the project to the high quality and safety standards that are mandatory in the nuclear industry.

During the project, ABB’s engineering team will work closely with EDF Energy staff to design, supply, install, test and commission new equipment and interface it with the station’s existing ABB Procontrol P13 distributed control system as well as carry out hardware upgrades and train the power station’s staff on a simulator system.

Tony Rooney, ABB’s General Manager for Power Generation in the UK, said: “ABB has recently secured a series of control system upgrade schemes across the UK fleet and this project for Dungeness further demonstrates ABB’s position as a leading competitive provider of power generation control systems, implementing advanced technology that ensures safe, reliable and efficient plant operation.”

Passing new tests with flying colours

As part of a new initiative to ensure the reliability and continuity of critical airport power networks, UK Power Networks Services (UKPNS) Airports Division has called for all future transformers to be fully tested to demonstrate that they can withstand extreme short circuit conditions.

Normally, transformer manufacturers need to provide evidence of impulse testing alongside calculations to establish the full short circuit capability but UKPNS’ new standards call for real-life testing of transformers to their limits.

With future supply of critical equipment at stake, ABB submitted a 2 MVA (megavoltampere) ground mount standard distribution unit and a 1 MVA unit type distribution transformer. Both were subjected to rigorous tests at an independent laboratory, including a 100 percent short circuit of their windings, and both passed all tests, leading ABB to be the first manufacturer to meet the new requirements.

“Having passed with flying colours, ABB was awarded two contracts to design, build and deliver a total of 16 packaged distribution substations to serve Heathrow Airport,” said Steve Blanche, General Manager for ABB’s transformer business in the UK.

A ground mount standard distribution transformer
The world is Aquamarine’s Oyster

A wave power technology part-funded by ABB Technology Ventures has received full consent for a 40 MW wave energy farm off the north-west coast of the Scottish island of Lewis. Announced at the All-Energy event in Aberdeen, Aquamarine Power has secured the consent which will see the deployment of up to 50 Oyster devices in one of the best wave energy locations in Europe.

Scottish Minister for Energy, Enterprise and Tourism, Fergus Ewing MSP said: “This is another significant milestone for Scotland’s wave sector. With 10 per cent of Europe’s wave power potential and 25 per cent of its offshore wind and tidal power potential, the opportunities for Scotland are enormous.”

East West Interconnector goes live

ABB has delivered the East West Interconnector to EirGrid, the Irish transmission system operator. The 500-megawatt (MW) HVDC Light® connection is the highest capacity link of its kind, based on voltage source converter (VSC) technology, to go into commercial operation.

The interconnector establishes an important link between the Irish and UK grids, enabling cross-border power flows and enhancing grid reliability and security of electricity supplies. The new link also facilitates power trading between the two countries and connects Ireland to the European grid. As Ireland expands its wind power capacity, it can export surplus electricity to the UK, and can import power when required.

A 262 km cable system connects Woodland in County Meath, Ireland and Deeside in North Wales. The cables are equipped with extruded polymeric insulation that provides strength and flexibility to endure the severe conditions of the Irish Sea. HVDC Light’s “black start” capability can help restore power quickly in the event of an outage, without the aid of external energy sources.

“This is yet another example of the growing role of HVDC transmission technology when enabling key emerging trends like integration of renewables and interconnections” said Brice Koch, head of ABB’s Power Systems business. “ABB remains a market leader in this field and we shall continue to push the boundaries of HVDC technology, building on our past legacy.”

An HVDC converter station
ABB’s largest indoor 132 kV substation

ABB has recently put the final finishing touches to a turnkey project to replace a 132 kilovolt (kV) substation at Creyke Beck, to serve Northern Powergrid customers in and around the city of Kingston-upon-Hull. The upgraded substation will ensure continuity of power supply.

Due to the large amount of space occupied by air insulated switchgear (AIS), a like-for-like renewal was impractical in terms of both availability and cost. There was not enough space available on the site to build a new AIS substation alongside the existing substation and to allow circuits to be transferred bay by bay.

Northern Powergrid decided that a substation based on compact gas insulated switchgear (GIS) technology would offer an alternative that was both cost-effective and enable minimal disruption to service, with the compact GIS substation taking up around one sixth of the space of the AIS alternative.

The project is ABB’s largest of its type in the UK and the new GIS station was built inside the boundary of the existing site while the old AIS substation remained in service, which meant an exceptional level of planning and logistics on the compact site.

The 40 x 25 metre substation was built on stilts to protect from floodwater and takes up only around one sixth the footprint of its predecessor. It houses 22 bays of ABB’s state-of-the-art ELK-04 GIS, comprising four bays of bus couplers and bus sections, four incoming bays that connect to the supergrid transformers at the adjacent 400 kV National Grid substation and 14 feeder circuits.

While the new substation was energised in May 2011, the full turnkey project called for ABB to demolish the old substation and flatten and stone-chip the cleared space, with final completion in early 2013.

The 22 bays of ELK-04 at Creyke Beck substation

ZX switchgear on track for approval

Another piece of equipment that has been proving itself is the new ZX1.5-R medium voltage GIS, which has been installed at 11 sites on the WCML between Stoke and Warrington as part of ‘plug and play’ packaged substations.

The railway-specific switchgear is based on ABB’s well-proven three-phase ZX switchgear, which has been reconfigured for the requirements of two-phase high speed lines and single-phase 25 kV rail applications.

While the ZX1.5-R is already in operation supplying safe and reliable power along the entire length of China’s 968 kilometre Wuhan-Guangzhou high-speed railway line, it is yet to receive Full Product Approval from the Network Rail Acceptance Panel.

Based on three-phase ZX switchgear, the railway version houses individual gas panels in separate compartments for straightforward installation and operation. It is possible to remove a panel and re-energise the switchboard without handling of SF₆ gas as the switchgear units are sealed for life during manufacture.
Subterranean substations

Going underground in urban centres.
The biggest challenge of supplying efficient and reliable power in a bustling city centre is often in finding space for large substations, especially as demand for power grows.

On one hand, local authorities’ planning departments are often protective of city centre sites, particularly those in historic settings, and on the other, the value of land in city centre sites for office or retail development often means that there are strong pressures to give land multiple uses.

One solution to make the most of a limited footprint is to dig down, placing the substation below ground level, which frees up the surface for other purposes while providing all the functionality of any conventional substation.

ABB’s state of the art underground substation concept enables up to 98 percent of an installation to be tucked away below ground, with only cooling ducts and access routes visible above ground.

**Hiding a substation in a city centre**

Underground substations are not a new idea, with many already in operation at many sites worldwide. The experience of constructing such substations, together with knowledge of planning regulations, has enabled ABB to develop its methodology. The approach means that ABB can integrate a transformer substation into any urban environment while meeting and future-proofing customer needs.

Using this approach, ABB can hide a substation underneath a building such as a shopping centre, car park or sports stadium. Public spaces like parks, public squares, traffic roundabouts or intersections can seem untouched to the casual observer but below the surface, can be an essential link in a city’s power grid.

An underground substation will accommodate transformers, GIS, automation, protection and control systems, auxiliary equipment, AC and DC distribution boards, batteries, ventilation, air-conditioning and fire protection systems.

**Good planning for faster completion**

When carrying out a construction project in any city centre, time is of the essence, with pressure to keep build times down and deliver projects quickly and to budget. With this in mind, ABB offers a modular approach that can be customised to meet the specific requirements of an individual installation.

Supported by comprehensive guidelines and sample concepts, ABB’s approach is based on the most important aspects of project execution. Running alongside this, 3D simulations will iron out any issues with the design and layout of the substation long before the start of the construction phase. This approach cuts out the margin for error and ensuring that all aspects are properly considered, including space for cable runs, ventilation ducts and safety equipment.

Ventilation equipment is an area that is examined particularly carefully, with the temperature profile of the surroundings being balanced against equipment operation to size ventilation and heat dissipation equipment with ducts sized to keep air velocity and therefore noise emissions within permitted levels.

Finally, the load-bearing characteristics of the ground and neighbouring structure are considered as these may inform the design and layout.

**Long-term operation**

But the proof of the concept is in the long-term operation of a substation, which is why ABB’s approach takes account of reliability, redundancy, safety, operation and maintenance.

As equipment ages and ultimately reaches the end of its working life, access becomes ever more important, not least for the station’s largest items, the power transformers. Envisaging delivery and removal of bulk items, ABB’s modular approach takes account of transportation and access to replace equipment on all levels.

Like most substations, underground stations are unmanned in normal operation but their design must take account of human safety, which is why safety features such as escape routes, smoke-free zones and separation of fire loads with bulkheads are designed in.

With only two percent of a typical substation being visible from the surface, ABB’s underground substation solution keeps potential hazards well away from the general public. At the same time, it meets the most stringent requirements for power supply and delivers compactness, economy, reliability and safety.
The pumping station is a major clean water pumping station built in the 1930s, which supplies ESW’s customers in south west Essex and the east London with water. The site is equipped with three pumps, each of which is powered by a 335 kW DC motor and variable speed drive system.

The symptoms of flickering lights, a high demand for reactive power and unexpected tripping of equipment at the pumping station led the utility to call in its long-term contractor, Mid Kent Electrical (MKE).

Improving power factor

As an ABB Motor Service Partner and member of the ABB Drives Alliance, MKE carried out an investigation of the site’s operation and power consumption. This revealed that the existing Power Factor Correction (PFC) capacitors serving the site’s three 335 kW pumps had failed and that there was an unusually high demand for reactive power.

Power Factor (PF) is the ratio of ‘real’ power that is used (in Watts) to the ‘apparent’ power that needs to be produced (in Volt-Amps). It is often seen as a measure of electrical efficiency and a power factor of one demonstrates that power is being produced and consumed most efficiently.

When PF falls below one, power is not being consumed efficiently and more reactive power is needed. This happens when the equipment being used on site causes the voltage and current waveforms to be out of phase with each other. A low power factor leads to energy loss through heat, which shortens the life of equipment. It also reduces the capacity of cables and equipment, preventing them being used to their full capacity.

When PF drops below 0.95, electricity suppliers can impose a charge for the additional power it needs to supply. In the case of the Pumping Station, the PF had dropped to 0.78, leading to a monthly bill for reactive power of more than £200 on top of the site’s normal power demand.

Capacitors are normally used to help correct a site’s power factor and the three failed capacitor units were each replaced with two of ABB’s CLMD 92 KVar 480 V capacitor units, which immediately improved the power factor, bringing it up to 0.95 and reducing the monthly charge for reactive power to only a few pence.

Russel Kimpton, Drive Systems Engineer at MKE said: “Solving the power quality issues on any site is always the right thing to do. The six CLMD capacitors installed are reducing Essex & Suffolk Water’s CO₂ emissions.”
emissions by about 80 tonnes per year and enabled significant savings on the annual electricity bills”.

Solving harmonic issues
As a separate issue, the unexpected tripping of equipment had its root elsewhere and ESW had also experienced failures of instrumentation at the site. When MKE investigated, it found that the tripping took place when the pumps’ DC variable speed drives were in operation. The drives have the role of controlling the voltage fed into the pump’s motor, which in turn controls the output of the pump.

MKE found that with one set of lights switched on, the current flow through the circuit breaker doubled when the DC drives were running and this additional current was at a higher frequency.

Known as harmonics, distortions like these are caused by loads that do not match the sinusoidal supply wave shape. Harmonics are found at multiples of the supply frequency (so, for 50 Hz, 100 Hz is the second order, 150 Hz is the third order, etc). They can often lead to serious problems for electrical and electronic equipment, including overheating, shortening of life and otherwise unexplainable issues.

The solution was to install ABB’s PQFM active harmonic filters, which are designed to smooth out the distortions created on the supply in medium scale industrial three-phase applications.

PQFM filters remove up to 20 harmonics simultaneously in the 2nd to 50th order. They are installed in parallel to the polluting load and monitor the harmonics for each harmonic frequency. They can then generate a compensation current in perfect phase opposition to the polluting current, therefore eliminating the harmonics. Site investigations found a high level of commutation spikes, which are electrical spikes that often appear in systems equipped with DC drives. These can cause problems for active filters, so as an ABB partner, MKE discussed the design of the filters directly with ABB’s Power Quality Division at Ellesmere Port, leading to a design that protected against these spikes.

Installing ABB’s PQFM active filters at the site solved the site’s harmonic problem and their installation meant that ESW could remove unnecessary equipment, making an immediate saving in power consumption. A further benefit of the PQFM filter is future-proofing the power supply in preparation for a planned upgrade of the drives.

Used together, ABB’s CLMD capacitors and PQFM harmonic filters resolved the power quality issues at the pumping station.
A smarter circuit breaker

A new Disconnecting Circuit Breaker (DCB) developed by ABB uses fibre optic technology to simplify substation design and significantly reduce the footprint required for high-voltage switchgear for 362 – 550 kV applications. The Fibre Optic Current Sensor (FOCS) also adds to the intelligence of the device, enabling it to be part of a more flexible, reliable and smarter grid.

Having been deployed successfully in a 420 kV pilot project in Sweden, the latest addition to ABB’s range of switchgear, the DCB-FOCS, was launched to the world at Hannover Messe this April.

Launching DCB-FOCS is just the latest in a long line of high-voltage innovations in this type of high-voltage circuit breaker.

Building on DCB innovation
Conventionally, air-insulated high-voltage switchgear comprises circuit breakers, disconnectors and current transformers as separate components. Disconnectors were located on both sides of each circuit breaker to isolate it in case of failure or to enable safe maintenance.

When ABB pioneered the DCB in 2000, it extended the functionality of the circuit breaker, integrating the disconnecting function into the circuit breaker’s breaking chamber and meeting the standards of both types of equipment.

This concept was revolutionary at the time, not only reducing the footprint but also paving the way for simpler installation, lower maintenance overheads, lower failure rates and improved levels of safety. Because the primary contacts in a DCB are enclosed in SF₆ gas and protected from pollution, DCBs offer significantly higher reliability than standalone air-insulated disconnectors.

Optical sensor measures current
The latest innovation integrates current measurement into the body of the DCB itself. FOCS replaces the multiple current transformers that previously carried out this role, representing a significant saving in space and complexity.

FOCS is a type of sensor that measures DC currents by viewing the changes made to a beam of light when it passes through the magnetic field generated by the current. It can measure currents of up to 600 kA (kiloamperes), providing readings that are accurate to 0.1 percent and it is equipped with a digital interface that is compatible with the IEC 61850 set of standards.

“This latest development is yet another milestone in our continued commitment to technology and innovation” said Giandomenico Rivetti, head of ABB’s High Voltage products business.

“Integrating the FOCS with the DCB
High-voltage switchgear

reduces footprint while delivering a ‘smart grid’ enabled solution that is virtually ‘plug and play’ and yet flexible enough to accommodate customer needs. This makes it ideally suited for new and upgrade substation applications with the added benefit of enhanced power availability and reliability.”

Because it measures changes to the physical properties of light, it does not require the regular re-calibration that a conventional current transformer arrangement demands.

More compact and low maintenance

Combining the space-saving aspects of both DCB and FOCS technologies, the new DCB-FOCS has the potential to reduce the overall physical footprint of a substation by 60 percent compared with a conventional arrangement.

It is supplied with standard ethernet cable connections, which make it simpler and safer to install and operate while improving efficiency by cutting electro-thermal and electrical losses.

Designed for low maintenance, it can be delivered on a standalone basis or as a component part of a complete switchgear bay. It is also more environmentally friendly than its predecessor, in terms of the CO₂ emissions and material used for production and insulation.
Hitting a record high in HVDC Light®

A newly energised converter station in Dörpen West in northern Germany has set a new record voltage record for HVDC Light®. At ±320 kV, the station is a new technology milestone, setting the new record high for a Voltage Sourced Converter (VSC) HVDC application.
The station is located on the receiving end of the DolWin1 transmission link and was built by ABB on behalf of Dutch-German transmission system operator, TenneT, which will integrate 800 MW of offshore wind power generated in the North Sea into the European transmission system.

Its energisation has enabled the capacity of power transmission to grow by more than 50 percent while keeping transmission losses below 1 percent per converter station.

Recent developments in converter technology have made the construction of the new station possible, including a new valve concept, enhanced semiconductor performance and advanced control systems.

The development adds further impetus to the evolution of multi-terminal systems and interconnected HVDC grids, made possible when ABB recently removed a major technology stumbling block with the announcement of its hybrid HVDC breaker.

“This latest achievement reinforces our leading position in HVDC transmission and our commitment to the ongoing development of this key technology," said Hanspeter Faessler, Head of ABB’s Grid Systems business. “ABB is uniquely positioned in this sector with manufacturing capability for converters, cables and semiconductors - the major HVDC components.”

HVDC Light
Designed to transmit power over long distances, usually underground and under water, HVDC Light was introduced by ABB in 1997 as an alternative to conventional AC transmission.

Using HVDC Light, it’s economical to transmit power from just a few tens of megawatts up to 1,200 MW at a voltage of ±320 kV. A classical HVDC installation, on the other hand, will typically transmit power in the range of 100 MW and above, with many installations in the 1,000 – 3,000 MW range and power is transmitted either using overhead lines, undersea or underground cables. Using both HVDC and HVDC Light, it’s possible to transmit power in both directions, an option that is not possible for AC transmission.

Applications include connecting wind farms to power grids, underground power links, providing shore power to islands and offshore oil and gas platforms, connecting asynchronous AC grids, city centre infeeds where space is a major constraint, and cross-border interconnections that often connect across the seas.

HVDC Light is a preferred solution for long-distance underground and underwa-ter power links and interconnections, one of its benefits being that power lines are ‘invisible’, usually being tucked out of site below ground or under water.

Compared with AC transmission, HVDC Light offers the opportunity to expand the transmission capacity with a technology that takes less footprint, offers neutral electromagnetic fields, oil-free cables and compact converter stations. By using underground HVDC cables, environmental impact is kept to a minimum, with no overhead lines giving local communities cause for objection.

One of the benefits of HVDC Light is its ability to stabilise AC voltage, a character-istic which is particularly important for wind parks, where the variation in wind speed can cause severe voltage fluctuations.

ABB has delivered more than 20 such converter stations, including the latest at Dörpen West, which takes the record of HVDC converter station with the highest rated voltage from another station installed by ABB, rated at ±200 kV.

The new ±320 kV Dörpen West converter station
ABB’s FSKII+ vacuum outdoor circuit breaker has already established a substantial track record with ABB’s railway customers thanks to its well proven reliable and essentially maintenance-free design.

ABB is now taking FSKII+ to the next level by offering it as part of the unique Structure Mounted Outdoor Switchgear (SMOS) Light modular concept designed to help network operators cut around 30 percent of the time required for construction, testing and commissioning of trackside switchgear.

SMOS Light integrates all the key elements required for isolating the supply to the catenaries, as well as for sectionalising of individual parts of track during inspection and maintenance including: the FSKII+ circuit breaker, disconnector and Voltage Transformers (VTs) and Current Transformers (CTs). They are all combined together within a modular steel structure, which is fully assembled and tested at ABB’s railway centre of excellence facility in Geneva and delivered to site virtually ready to ‘plug and play’.

By eliminating the need to install and commission discrete components, ABB’s SMOS Light concept simplifies the major on-site elements of civil works, especially the installation, testing and commissioning required. The result is a dramatic reduction in installation and commissioning time and costs.

Building on previous SMOS projects
While the ABB Railway Modular concept is a unique development for the global market, it has built on the success of a number of previous classic SMOS projects. These include High Speed 1 in the UK, Gautrain in South Africa and for SBB, the Swiss national railway.

Designed for ease of on-site installation, the environmentally friendly FSKII+ switchgear meets Network Rail’s standards, especially the requirement not to use gas-insulated switchgear as it is free of SF gas. It has been used widely on projects in the UK and worldwide so it is ideally suited for the SMOS Light concept.

ABB is submitting the SMOS Light to Network Rail’s product approval process and is planning to carry out type testing later this year.

The FSK II + vacuum breaker
The latest version of ABB’s railway circuit breakers is an integral part of the SMOS Light concept. The vacuum breaker uses a well proven combination of magnetic actuator and electronic controller and is robust, reliable and essentially maintenance-free.

Building on the 10-year long success of the previous vacuum breaker, the FSK II, the design of the FSK II+ includes externally bolted HV terminals and polymeric insulators. It has achieved over 10,000 operations under test conditions, which is equivalent to a service life of well over 20 years in typical railway applications.

While ABB already offers the FSKII+ either as loose equipment or integrated into assemblies, the approach with SMOS Light is designed to be a significant advance for the switchgear, saving time on-site and stripping the unknowns of risk and cost from the on-site phase of railway electrification projects.

Indicative layout of a substation featuring SMOS Light
A major 26-month project carried out by ABB for the High Speed 1 (HS1) route has delivered a reactive power compensation solution on the 68-mile line to prevent the line voltage dropping below 25 kV.

After carrying out technical evaluation to establish the best solution, ABB pulled together an international team including engineers from its centre of expertise in Ludvika, Sweden, as well as from its Transmission & Distribution Infrastructure business unit in London. The source of the issue was found to be the level of inductive reactive power demand as a result of the inherent design of the system’s isolation transformers.

The solution put forward was a series of 17 bespoke units to install at nine AC/DC compounds which effectively cancel out the inductive power demand of the transformers on the line, reducing the voltage drop.

Each unit consists of a capacitor bank rated at 6.4 MVAR (mega volt amperes reactive) and a reactor rated at 27.5 kV and 303.134 mH (milliHenry). The bespoke design was jointly developed by engineers at ABB’s centre of expertise in Sweden and at its Transmission & Distribution (T&D) Infrastructure business unit based in London.

With sites in both urban and rural locations, the variety of sites set some unusual challenges for the project team, including having to time visits to rural sites to avoid disturbing farmers’ harvest activities.

As well as the innovative design of the units themselves, the project team developed a new design for a terminal cap for the bushing of each capacitor unit, which prevents birds being electrocuted when they land on the terminals. This new design is now being rolled out worldwide on ABB capacitor unit products.

During the project, the team overcame some unusual access challenges due to some substations being located far from the public road on farmland. For these sites, the team had to contend with conditions due to heavy snow during winter months and avoiding disruption to harvest activities in late summer.

Commenting on the project, Richard Holliday, ABB’s General Manager for its T&D business in the UK, said: “We were very pleased to work together as a single unit with HS1. Their input went a long way to deliver the project in a collaborative and supportive environment.”

ABB’s reactive power solution prevents voltage sags on HS1
A higher calling

John Edwards, General Manager for High Voltage Products in the UK, explains why there is a growing trend towards higher voltage grids for offshore wind power networks.

The whole renewable energy sector is under ever increasing pressure to reduce the cost of energy and especially reduce the reliance on government subsidies, such as Renewable Obligation Certificates (ROCs). In 2011, the UK Government made it clear in its Renewable Energy Roadmap that the cost of electricity generated from offshore wind would have to fall significantly by 2020. DECC’s Cost Reduction taskforce also commented in June 2012 that “the current cost of around £140 per MWh (megawatt hour) needs to be reduced to around £100 in order to maximize the size of the industry.”

In response to this drive for cost efficiency, there is a growing trend towards maximising the economies of scale that can be realised from the deployment of a significant volume of wind generation far from shore. An example of this is the ever-increasing power output ratings being developed for wind turbine generators; rather than the 2 – 3 MW turbines that are commonplace today for onshore application, the future will see offshore wind turbines growing to 5 MW and above, operating in parks producing many hundreds, and in some cases, thousands of megawatts. Scaling up in the offshore wind sector requires more turbines with higher output power ratings, spaced farther apart in wind park arrays installed at a greater distance from the shore. This has led to a greater emphasis on the need to optimise the offshore collection grid and customers are now demanding that arrays operate at 66 kV rather than the traditional 33 kV seen onshore and for current offshore wind parks.

This higher voltage solution has many attractions. Financially, there’s lower CAPEX for inter-array collection infrastructure potential to cut costs by increasing the number of wind turbine generators connected to a single array, a reduction in the overall cable requirement, and the possible application of single array collection platforms to connect all of the wind turbines together.

Technically, 66 kV substation transformers are significantly lighter than the equivalent rated 33 kV units. There are lower losses in the array cables and wind turbines can be connected in loops to improve operational availability by creating a ring network. Also, it’s possible to reduce the number of substation transformers. In essence, changing to 66 kV offers greater performance headroom, flexibility and potentially lower investment costs.

To meet the changing needs of HV offshore networks, ABB has introduced the hybrid PASS M00, 72.5 kV, multi-function SF6 gas insulated switchgear range. This offers a combination of conventional air insulated switchgear (AIS) and metal-clad gas insulated (GIS) switchgear modules. In the application for offshore wind, all of the necessary substation switchgear bay functions, including circuit breaker, one or more combined disconnector/earthing switches, cable connections, current transformers are integrated in one compact module. This eliminates the need for discrete items of equipment for each function.

PASS M00

PASS M00 has been introduced to meet the specific requirements of the fast expanding markets for 66 kV systems. It has an exceptionally compact design based on a combined disconnector and earthing switch system integrated in the same gas chamber as the circuit breaker. The five-position disconnector enables the following functions:

- line disconnection
- busbar disconnection
- earthing of the line through the circuit breaker
- earthing of the busbar through the chamber

The multifunctional PASS M00 module can also integrate current and voltage transformers, surge arresters and protection and control systems. It is available for single and double busbar configurations, has an optional single and triple pole operating mechanism and is ideally suited for...
use as a standard product in the design of new modular substations or for retrofit applications.

PASS transportation
The PASS modules can be delivered in a standard shipping container without packaging, so no special arrangements are needed for shipping and transportation. PASS M00 is delivered completely ready to install, with no on site gas treatment or HV testing required.

PASS M00 for new generation wind parks
PASS M00 is ideally suited to high-voltage (HV) wind park collection grid applications where its advantages are:
- compactness due to full gas insulation
- fast installation time (no HV test is required on site)
- high reliability obtained through lean design
- fast repair in case of faults due to modular assembly
- remote control provided by motor operability
- easy combination with oil insulated, gas insulated and dry power transformers flexible internal configuration and higher reliability

Case study
A design developed by ABB for new generation offshore wind farms equipped with 5 MW turbines revealed that the use of PASS M00 modules in 72 kV collection grids made it possible to fit a complete HV substation within a tower with the following advantages:
- reduction in the number of arrays necessary to export the energy produced
- reduction in the number of cables in parallel for each feeder
- increase in the power capacity/current ampacity of a single feeder
- reduction in the losses in subsea AC internal grid array cables
- decrease in the voltage drop in the feeder/string
- decrease in the short circuit value of internal grid apparatus
- elimination of the need to construct an offshore HV/MV platform substation when offshore wind parks are close to land
A fast-track packaged substation for Lindsey Oil Refinery

ABB has delivered a complete modular packaged substation, including 26 panels of UniGear ZS1 medium voltage (MV) switchgear and future-proof protection and control technology for a power network upgrade programme at one of the UK’s most important oil refineries.

The six metre wide container houses two face to face rows of switchgear panels
ABB’s fast-track modular packaged substation service has delivered a new 11 kV substation for the Total Lindsey Oil Refinery (LOR) site in North Lincolnshire. Working within a tightly defined project window, ABB designed, manufactured, delivered and commissioned a complete containerised substation, based on its compact UniGear ZS1 MV switchgear.

LOR was established in the 1960s on a site five miles from the Humber River estuary and was the first UK refinery to process North Sea Oil. It is currently the country’s third largest oil refinery, processing 10 million tons of crude per year, equivalent to 200,000 barrels per day.

The refinery’s processes require an extensive power network comprising several substations from 11 kV down to the sub-distribution level of 415 V.

A key element in the upgrade programme was the replacement of the strategic 1A/2B 11 kV substation that acts as a main power distribution hub for the site.

A fast-track solution was required to complete the work within the tightly defined 32-week window offered by a planned ‘T&I’ (Turnaround and Inspection) outage. Both the short timescale and space constraints at the selected location – right in the heart of the refinery – made it difficult to build a new substation building, especially in carrying out the substantial civil works to meet blast rating requirements.

ABB offered the ideal alternative in the form of a containerised substation in a blast rated enclosure, delivered ready to ‘plug and play’ and installed on deep piled foundations to withstand blast shockwaves.

**UniGear ZS1 switchgear**

The substation comprises 26 panels of ABB’s UniGear ZS1 switchgear. The compact design of this 50 ka fault rated switchgear, including front cable access, has enabled it to be configured as two front facing rows made up of one 14-panel board and one 12-panel board – joined via a low-level bus-trunking link.

The slimline design of the UniGear panels meant that two rows of panels, a central walkway, thick blast-proof walls and 100 mm gaps between the panels and internal walls could be accommodated within a single 6-metre wide standard container, along with protection and control equipment and back-up batteries.

The ability to fit the entire packaged substation within the footprint of one container was crucial as a second container would have raised challenges in complexity and blast-proof integrity of the completed substation.

**REA arc flash protection**

A further vital factor in the compact design was the use of ABB’s innovative REA arc flash protection system that effectively eliminated the need for a conventional bus-zone protection scheme.

The REA system uses ABB’s class leading fibre optic light sensing and high speed fast switching techniques to continuously monitor key areas of the switchboard. If the light from a developing arc fault is detected, it will trip the incoming breaker in less than 2.5 ms (milliseconds).

**Relion® future-proof relays**

The innovation in the LOR compact substation project continued with the use of ABB’s Relion family IEDs (Intelligent Electronic Devices) to provide a future-proof relay solution for a variety of demanding functional requirements including generator protection, feeder protection, transformer protection and line differential protection.

The Relion units are operating on LOR’s Modbus protocol and they are compatible with both fibre optic communications in new build substations and retrofit substations’ existing copper pilot cables using a modern link. ABB’s preparatory site tests confirmed the Relion IEDs’ capability, even over the longest cable routes.

**RTU 560 remote terminal unit**

To complete the substation communications solution, ABB supplied its RTU560 remote terminal unit as the local HMI (Human Machine Interface). The RTU integrated the new substation within the previously localised 11 kV site network and enabled remote equipment access at the 1A/2B substation for the first time.

**New project for Substation 16**

Following on from the success of Substation 1A/2B, ABB is now working on Substation 16 that will provide a new power intake connection from Northern Powergrid for the LOR site, as well as the connection for the main 40 MW back-up generator.

Installed in a conventional substation building due to its non-critical location, Substation 16 has a similar scope to Substation 1A/2B in terms of design, delivery, installation, and commissioning of the complete substation solution.

It will feature 3150 A (amp) busbars and UniGear ZS1 switchgear, rated at up to 4000 A and 50 kA fault current. The switchgear is a withdrawable pattern design that features ABB’s well proven VD4 vacuum circuit breakers. Relion IEDs will enable Substation 16 to utilise the full inbuilt capability of the latest IEC 61850 communications standard for substations.
Variable Shunt Reactors ensure transmission line stability

Steven Blanche, ABB’s General Manager for Transformers, explains why Variable Shunt Reactors (VSRs) are an increasingly popular solution for maintaining voltage stability on transmission lines.
T he voltage along an overhead transmission line or underground cable depends on both its capacitive charging characteristics – which generate reactive power – and its loading.

If the transmission system is working at its natural load, also called the Surge Impedance Load (SIL), there is a balance between the reactive power generated and consumed. The voltage profile along the line is ideal and no reactive power compensation is needed. If the line is loaded above its natural load the consumption of reactive power will be higher than that generated and the voltage will decrease along the line.

When the system is not loaded, or only slightly loaded, it consumes little reactive power. This results in a voltage increase along the line that can reach damaging levels. To avoid this, we use a device - known as a shunt reactor - to consume the reactive power, thus stabilizing the voltage along the line. A shunt reactor is similar in appearance to a transformer, but with the difference that it has just a single voltage system (one set of main bushings).

Traditionally, shunt reactors have had fixed ratings, with no means of regulation. If regulation is needed, then they are switched in and out to follow the load variations. This can result in step changes in the system voltage level and more stress on breakers.

There is now growing interest in the use of a new design of variable shunt reactor (VSR) developed by ABB. This uses a tap changer, of the same type used in power transformers, to vary the inductance by changing the number of electrical turns in the reactor windings. It is now possible to fine tune the system voltage to provide regulation capability. Overall, the transmission system benefits from improved power quality, optimized grid operation and the possibility of interaction with other regulation devices, such as SVCs (Static Var Compensators).

VSR application scenarios

- Reduction of network voltage spikes when switching in and out fixed power rated reactors. Instead of two or more fixed rating reactors a single VSR will reduce both the number of circuit breakers required and the installation footprint
- In substations with SVC equipment and/or rotating phase compensators a VSR can be coordinated with them to maximise the dynamic capacity of the network during a network failure.
- For wind power plant applications, a VSR may be the optimal device for controlling reactive power.
- A switched reactor or capacitor requires far too many switching operations, while the advanced control offered by an SVC may not be needed.
- Seasonal load variations. To maintain a stable voltage at low loading condition the full Mvar rating is needed. As the load increases in the intermediate season the VSR acts to fine tune the voltage to the required level
- Daily load variations. The requirement for more flexible compensation of reactive power can be achieved by regulating the VSR
- High voltage AC cables generate much more reactive power per unit length than overhead lines and due to thermal constraints in the cable it can normally not be operated at its natural load. There is a need for reactive power compensation to stabilise the voltage. At variable stationary loads, better fine-tuning of the voltage, which leads to enhanced network control, can be achieved using a VSR
- Network topology changes. As network topology changes, then the demand for reactive power compensation may change. The new demand can be met by regulating the VSR.
- Flexible replacement of reactors. During maintenance or a reactor failure, the VSR can be adjusted to act as a replacement
- VSR field references

The main transmission line system in Norway has been upgraded from 300 kV to 420 kV. In the new 420 kV grid, the system operator has decided to use only VSRs instead of shunt reactor units with fixed power ratings. This offers several advantages:

- If the MVar size of the reactor is low compared to the short-circuit power of the network, the voltage will jump when the reactor is switched in or out. To minimize this phenomenon,
ABB showcased its suite of products for railway energy efficiency at London’s Railtex 2013 exhibition and conference. The event brings together railway policy makers, opinion formers and senior figures.

The ENVILINE Energy Recuperation System (ERS) made a particularly strong impression when it won the electrification category of the inaugural Railtex Awards.

Meeting demand for energy efficiency
ABB developed the ERS as part of the ENVILINE range to meet the growing demand for energy recovery, storage and dissipation in traction infrastructure.

Currently, rail vehicles regenerate their braking energy into electrical energy. Most of the time, a small portion of this kinetic energy is used to power on-board loads, while the remaining energy is sent back to the network and reused if a nearby vehicle is accelerating. If this is not possible, the network voltage increases due to the excess energy and the surplus must be dissipated into wayside or on-board resistors, which can contribute significantly to tunnel heating.

The ERS was developed to allow the energy flow from the DC traction grid back to the AC grid, avoiding the waste of surplus braking energy and reducing the operator’s CO₂ emissions. The new approach to managing surplus braking energy can reduce a rail operator’s overall energy consumption by as much as 10 to 30 percent without the need to invest in new rolling stock or network control systems.

An additional benefit of the ERS is that it can mitigate reactive power when not pushing energy back to the AC network and provide active filtering, thus improving power quality.

The ERS has been designed to be compatible with new and existing systems and has a small footprint, low capital cost and low maintenance requirements.

Reacting to receiving the award, David Hughes, Head of ABB Power Products UK, said: “We are delighted to be one of the first winners of a Railtex award. Our success in the Electrification category is an important recognition of the very significant contribution that we believe the Energy Recuperation System can make to boosting the energy efficiency of DC traction systems.”
A GB first for FACTS technology

National Grid has selected ABB’s TCSC (Thyristor Controlled Series Compensation) equipment in the country’s first installation of this type of equipment, which will boost the power transfer capacity from Scotland to England. The project is part of National Grid’s preparations for Great Britain’s electricity transmission network to meet the target for 15 percent of the UK’s energy to be produced from renewable energy sources by 2020.

National Grid has selected ABB’s TCSC (Thyristor Controlled Series Compensation) equipment in the country’s first installation of this type of equipment, which will boost the power transfer capacity from Scotland to England. The project is part of National Grid’s preparations for Great Britain’s electricity transmission network to meet the target for 15 percent of the UK’s energy to be produced from renewable energy sources by 2020.

The TCSC equipment, which is scheduled to go live in 2014, is one of a number of infrastructure enhancements on the existing AC power system which together will increase the power transfer capacity between the Scotland and England network boundary by around 1 gigawatt (GW).

The project will be delivered through National Grid’s Electricity Alliance Central. Its scope includes design, supply, installation and commissioning of TCSC equipment at the Hutton 400 kV (kilovolt) substation in Kendal, Cumbria, with associated works being carried out at the nearby Harker, Heysham, Penwortham and Stanah substations.

TCSC is a type of equipment that uses thyristor control to regulate the power flow and ensure that the power supply system remains stable. It uses the technique of series compensation, which improves power system stability and allows more power to be transferred through existing circuits.

It is part of ABB’s FACTS (Flexible Alternating Current Transmission Systems) portfolio, which allows more power to be transferred over long distances when using AC by enhancing the security, capacity and flexibility of power transmission and distribution systems.

The series compensation equipment to be installed at Hutton substation will use thyristor control to increase the power flow, mitigate SSR (subsynchronous resonance) and ensure that the power supply system remains stable. It is the first time that TCSC equipment will be installed in GB and so is a landmark contract.

“We are delighted that National Grid has selected ABB’s TCSC equipment for its first GB installation in this critical infrastructure project. It’s an important recognition of ABB’s position as a cost effective global market leader in FACTS, with a complete portfolio of solutions and key components manufactured in-house,” said Jon Downs, ABB’s Director for Utility Substations in the UK.

A typical TCSC installation
UniGear digital is ready for the smart grid age

A new generation of switchgear was born in June at Stockholm’s CIRED conference and exhibition when ABB launched the latest in the UniGear line of medium voltage switchgear. UniGear Digital takes ABB’s popular switchgear to the next level, ready for the coming smart grid era.
A n innovative solution combining protection, control, measurement and digital communication, the switchgear panels are designed to enable a safe, flexible, eco-efficient and smart electrical network that can deliver power reliable and efficiently.

The IEC 61850 communication protocol is central to the new approach to UniGear Digital and the switchgear’s advanced design and components help to reduce resources and minimise environmental impact.

The difference to earlier models is that state-of-the-art digital current and voltage sensors are integrated into each panel, alongside ABB’s multifunctional Relion IEDs (Intelligent Electronic Devices), which ensure compatibility with the IEC 61850 digital communication protocol.

A combination of well-proven technologies, the new digital switchgear panels are based on ABB’s well established and reliable UniGear design. The digital elements are provide by ABB’s state-of-the-art Relion IEDs and digital current and voltage sensors.

The combination is designed to perform a central role in medium voltage smart grids, with the Relion 615 range providing the backbone of the UniGear Digital communication concept.

**Save time**

Because it packages switching and communication functions together, the new generation of switchgear offers a 30 percent shorter delivery time together with easier purchasing, engineering, installation and commissioning.

In one move, the digital offer has removed a whole raft of complexity, with associated lead time, risk and cost. Using IED connectivity packages, it’s quick and easy to connect the digital switchgear to a customer’s SCADA system.

Furthermore, because UniGear Digital’s interface is based on the Relion range, switchgear operators will be able to adapt readily to the user-friendly human machine interface (HMI).

**Better operational performance**

From an operational perspective, the digital switchgear represents increased substation availability and equipment safety.

The new UniGear Digital panels meet the highest requirements for peer-to-peer GOOSE (Generic Object Oriented Substation Event) communication, which is faster than systems that use the traditional hard-wired approach. Constant supervision of peer-to-peer communication links between panels will ensure that switchgear trips quickly and reliably following an event.

New, high performance applications such as high-speed busbar transfer and fast load shedding are also enabled under the digital approach, meaning that UniGear Digital is ushering in a level of performance that is better than ever before.

Remote connection via an ethernet interface means that it is possible to reconfigure an IED or carry out monitoring remotely, avoiding the need for a site visit.

**Future proofing**

As demand grows, the new digital panels can be plugged in to extend and upgrade substations ready to be part of a smart grid, using the concept of interoperability under the IEC 61850 standard to ensure that devices are compatible irrespective of manufacturer. This means that UniGear Digital is built for flexibility, scalability, modification and expansion without the need for complex additional wiring.

**Availability**

While the UniGear range includes switchgear for single level, double level and double Busbar solutions, UniGear Digital is currently available exclusively as an option for the popular UniGear ZS1 up to 17.5 kV, which has applications in utilities, industry, marine, transport and infrastructure settings.

ABB plans to extend the digital concept to the entire UniGear portfolio as demand for smart grid-ready technology grows.
Data centres power ahead with ‘grid to chip’ solutions

David Hughes, Head of ABB Power Products UK, outlines how ABB covers every data centre need, from creating a new 132 kV grid connection to distributing power down to 240 V.
The essence of ABB’s philosophy for data centre projects is our comprehensive ‘grid to chip’ power solution. This was exemplified in the project we carried out recently for Telehouse, the leading provider of global data centres and managed ICT solutions. Starting with the creation of a dedicated primary 132 kV substation for the London Docklands campus, we delivered a turnkey service to design, supply, install and commission all the electrical plant from the high voltage gas insulated switchgear (GIS) and transformers to the low voltage switchboards.

Grid connection
A key aspect of ABB’s data centre service is that we can operate as an Independent Connection Provider (ICP), up to the 132 kV level that is beyond the scope of most ICPs, to carry out new connection projects ranging from the regulated provision of service alterations to the turnkey management of multi-million pound contestable connections for commercial customers. Using our knowledge and experience of working with Distribution Network Operators (DNO), developed over many years, we work closely with the host utility and provide a project-focused single interface to drive down costs, speed up the programme and reduce the overall project risk.

Medium voltage services
Typically, power for a data centre will be supplied by ABB medium-voltage transformers. Our Midel oil range is especially popular for locations where fire resistance and safety are essential and it also enables the transformers to be installed inside the buildings, rather than externally.

To distribute power throughout the site we recommend our 11 kV UniGear 500R primary metal-clad Air Insulated Switchgear (AIS) that has been developed specifically to meet the needs of customers requiring the simplicity, lower cost and smaller installation footprint offered by a fixed circuit breaker panel. At just 500 mm wide, the UniGear 500R represents a significant space saving compared with standard switchgear panels, especially in applications such as data centres where banks of 10 or more panels are installed.

The UniGear 500R panel ensures maximum safety and reliability, with mechanical interlocks between the circuit-breaker, three-position line disconnector and cable testing device. All components can be accessed directly from the front, so there is no need for rear access for maintenance and service operations. The panel incorporates ABB’s proven Vmax vacuum circuit breaker in a special fixed version – if a problem should arise it can be replaced in less than 90 minutes.

For IEC 61850-based protection and control, the UniGear 500R panels can be fitted with ABB Relion® intelligent electronic devices (IEDs).

In addition to the high level of safety and reliability required to ensure continuity of supply for the data centre, this ABB equipment is also exceptionally energy efficient as it can operate under free cooling conditions, with no requirement for air conditioning.

Increased energy efficiency
Data centres use very significant levels of power, so there is an ever increasing emphasis on enhanced energy efficiency. ABB’s new EcoDry™ range of ultra-efficient, dry-type distribution transformers can play a vital role in improving energy efficiency in power distribution networks. At the heart of the EcoDry design is AMDT (Amorphous Metal Distribution Transformers) core technology. This, combined with optimized coil designs, can provide significant reduction in no-load losses by up to 70 percent, and more than 30 percent under full load.

Dry-type distribution transformers also offer major practical advantages. These include no fire risk, no risk of escape of pollutants or fire-hazardous substances, long lifetime; high mechanical strength, ability to cope with load changes, overloads, short-circuits and over-voltages and reduced installation footprint. This means they can be installed near their place of use – reducing cabling and losses in cables and terminals on the low-voltage side.

Enhanced safety
To ensure the enhanced safety of data centre power supplies ABB offers state-of-the-art technologies, including two major developments:

– The REA arc flash mitigation relay that uses patented fiber-optic sensor technology to instantaneously detect light from an arc to signal a ‘trip’ to the designated circuit breaker in less than 2.5 ms, minimizing an arc flash incident
– UFES, an ultra fast earthing switch, provides detection and grounding of faults in times significantly faster than breaker clearing times, leading to the avoidance of injury and damage and the reduction of production outages. The UFES arc protection system channels the uncontrolled release of energy by the arc into a solid metal, 3-phase connection to earth potential. The internal arc is extinguished within an operation time of < 4ms after detection of the fault

To round off the portfolio, ABB also offers low-voltage (LV) switchboards, power distribution units, protection relays and transformers as well as variable speed drives (VSDs), motors and power quality equipment. Naturally, this all comes with the installation, maintenance and 24/7 service support of a major global organisation.

Overall, with ABB, data centre customers can meet all their power supply requirements from a single source, secure in the knowledge that their comprehensive solution will offer the ultimate in safety and energy efficiency.
New Relion® 620 range extends control capability

ABB’s recently launched 620 series of its highly successful Relion® family of protection and control IEDs has extended the product line’s ability to meet the demands of utility and industrial power distribution systems.
As a whole, the Relion® family includes a wide range of products for the protection, control, measurement and supervision of power systems. Products range from protection of secondary distribution systems with the 605 series to the fully customisable 670 series for interconnected transmission networks.

What unifies all members of the family is that they are built for interoperability to the IEC 61850 standard for design of automation equipment, while at the same time being compatible with Modbus and other protocols, when specified.

The new 620 series shares the same Human Machine Interface look and feel as the other Relion IEDs. In fact, throughout the product family, the location of a push button with a certain function is always the same, and the menu structure identical, whatever the model. Consequently, once you are familiar with one Relion IED, you can use them all.

Another advantage is that the casings have a patented plug-in design to speed up installation, testing and commissioning, allowing controllers to be installed and wired before delivery of the plug-in units. This also reaps benefits during the operational life of the equipment because an operator can always be confident that a spare will fit, a fact that shortens the mean time to repair.

### Feeders, motors, transformers and reclosers

The new 620 series is intended as the ‘big brother’ of the 615 series, with current products being suited to perform protection and control for feeders, motors and transformers.

The feeder protection IED, the REF620, protects cable and overhead line feeders, whereas protection for transformers is available from the RET620, which supports power, unit and step-up transformers in distribution systems. Finally, the REM620 is an IED dedicated to protection and control of medium and large asynchronous motors in medium-voltage applications.

Like models in the 615 series, models in the 620 series are housed in compact and withdrawable units that can be wall or panel mounted and which feature a large display screen and navigation buttons.

The difference is that the 620 series offers more scalability and flexibility than the 615 series, which is more standardised.

Members of the 620 series feature 16 programmable push buttons which can be used as additional alarm LEDs or control buttons for tasks such as blocking, setting groups or triggering the disturbance recorder, an option which can be set up to log faults.

Configurable at the unit itself or remotely from a control room, the Relion® 620 series fills a gap in substation control and automation, with the IEDs in the series protecting electrical equipment with an additional level of customisation, making it ideal for both new build and retrofit projects.

It is also possible to wire additional inputs and outputs into the 620 series, compared with the 615 series. The wider casing of the 620 models can accommodate additional wiring, which makes the series more suited to applications where new control and automation needs to be compatible with a legacy system.

### Better communication

The GOOSE communication protocol is the approach that meets the IEC 61850 standard. GOOSE enables IEDs to exchange information over an ethernet-based network and so saves the need to hard wiring a conventional root and branch communications layout, saving time and bringing inherent security.

When faults inevitably take place on a distribution grid, it is vital that control systems maintain communication. Fast and secure peer-to-peer communication is built into all models across the entire Relion® family.

In common with the entire product family and as devices that support IEC 61850, the new 620 devices offer options for redundant communication, ensuring that the breakdown of a single component in a communication network will not impact the system as a whole.

High Availability Seamless Redundancy (HSR) sends messages through both directions in a network. When this detects a broken communication link, it raises an alarm.

Alternatively, Parallel Redundancy Protocol (PRP) sends messages from an IED over two identical networks that are independent of one another. This removes the risk of communication breakdown in the case of a fault in one of the networks.
Continued support to Special Olympics GB

ABB has continued its support for Special Olympics GB, the country’s largest provider of year-round sports training and competition programmes for children and adults with intellectual and learning disabilities.

The city of Bath hosted this year’s Summer Games from 28th August to 1st September, bringing together 1,700 athletes over 12 sports in five days. ABB’s staff were on hand to help run the ten-pin bowling event, as well as attending the Games’ opening ceremony at Bath’s famous Royal Crescent. Eighty-one athletes competed in the ten-pin bowling event, which was held at Bowlplex in nearby Bristol.

ABB has lent its support to the charity since 2000 and more than 100 ABB employees signed up to volunteer at the Special Olympics ten-pin bowling event. Through the contribution of its employees, ABB is contributing to Special Olympics GB’s goal of increasing its volunteering network to 6,000 by the end of the year.

ABB staff members supported Special Olympics GB’s ten-pin bowling event
Reaching out with ABB’s Leadership Challenge

ABB’s Head of Human Resources, Gary Steel explains the success of the firm’s Leadership Challenge programme and why ABB offers to run it for customers, suppliers and the community.

When it was launched in 2003, the Leadership Challenge was only meant to last a short time but after 10 years and more than 50,000 delegates, it’s still going strong.

“We have more than 300 people all over the world as trainers and we tend to run it with intact teams, which means people have a common background. It’s 20 percent teaching tools and processes then the other 80 percent is people discussing using the tools and how to apply them in their own workplace.”

The leadership challenge is based on psychology developed at MIT, which finds that when people are thrown a challenge, they naturally think about the best outcome for themselves and overlook the big picture but Gary wanted to encourage ABB employees to think about what’s best for the company and it’s this that embodies leadership.

“It’s not a deeply psychological programme but it gives people three days out to think on a number of concepts and is premised around the notion that people have too much vested in an issue to be truly objective about how to resolve it and so they allow that vesting to get in the way of the best result. So far we’ve had about 50,000 people go through the programme worldwide and it’s run in 16 languages in 70 countries.”

“We’re predominantly a company of engineers, who love certainty and sticking to the plan but the business world has never been more volatile and uncertain. And if you don’t have your radar tuned to what’s changing, which it could be by the minute, the risk of all those qualities that used to be relevant to our industry is that something maybe missed and you’ve got the Polish cavalry system. The Polish cavalry had the best horses, the best riders, and the best fighters in 1939 but they were just one war too late.”

To open up a channel into the community and raise its profile, ABB has extended the programme to reach out to suppliers, customers and young people in education, with Gary’s philosophy being that the earlier someone encounters the principles, the longer they will have to perfect their practice.

“It’s around getting rid of these advocacy wars where he who shouts loudest wins. People rarely step back from the normal practice of thinking that they should be best as an individual. The whole design of the programme is to get people thinking ‘us’ and how much better we can be if there’s an ‘us’.”
Condition-based monitoring for GCBs

ABB’s reliability feedback system (RFS) project is developing tools for Generator Circuit Breakers (GCBs) to facilitate a shift from traditional time-based monitoring to condition-based maintenance strategies.

G

CBs play a vital safety role in power plants, where they are used to interrupt very high fault currents (up to 250 kA) in the busbar between the generator and main transformer. In addition, routine operational procedures, such as synchronization of the generator with the grid, are simplified compared with block layouts without a GCB.

This vital role demands 100 percent availability and reliability. So ABB is developing increasingly sophisticated tools to provide customers with increased visibility of the condition and remaining life of their GCBs. This has resulted in the creation of the reliability feedback system (RFS) pilot project. Its goal was to obtain residual life data from the field to help ABB’s service teams to recommend the optimum overhaul intervals for GCBs.

A typical life span for a GCB is 20 to 40 years. Their safety critical application requires regular inspections and overhauls. The residual life of a GCB is the amount of ablation the breaker can take before an overhaul is required. The breaker has three types of residual life (the overhaul is indicated when the first of these reaches zero):

- **Electrical residual life**
  Every time a circuit breaker operates, its contacts are ablated and eventually are no longer functional.

- **Mechanical residual life**
  The mechanical residual life is reduced by one every time the circuit breaker is triggered. This represents the mechanical wear on the system.

- **Time-based residual life**
  If neither the mechanical nor the electrical residual life is used up within a certain time limit, an overhaul is still required to account for additional concerns not modelled in the other residual life concepts.

Using residual life in maintenance ABB service teams use a myriad of information to determine the right time for a GCB overhaul, including experience, measurements and service reports. The new RFS-GCB software aids the process by using residual life information to suggest possible overhaul dates as the basis for long-term overhaul planning.

For a GCB there are two different maintenance jobs – overhauls and inspection. An overhaul occurs when either one of the three residual life indications reaches zero. When half of the time-based residual life is used up, an inspection should be performed.

With RFS, ABB’s service teams are able to periodically review the condition of the GCB to proactively determine and recommend service activities like inspection and electrical overhaul. It offers great potential for power plant operators to reduce their maintenance downtime while still ensuring that GCBs are kept in the ideal safe and reliable operating condition.

Electrical residual life

Mechanical residual life

Time-based residual life
Forthcoming events

ABB has a full and stimulating schedule of events for 2013 and we would be delighted to see you at one of the major exhibitions and conferences we are attending.

<table>
<thead>
<tr>
<th>Event</th>
<th>Location</th>
<th>Date</th>
<th>Website</th>
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</thead>
<tbody>
<tr>
<td>Scottish Renewables Marine Conference</td>
<td>Inverness</td>
<td>18-19th September</td>
<td>scottishrenewables.com</td>
</tr>
<tr>
<td>IET Innovation Awards</td>
<td>London</td>
<td>20th November</td>
<td>theiet.org/innovation</td>
</tr>
<tr>
<td>RenewableUK Conference and Exhibition</td>
<td>Birmingham</td>
<td>5-7th November</td>
<td>renewableuk.com</td>
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<tr>
<td>Scottish Renewables Green Energy Awards</td>
<td>Edinburgh</td>
<td>5th December</td>
<td>scottishrenewables.com</td>
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Help Joyce Rock reach her pinnacle

One ABB employee is going the extra mile this November when she will be trekking to Everest Base Camp to raise funds for Macmillan, one of ABB’s chosen charities.

Joyce Rock is no stranger to challenge events, having already crossed the Sahara, trekked across Iceland and climbed Kilimanjaro alongside ABB team-mates. Joyce’s major contribution during these challenges was recognised when she was chosen as a Torchbearer in last year’s Olympic Torch Relay.

But her trip to Everest Base Camp will be the most strenuous challenge so far. During her 19-day adventure, the 60 year-old PA in the Power Products division will face tough conditions, trekking for up to 8 hours per day across varied terrain, facing extreme weather conditions and taking precautions against altitude sickness. Climbing almost 3,000 metres, Joyce will reach a high point at the lookout of Kalapatar, which at 5,545 metres above sea level is at ‘extreme altitude’ – truly on top of the world.

Explaining why she has been driven to take on her latest challenge for Macmillan, Joyce said: “I started fundraising for Macmillan having lost friends and family to cancer and because it was one of ABB’s chosen charities. I’ve had great support from my family and from my colleagues at ABB, who have been amazing with fundraising.”

Joyce will be one of the many ABB employees helping to raise funds for Macmillan on 27 September, when ABB offices across the UK will host their individual coffee mornings in support of the charity’s World’s Biggest Coffee Morning.

Help Joyce reach her target at justgiving.com/JOYCE-ROCK3.
Bustling urban centers need efficient and reliable electricity, but have little room to accommodate large electrical installations. ABB's Gas Insulated Switchgear (GIS) technology can shrink the size of an electrical substation by as much as 70 percent, so it can be located in the midst of cities and in other space-restricted areas, sometimes even indoors or underground, minimizing environmental impact. We offer a range of products, systems and services for power generation, transmission and distribution to help increase power capacity, enhance grid reliability, improve energy efficiency and lower environmental impact. With a 125 year heritage of technology innovation ABB continues to shape the grid of the future. For more information please visit us at www.abb.com