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Offshore renewables special issue

Dear Reader,

Welcome to this special issue of ffwd, the UK customer newsletter for ABB Power Products and Power Systems, with a special focus on the offshore renewables sector.

These are great times to be involved in the power engineering industry, with the ever increasing global emphasis on renewable energy creating many new opportunities and challenges. More than ever before we have the chance to create a lasting green legacy for future generations.

Perhaps nowhere are the opportunities greater than in offshore wind. In just 10 years we have seen it grow from an emerging fledgling industry to form a vital element at the heart of our energy future.

ABB has been firmly committed to the offshore wind industry since its infancy and in this newsletter you can read about the wide range of products, services and technologies we have developed. As you will see, our portfolio covers everything from the supply of wind turbine components to the delivery of complete turnkey grid connection projects.

Naturally, there is a great deal of excitement about our HVDC technology with the first long distance offshore power transmission projects now in service and I would like to draw your attention to the article on page 10 about our innovative approach to the design and construction of offshore converter platforms.

AC technology is though equally important for ABB. On page 16 you can read about our project to supply an offshore substation for Thornton Bank, while the article on page 18 provides a practical example of how our STATCOM solutions have enabled a wind farm to meet grid code requirements.

While the technology is crucial, our most important resource is our people. ABB is making a long term commitment to developing the UK as a global centre of excellence for power engineering projects by investing around £20 million in regional facilities across the country. This includes a major extension to our facilities in the Midlands and the opening of a new engineering hub in Scotland.

To make the very best use of our state-of-the-art facilities we are actively seeking the very best people at all levels from apprentices to senior engineers. In 2011, ABB UK recruited more than 300 people at all levels and in 2012 we will continue our long-term recruitment plans in support of our growth aspirations.

Having attracted the best people, we aim to provide them with the best possible training to ensure they are fully equipped with all the engineering and management skills required to deliver offshore wind projects. As part of this process we are engaging and getting fantastic support from professional institutions such as the IET Power Academy, UK universities, National Skills Academies, local colleges and schools.

I would like to end by thanking Maria McCaffery, chief executive of RenewableUK, for kindly agreeing to contribute her insightful introduction to this special issue of ffwd.

As always If you have any feedback on the subjects covered in this issue, or suggestions for future articles, we would love to hear from you.

Stephen Trotter
Division Head of ABB Power Systems UK

ABB Power Products

Power Products are the key components to transmit and distribute electricity. The division incorporates ABB's manufacturing network for transformers, switchgear, circuit breakers, cables and associated equipment. It also offers all the services needed to ensure products' performance and extend their lifespan.

ABB Power Systems

Power Systems offers turnkey systems and services for power transmission and distribution grids and for power plants. Substations and substation automation systems are key areas. Additional highlights include flexible alternating current transmission systems (FACTS), high-voltage direct current (HVDC) systems and network management systems. In power generation, Power Systems offers the instrumentation, control and electrification of power plants.

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Mind the gap: time to build on a good start

Maria McCaffery, Chief Executive of RenewableUK, welcomes the direction of the UK’s draft Energy Bill, but highlights the need for renewed commitment if the UK is to build on its excellent start in offshore wind and avoid a looming energy gap.
The publication of the UK Government’s draft Energy Bill at the end of May 2012 demonstrated just how far the UK wind and marine energy market has come over the past decade or so. It outlines some excellent initiatives that will help ensure the delivery of low-carbon generation through a new support system, for example, but it also demonstrates just how far there is still to go if the UK is to truly make the most of its excellent head-start in offshore wind.

The UK is the world leader in offshore wind, with as much capacity already installed as the rest of the world put together. As I write, there are 568 installed offshore wind turbines in UK waters, with a combined generation capacity of 1,858 MW, providing over 10 TWh per annum – enough to supply more than a million homes with electricity all year round.

There are a further 665 turbines in construction which will add a further 2,359 MW of capacity and, when the offshore wind farms with planning consent are added in, the pipeline represents a total project base of 9,016 MW.

We calculate that by 2016 the UK will have 8 GW (8,000 MW) of offshore wind generation capacity installed, and a total of 18 GW by 2020. In terms of contribution to net UK electricity production, offshore wind supplies around 1.5 percent today, and this will grow to around 8 percent by 2016 and to around 17 percent by 2020.

Combined, offshore and onshore wind farms currently provide enough clean, secure energy to power nearly five million homes in the UK. Our industry intends to increase this to 17 million homes by 2020.

Longer term there is even greater potential. Beyond the immediate pipeline of projects, there are close to 40 GW of projects with leases and at various stages of pre-planning development, including extensions to current offshore wind farms and projects in Scottish Territorial Waters in addition to the ‘Round 3’ developments.

Quite apart from the benefits of security of supply, wind energy brings substantial economic benefits to the UK. Over the past decade, offshore wind energy has attracted £5 billion in investment to the UK and this is set to exceed £50 billion by 2020. Together, the UK offshore and onshore wind industries already employ nearly 12,000 people, and will create an estimated 80,000 new jobs by 2021. Which other industries can offer such tremendous opportunities to develop our engineering skills, manufacturing base and supply chains?

Even so, turning this potential into reality is far from being a fait accompli.

While the draft Energy Bill outlines some very welcome initiatives, it is vital that the UK’s Department for Energy and Climate Change (DECC) continues to consult and provide reassurance in areas where detail is still missing.

The offshore wind supply chain needs to be sure that there will be sufficient orders if key players are to base operations in the UK, and bring the jobs and cost savings that we and the UK Government are keen to see. Companies like ABB need to feel comfortable making the investments that are undoubtedly needed to meet the UK’s ambitious offshore wind targets.

Working closely with DECC we have seen reassuring movement on some of the central aspects of Electricity Market Reform and elements of the draft Energy Bill show positive signs of our engagement but we still have concerns about the proposed timescales. We are acutely conscious that much of the current portfolio of conventional generating capacity is about to be permanently decommissioned and that this could cause a significant energy gap. We are also alert to the danger of increasing our dependence on imported fossil fuels and the associated volatility of prices but we are talking about the most radical changes to the way wholesale electricity markets operate since privatization and we believe it is far more important to get it right than to do it quickly.

The UK’s independent energy regulator, Ofgem, recently published a report which showed that financial support for wind now costs the average household just 15 pence per week. Onshore wind is the least expensive form of renewable electricity and offshore wind is the only renewable energy technology that can deliver at the scale and in the timescales required to fill the gap. Together, wind, wave and tidal energy will secure our energy independence, stabilise the cost of electricity for all, attract billions of pounds of inward investment into our ailing economy and provide employment for nearly 100,000 people.
ABB’s offshore energy portfolio
ABB has built on over 100 years of experience in power and automation technology to develop a complete portfolio of services for the offshore energy industry. This covers virtually any requirement, from individual components for a wind turbine installation through to the turnkey delivery of onshore or offshore grid connection schemes.

**Wind turbines**
- Generators
- Motors
- Converters
- Low-voltage equipment
- Switchgear
- High voltage PASS hybrid switchgear
- Cables and connectors
- Protection and control

**Service**
- Installation and commissioning
- Planned maintenance contracts
- Emergency breakdown support

**Infrastructure**
- Electrical balance of plant (EBoP)
- Wind farm interconnection
- AIS and GIS substations
- Offshore substation platforms
- Underground and subsea cable transmission
- Overhead line transmission
- Power grid connection
- Control and protection systems
- Flexible AC Transmission Systems (FACTS) technologies, including SVCs
- HVDC Light®
- Control and protection systems
- Network management
Creating the ideal connection

Grant McKay, ABB Marketing and Sales Manager for offshore wind transmission connections in the UK, reviews the technology options for offshore wind farm connection projects.

The construction of offshore wind farms presents some significant engineering challenges in getting the power generated back to the main interconnected transmission system onshore efficiently, reliably and cost effectively. This can be done using both high voltage alternating current (HVAC) and high voltage direct current (HVDC) technologies. However, careful consideration needs to be given to the characteristics and location of each project to determine the most appropriate solution in each case.

A general rule of thumb is that for connections of less than 60 km HVAC is the appropriate choice, while for distances above 100 km HVDC offers significant advantages. However, project specific characteristics can play a major part in determining the optimum solution in each situation.

Regardless of the final technology choice, ABB offers market leading turnkey solutions for the reliable delivery of large scale offshore wind generation onto national transmission systems.

HVAC

HVAC is the predominant technology used for the electricity transmission and distribution networks across the world. It is flexible and easily facilitates connection as a meshed network. However, it has limitations when it comes to transmitting large volumes of power over long distances when using underground or subsea cables.

To date, HVAC has been used to connect all of the UK’s offshore wind farms at export voltages of 33 kV and 132-150 kV. The connection distances for these have been up to 50 km via 3-core submarine cable and single core land cable circuits.

For long lengths of HVAC cable, reactive compensation is required in the form of shunt reactors. As the length and voltage of HVAC cable circuits increase, shunt compensation may be required on both ends of the cable circuit and, potentially at an intermediate point along the route.

In order to meet the National Grid connection requirements some dynamic reactive compensation will also be required. This is generally provided by a Static Var Compensator (SVC) or a Static Compensator (STATCOM), sized against the connection capacity of the wind farm.

With recent developments in XLPE cable technology, HVAC transmission connections for large offshore wind farms can now be considered at higher voltages, specifically 220 kV. This increases the power carrying capacity of each cable circuit while also reducing losses.
For each HVAC system, detailed studies and simulations need to be carried out to ensure that the system will remain stable under all possible operating conditions and that phenomena such as harmonic resonances can be avoided.

Within the ABB offshore wind connections team, we have both the expertise in power system analysis and the advanced analytical tools required to define the optimum transmission system. We have extensive expertise in the design and delivery of large and complex offshore platforms and a long-standing track record of successful delivery of onshore transmission substations. These capabilities together with the unrivalled range of ABB HVAC equipment and proven XLPE cable technology allows ABB to provide the complete turnkey HVAC electrical transmission system.

A good example of this scope of work is the Thornton Bank project in Belgium described in more detail on page 16.

**HVDC Light®**

Depending on the rating of the offshore wind farm concerned, an HVDC transmission option may be financially viable even for shorter distances. ABB’s HVDC Light® package represents the most up-to-date system for power transmission. While it is constantly being developed and improved, HVDC Light is not new technology. Based on VSC (Voltage Source Converter) power electronics technology pioneered by ABB, HVDC Light has been well proven in the field over the past 15 years.

HVDC Light is ideal for integrating dispersed, renewable generation, especially wind power, into existing AC grids. It is also used for smart transmission and smart grids due to its great flexibility and adaptability.

The connection between the onshore and offshore HVDC convertor stations is made by pairs of single core XLPE cables. There are none of the reactive power issues associated with HVAC cable circuits, allowing the possibility for far greater power transfer capability.

As with HVAC systems, detailed studies and simulations are carried out to ensure that the HVDC control system is tuned to work in harmony with both the wind turbine network and the onshore transmission system.

For an offshore HVDC convertor station, large offshore platforms are required. More details of ABB’s innovative approach to the design and delivery of these platforms can be found on page 10.

As the world leaders in the delivery of offshore HVDC transmission systems, ABB has all of the technical and construction expertise to deliver turnkey HVDC offshore transmission solutions in the most demanding of environments.

**Three characteristics make HVDC Light® the ideal solution for linking up offshore wind farms**

**Provision of highly flexible reactive power**

This supports voltage stability and allows full compliance at the connection point to the National Grid, enabling the high power levels of offshore wind farms to be fed into the network without any adverse effects on the system.

**Black-start capability**

The transmission system can be run up from a powerless state, e.g. if the wind has stopped blowing.

**Network decoupling**

With a DC transmission system, the wind farm’s offshore network is decoupled from the power grid on the mainland by the DC link, which prevents resonances and instabilities.
Self-installing platforms for offshore HVDC projects

Peter Jones, Engineering Manager Grid Systems ABB UK, explains the background to the development of ABB’s new self-installing gravity-base structure (GBS) platform concept for offshore HVDC projects.

ABB is currently working on a contract worth around $1 billion for TenneT, the Dutch-German transmission grid operator, to create the 900 MW DolWin2 power link that will connect offshore wind farms in the North Sea to the German mainland grid.

DolWin2 is ABB’s third offshore wind connection order for TenneT, following the 800 MW Dolwin1 link awarded in 2010 and previously the BorWin1 project. Both the BorWin1 and Dolwin1 projects feature conventional fixed platforms to house the offshore converter stations. However, the DolWin2 platform will be based on a new GBS design concept, building on experience gained from semi-submersible floating platforms for the oil and gas sector.

Wind farms in the DolWin cluster – including the 400 MW Gode Wind II project and other wind farms – will be connected by 155 kV AC cables to the HVDC Light converter station platform situated in the North Sea. This will then transmit the electricity at +320 kV DC via 45 km of subsea cable and 90 km of land cable to the HVDC onshore station at Dörpen-West connecting to the German main grid, where it will be converted to 380 kV AC.

The platform challenge

The first HVDC link to connect an offshore wind farm with an AC grid is the 400 MW BorWin1 project. Based on HVDC Light® technology, this 200 km link connects the Bard Offshore 1 wind farm located off
Germany’s North Sea coast to the HVAC grid on the German mainland.

The drawback of the conventional fixed platform (jacket and topside) featured on BorWin1 is that installation/lifting is only possible in the better sea conditions found during May to September. Furthermore, with a 1,000 MW HVDC station weighing in at around 10,000 tons, it requires the world’s largest crane vessel, which has implications for both costs and availability, and multiple offshore lifts. Most designs are also not suitable for shallow water.

Platform alternatives
A possible alternative is the jack-up self-installing (floating) platform. This does not require a large crane vessel to install and there are many yards with the capability to fabricate platforms with no design risk. However, current experience is limited with large platforms (over 10,000 tons). A complex design of jack-up system and platform is also required to handle offshore jack-up operation for this weight.

ABB has therefore worked with Aibel, the Norwegian offshore engineering company, to develop a new self-installing gravity-base structure (GBS) platform design, based on proven technology from the oil and gas sector. It provides a global design for 700 to 1,100 MW projects and detailed designs for 800 and 900 MW applications with a design life of 30 years.

The GBS platform is mainly intended for use with wind farms in sea depths of between 15 and 45 metres. It is constructed onshore and all the platform systems are fully commissioned in dock. This minimizes offshore hook up works. Offshore commissioning is limited to energization and trial runs after installation of the HV cables.

The platform is towed into position by tugs and secured on the seabed by its own weight and ballasting. This approach significantly reduces the weather dependence of the installation operation.

Reduced environmental impact
The GBS platform is designed to reduce environmental impact. It has the potential to simplify the requirements for seabed preparation, while the elimination of noisy piling operations ensures there is no impact on wildlife. The platform is also easy to remove and decommission at the end of its service life.

Optimized operation and maintenance
Optimization of operation and maintenance were key factors in the design of the GBS platform. It is intended for remote operation, but is also prepared for helicopter and boat access. The provision of living quarters and equipment storage facilitates the use of the platform as a service point. Indoor walkways are provided and the living and working sections are localized to ensure working safety. Systems for large equipment replacement projects are incorporated.

GBS moves from concept to reality
The first ever GBS platform, for Dolwin2, which is believed to be the world’s largest offshore wind platform, will be built on behalf of ABB and Aibel by the Dubai shipyard, Drydocks World.

The platform will have a capacity of 900 MW and include accommodation facilities and a helicopter deck. Following fabrication, it will be delivered to Aibel’s yard in Haugesund, Norway, for fitting out. DolWin2 is scheduled to come on line in 2015.

New engineering joint venture for offshore wind power integration
ABB has signed an agreement with Inocean AS Norway, to set up an engineering services joint venture specializing in offshore wind integration projects.

ABB will have a majority shareholding in the new entity, ABB Inocean AB, which will be located in Gothenburg, Sweden, a region with a shipbuilding history and recognized as a resource base for offshore industry expertise. The new entity will undertake design, engineering and project management activities, including fabrication supervision of platforms required for offshore wind connections supplied by ABB. The move is aimed at accelerating the build-up of offshore competence to support ABB’s growing offshore wind power integration business.
Switchgear

Forward PASS for wind farm projects

Dave Knapper, General Manager – High Voltage Products at ABB UK

Current forecasts by the European Wind Association (EWEA) predict that in the next two decades the 2 MW and 3 MW turbines in common use in offshore wind farm projects will nearly completely give way to turbines of 5 MW and above, operating in farms producing hundreds of MW each. This increase in the produced power, the distance from shore, the distance between wind turbines and the number of turbines in a single wind farm now place a growing emphasis on the need to reduce the power losses of the offshore collection grid. There is also a growing trend for grid voltage increases to 72 kV and above.

ABB has responded to this challenge by re-engineering the hybrid PASS M00 multi-function switchgear modules, that cover applications from 66 kV up to 100 KV, to meet the specific needs of wind farm applications. The new PASS M00 modules now offer an increased short-time breaking current rating up to 40 kA and a maximum continuous current up to 3150 A.

Hybrid switchgear philosophy

Hybrid switchgear combines conventional air insulated switchgear (AIS) and metal-clad gas insulated (GIS) switchgear. This hybrid solution, as found in ABB’s ‘Single-Phase Encapsulated Plug and Switch System’ or PASS design, uses existing, tried and trusted SF₆ gas insulated components together with outgoing cables to connect towers within the same wind farm array.

All the necessary substation switchgear bay functions, including a circuit breaker, one or more combined disconnector/earthing switches, cables or bushings for connection to single or double busbar systems and a current transformer are integrated in one compact module, eliminating the need for discrete items of equipment for each function.

The PASS philosophy offers these main advantages:

- very high reliability and availability of the substation
- drastic reductions in the time needed to install the equipment
- much less space required
- simplified substation layout
- less maintenance required (maintenance-free)
- very good cost performance for purchasing, maintenance, operation, outage and relocation
- environmentally friendly: recycling/disposal at end of life
PASS M00

PASS M00 was introduced in 2003 to meet the specific requirements of the fast expanding markets for 66 kV and 100 kV systems. Its exceptionally compact design is 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

PASS M00 for new generation wind farms

PASS M00 is ideally suited to high-voltage (HV) wind farm collection grid applications where it offers these advantages:
- 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

A case study of new generation off-shore 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
- eliminate the need to construct an offshore HV/MV platform substation when offshore wind farms are close to land
- flexible internal configuration and higher reliability

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 a single and triple pole operating mechanism option 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 fit into 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.
Life cycle services for offshore wind projects

ABB’s portfolio of life cycle services is designed to increase a customer’s return on investment and keep offshore wind projects operating with maximum efficiency and reliability throughout their service life.

Comprehensive services portfolio
ABB’s services span the entire product ownership life cycle, from pre-purchase engineering, installation and commissioning, technical support, online and classroom training, preventive maintenance schedules, spare part kits and spare parts management, to retrofit and refurbishment.

Custom made service contracts
We understand that every turbine manufacturer or wind power plant operator has their own unique service needs. We aim to provide customers with the right mix based on service contracts.

Individual services can be bundled into one contract. Contracts can be implemented at any stage of product ownership, throughout the product’s life cycle. Contracts can be built around a mix of services, including spare part agreements, preventive or corrective maintenance agreements, technical support and training.

Service contracts provide customers with improved cost controls, increased operational efficiency, lower capital expenditures, reduced downtime and extended product life time.

Training improves efficiency and performance
Wind turbines are complex machines. Understanding how to efficiently integrate and operate ABB products provides the basis for improved product quality and reduced production costs.

We offer specialized training for many products to suit the needs of wind turbine manufacturers, power plant operators and service providers. Training can be provided through our own training centres, online through e-learning classes or even on a customer’s own site. Training can also help customers keep right up-to-date with the latest product developments and information.

Engineering and technical support
ABB’s engineers can work with turbine manufacturers during the product specification phase to ensure all of the technical questions and issues are addressed. Engineering and technical support is available by phone, email, or on-site visits, as specified in a service contract.

Regional service hubs
ABB has established certified regional service hubs around the world. They can perform repair, refurbishment and retrofit work.

Training highlights
– Global services for the complete life cycle
– Tailor made service contracts
– Classroom and online training
– Pre-sales engineering
– Regional service hubs
– Spare parts management
Eliminating the connection bottleneck

ABB is a leading Independent Connection Provider (ICP) with the proven capability to deliver new connection projects. These range from the regulated provision of service alterations to support the day to day maintenance and system reinforcement activities of Distribution Network Operators (DNOs) to the turnkey management of multi-million pound contestable connections for renewable energy projects and clients.

Working with DNOs to achieve a fast connection
Procuring and delivering utility connections is a major concern for the developers of renewable energy projects, both in terms of cost, risk and on-time delivery. Many of the UK DNOs are heavily over-subscribed with new connection applications. In some cases they are simply unable to offer a new connection and/or the associated works within the desired timescale, which can prevent otherwise viable projects going ahead.

ABB offers a very successful approach to new connections that can help reduce this bottleneck by allowing the DNO to focus on the ‘non-contestable’ element of a project – in essence they just need to verify that there is a connection point available with sufficient capacity. ABB then delivers a project-focused single interface to design and construct the actual connection substation to the DNO’s own standards.

Once the works are complete the substation can be handed over to the host DNO to manage and earn the associated revenue. Because of this approach, DNOs regard ABB as working in partnership with them and they have come to welcome our services as relieving the burden on their internal resource.

Years of experience
Ofgem, the UK’s regulator of gas and electricity markets, first brought competition to the new connections market in 1997. Since then, ABB has completed many new connection projects for private developers and end users from 11 kV up to 132 kV, something that is beyond the scope of most ICPs.

Commitment, expertise and customer focus
The specific benefits of working with ABB will vary from project to project. In the majority of cases we can offer significant cost and time savings, but the real advantages often lie in our commitment, technical expertise and customer focus. Indeed, many customers are delighted to find that, when we are invited to tender for a new connections project we often find more innovative options or approaches to a particular new connection requirement which can reduce time, money or programme risk – all of this is detailed in a comprehensive tender document.

NERS Accredited
ABB is one of a select group of companies to be accredited under the National Electricity Registration Scheme operated by the Lloyd’s Register Group on behalf of the UK DNOs. This scheme provides technical assessment of service providers who elect to be assessed for accreditation for contestable works associated with the installation of electrical connections.

ABB has a broad NERS registration that covers design, project management, cable laying, cable jointing, overhead lines, substation installation and associated civil engineering works.

Flexibility
Making a new connection is a critical part of most projects. On major developments, the one thing a client needs is flexibility. If the project needs to go ‘off-plan’ for any reason, it is vital that the electricity contractor can adapt to meet the changing requirements.

In our role as an Independent Connections Provider, ABB understands the evolving needs and priorities of different projects. We also recognise the need to work with all the equipment suppliers whose products are approved by the local network operator and understand the need for financial flexibility. We can arrange contracts with commercial terms that reflect the competitive nature of the market, including staged milestone payments as the project progresses.

Why connect with ABB?
- Comprehensive scope from low voltage through 11 kV, 33 kV, 66 kV up to 132 kV
- Just one interface for the entire connection project
- Flexible, responsive service for fast-track ‘power-on’
- Commercial flexibility with milestone payments
- UK-wide coverage
- NERS accredited

Cable installation
After leaving the shipyard in the Netherlands where it was constructed, the 2,000 ton platform is now in position 30 km off the Belgian coast, energized and ready to connect the Thornton Bank wind farm to the power grid onshore.

Ready ahead of schedule
The project is being undertaken on behalf of the Belgian customer C-Power. ABB is responsible for system design, manufacture, delivery and commissioning of the offshore substation, including the platform as well as the offshore cable systems from ABB’s high voltage cable facility in Karlskrona, Sweden.

The key components of the project come from ABB and equipment from Sweden, Finland, Germany, the Netherlands and Poland has been assembled to create the complete plant at the Dutch shipyard. The project has gone very smoothly and the installation of the transformer platform even took place ahead of schedule.

“The transformer platform being ready is an important milestone. Now we can start the commissioning work offshore and connect the wind turbines first to the substation and then from there to the onshore grid with our submarine cables,” commented ABB project director Jorge Brischetto.

Important environmental benefits
The Thornton Bank wind farm will have a total capacity of 325 MW. When it is in full operation in 2013, it will generate 1,000 GW of electricity per year, equivalent to the needs of 600,000 inhabitants in Belgium. That is 10 percent of the country's 2020 target for renewable energy. The new wind farm is expected to reduce carbon dioxide emissions by 450,000 tons per year compared to the most efficient gas-fuelled power plants.

In May 2012 ABB achieved an important project milestone with the successful delivery of the large transformer platform to the Belgian wind farm known as Thornton Bank.
Historically electricity generation has been dominated by large synchronous machines. These are fitted with variable excitation systems, which allow fast and significant changes to the power factor of the generator and variable reactive power output. In contrast, wind power plants (WPP) typically comprise many distributed smaller generators. This can mean that the reactive capability range of some WPPs is not as wide as conventional plants. ABB STATCOMs can offer the right solution to provide additional reactive compensation.

The significant increase in the level of wind power has forced grid operators to tighten their grid connection rules – also known as grid codes – in order to maintain grid stability. This is especially true in the UK, which has the most stringent grid code worldwide.

England’s largest wind power plant, Fullabrook in Devon, developed by ESB International with a total power output of 66 MW, required additional support to fully guarantee grid code compliance. The wind farm has been producing green electricity for export to the grid since autumn 2011. It was economically attractive to combine the reactive power contribution of the turbines and ABB’s PCS 6000 STATCOM. As the wind turbines have more inductive than capacitive output capability, mainly capacitive contribution is required.

This solution was made possible by the close cooperation between ABB and the turbine manufacturer, whose overall WPP control system controls the sum of reactive power from the plant.

The ABB STATCOM range is based on voltage source inverter (VSI) technology and therefore has the ability to provide symmetrical reactive power control, i.e. both capacitive and inductive. Systems based on VSI technology respond rapidly to
ABB’s compact PCS 6000 (Power Converter System) represents a quantum leap in high power technology, particularly in terms of technical performance and economic operation. The PCS 6000 is an efficient and effective power system package that is specifically designed to interconnect normally incompatible networks. The flexibility of the system allows it to be applied to a wide range of applications. The PCS 6000 is particularly competitive in terms of installation time and space requirements. Furthermore the high efficiency and low maintenance lead to low operational costs.

The new generation PCS 6000 is designed for applications of up to 32 MVA per unit. Higher powers can be achieved easily by paralleling multiple PCS 6000 systems.

PCS 100

ABB’s PCS 100 platform is a flexible, scalable system which can be configured for a variety of power quality applications including voltage stabilizing, grid interconnection, reactive power compensation and energy storage.

In the energy storage configuration, ABB’s PCS 100 ESS (Energy Storage System) provides wide bandwidth performance with a flexible and highly modular power electronic configuration. It is possible to use the PCS 100 ESS with both new and “second life” batteries from electric vehicles to store the surplus energy generated by a source, such as a wind farm and return it to the electricity grid when required. This offers a range of options to reinforce and enhance the performance, quality and reliability of smart electricity grids.

The PCS 100 ESS is available in load capacities of 100 kVA to 10 MVA and allows control of both real power (P) and reactive power (Q) based on the system requirement. Advanced control features in the ‘Generator Emulation’ mode of operation enable this storage system to function as a true power system component. The PCS 100 ESS offers power system load levelling, grid stabilization, grid compliance for renewable and generation systems and power quality improvement.

To the power system, the PCS 100 ESS looks like a traditional synchronous machine. This is achieved through power electronics and advanced control alone, i.e. there are no large spinning masses. Even inertia can be modelled within the system enabling it to deliver to, or draw power from, the grid dependently on the system frequency and rate of change. Should the grid supply be lost the PCS 100 ESS can detect this, disconnect itself from the grid and shut down.

In some applications it is desirable to keep sections of load supplied, so alternatively the system can be set to operate in island mode where the system disconnects from the main grid but continues to supply local loads. When the grid returns the systems will automatically resynchronise and return to grid connect mode.

Combined reactive power control and energy storage

To further demonstrate the flexibility of the PCS 100 range, the facilities of the PCS 100 ESS and PCS 100 STATCOM can be combined into a single unit. By connecting batteries to the DC link of the PCS 100 STATCOM, both load levelling and peak shaving can be added to the control of reactive power. This provides the end user with a compact and flexible power quality solution.
ABB has the proven capability to design and install the ideal high-voltage (HVC) cable system for a wide variety of onshore and offshore renewable energy projects worldwide.

Power export cable for Humber Gateway offshore wind farm
ABB has won a major order from E.ON UK, to supply the power export cables for Humber Gateway offshore wind farm. The contract includes 2 x 14 km circuits of 132 kV 3-core AC submarine cable, with integrated fibre optics and accessories, that will connect Humber Gateway, one of the UK’s largest offshore wind farms, to the mainland grid.

When completed, in spring 2015, Humber Gateway will consist of a 73 turbine array that will generate up to 219 MW of electricity, enough energy to power up to 170,000 homes. The wind farm will be located 8 km off the East Yorkshire coast, just north of the mouth of the river Humber.

The cable will be manufactured by ABB’s factory in Karlskrona, Sweden, with delivery scheduled during the summer of 2013.

The world’s highest voltage 3-core AC subsea cable
ABB has won an order worth around $30 million from Energinet.dk, the Danish transmission system operator, to supply a high-voltage submarine and underground power cable system for the Little Belt strait in Denmark. The cable system is one of several government-initiated projects to replace high-voltage overhead lines and transmission pylons in environmentally sensitive areas.

ABB will supply single-core 420 kV underground cables with a total length of 30 km and two, 3-core 420 kV submarine cables with a total length of 15 km. This is part of a turnkey solution to design, supply and commission the cable system, including cable terminations and the laying of the submarine cable. When completed in 2013 this cable system will be the most powerful 3-core alternating current (AC) submarine power cable in the world.

Installing a 3-core 420 kV submarine cable instead of three separate single-core cables will reduce costs considerably and reduce the cable’s footprint so that it has a lower impact on the seabed. The cable will be manufactured in a single continuous length, without factory joints, drawing on ABB’s significant expertise and sophisticated extrusion technology.
ABB recently completed a similar record-breaking submarine cable system across New York Harbour in the United States. The cable system connects a new high-efficiency power plant in New Jersey to a high-voltage substation in Brooklyn at a record voltage level of 345 kV AC.

**Lewek Connector installation vessel defies the waves**
ABB has chartered the Lewek Connector (formerly known as AMC Connector), a newly built state-of-the-art cable ship, to boost our capacity to meet the ever-growing demand for submarine cable project management and installation services.

The vessel, chartered by ABB under a long term agreement, is equipped to handle a total payload of 9,000 tons, divided onto two turntables, making her ideal to install long and heavy subsea power cables. The Lewek Connector’s design enables her to comfortably operate in significant wave height (Hsig) of 4-5 metres, which means that she has an operating window at the leading edge for installation and construction vessels.

**Cable repair services with 24/7 availability**
ABB has developed a complete portfolio of cable system services that makes fault location, repairs and other services for submarine and underground cable systems available 24 hours a day. Spare parts and other essential equipment are kept at the customer’s site to ensure availability and the fastest possible service. ABB has a long experience of AC and DC cable system installations and repairs all over the world, and has developed efficient approaches to minimize system downtime.

Our repair services include:
- cable testing
- fault location
- repairs of:
  - HVDC cables up to 500 kV
  - HVDC Light® cables up to 320 kV
  - AC cables (XLPE or oil-filled) up to 420 kV
- annual inspections and maintenance of submarine and underground cable systems
ABB also has extensive experience of handling all types of HVC accessories from leading manufacturers of high voltage accessories. We also have expertise with low pressure oil-filled cables up to 420 kV AC, transition joints between XLPE cables and oil-filled cables, straight joints, and the repair and installation of oil-filled cable terminations.
Safety by design features include special feet to improve cabinet stability.
Offshore wind farm project adopts IEC 61850 philosophy

ABB has delivered a state-of-the-art substation protection and control system, based on the IEC 61850 international standard for substation automation, for EDF Energy Renewables’ Teesside Offshore Wind Farm.

The project for Warrenby substation, the wind farm’s onshore connection constructed by Morrison Utility Services, is a significant development as ABB’s first UK implementation of the global IEC 61850 standard that represents a major step forward in simplifying the integration of intelligent electronic devices (IEDs).

The offshore wind farm at Redcar, Teesside consists of 27 turbines producing power exported by 33 kV subsea cables to Warrenby, where it will be stepped up by two grid transformers to 66 kV so it can be fed into the regional and national grids via the Northern Powergrid network.

Complete protection and control system
Morrison Utility Services, the UK’s leading utility service provider, awarded ABB the contract to provide the complete protection and control system for Warrenby substation. According to Andy Osiecki, ABB’s General Manager for Power System Network Management, “The Teesside Offshore Wind Farm project has been a significant challenge, working not only with a new customer, but also a whole new technical approach that effectively required us to start from a blank sheet of paper and also combined with the need to ensure fast-track delivery. In fact, the whole process from design, engineering, building the panels, carrying out the FAT (factory acceptance test) and shipping them to site was accomplished in just three months.”

Flexible open system architecture
The adoption by ABB of the IEC 61850 standard offers significant technical advantages through its flexible open system architecture. These include a standardized model of the IEDs and their data and communication services, full interoperability between electrical devices from different vendors, reduced cabling and effective future-proofing of the infrastructure by making it easy to extend and update as needs change.

Relion® family
The protection and control system for Warrenby substation is based on IEDs from ABB’s Relion® family, a collection of equipment developed specifically to implement the core values of the IEC 61850 standard. They include Relion RET 650, RET 630 and RET 615 transformer protection and control devices. As an example of the ease of integration with third-party equipment, the scheme incorporates an AVC (automatic voltage control) device supplied by another manufacturer.

One of the key technical challenges solved by ABB in designing the system was to ensure that it met the needs of the engineering recommendation G59, that sets out the standards required for the connection of a generating plant to the distribution systems of a licensed Distribution Network Operator (DNO).

Rigorous FAT
The rigorous FAT for the Warrenby panels was carried out at ABB’s unique automated System Verification Simulator (SVS) based at Stone, Staffordshire. Rather than carrying out manual switching of equipment to simulate the operation of substation plant, the SVS is able to duplicate the whole substation within the test laboratory. It runs automated, self-monitoring test sequences to provide a high level of rigour and repeatability as well as a full audit trail.

“Teesside Offshore Wind Farm is a vital reference project that confirms ABB’s capability to deliver IEC 61850 substation projects” concludes Andy Osiecki. “It is proof positive that this key new development in substation design is now making the transition from the laboratory to practical real-world applications.”
Oyster 800 opens up new wave power opportunities

ABB Technology Ventures, our venture capital arm, has made a major investment in Edinburgh-based Aquamarine Power which is developing Oyster wave power technology to capture energy found in nearshore waves and convert it into clean sustainable electricity.
The Oyster wave power device is a buoyant, hinged flap which is attached to the seabed at around 10 metres depth, around half a kilometre from shore.

This hinged flap, which is almost entirely underwater, sways backwards and forwards in the nearshore waves. The movement of the flap drives two hydraulic pistons which push high pressure water onshore to drive a conventional hydro-electric turbine.

In essence, the Oyster wave power device is simply a large pump which provides the power source for a conventional onshore hydro-electric power plant. All of the complex electronics are onshore and there are only seven moving parts offshore – a hinge, two hydraulic pumps that pump the high pressure water to the shoreline and four valves.

Oyster has been designed to survive. By locating Oyster near the shore, the device naturally avoids the massive storm forces which other devices are exposed to in the open ocean. By the time a storm reaches the Oyster, the waves are a maximum 12 metres high. These big waves push the Oyster towards the seabed before it bobs back up to meet the next wave. As the waves get bigger it is pushed further under the water allowing the excess energy in the wave to flow over the top of the Oyster. This inherent survivability means there is no need for complex control systems or for Oyster to shut down in stormy conditions – it will continue to produce power, whatever the weather.

Oyster is one of the few wave energy technologies which has moved off the drawing board into full-scale power production. The first full-scale 315 kW Oyster was officially launched by Scotland’s First Minister Alex Salmond at the European Marine Energy Centre (EMEC) in Orkney in November 2009, when it began producing power to the National Grid for the first time. The device withstood two winters in the harsh Atlantic waters off the coast of the Orkney Islands in northern Scotland and delivered over 6,000 offshore operating hours.

Aquamarine Power installed the next generation 800 kW Oyster 800 device in 2011 and has been granted consent to install a further two devices in the same location. Together the three Oyster devices would form a 2.4 MW array connected to a single onshore generating plant.

In 2009, in a ground-breaking development for the marine energy sector, Aquamarine Power signed a joint venture partnership agreement with SSE Renewables to co-develop up to 1 GW of marine energy sites using Oyster technology. In March 2010 the joint venture partnership was awarded exclusive rights by The Crown Estate to develop the first 200 MW Oyster wave farm. In May 2011 Aquamarine Power secured a further two lease options for an area of the seabed off the Isle of Lewis in Scotland with a potential installed capacity of 40 MW.

To see videos of Oyster in operation please visit: www.youtube.com/aquamarinepowerltd

Pentalum launches SpiDAR – a reliable cost effective wind LIDAR

ABB has made a strategic investment in Pentalum Technologies, a company developing advanced wind-sensing technology for control and optimization of wind turbines and wind farms. Recently, Pentalum launched SpiDAR – a pulse wind LiDAR (Light Detection and Ranging) system, for remote sensing of wind.

The unique architectural structure and measurement methods patented by Pentalum, allows SpiDAR to provide simultaneous, accurate and reliable measurements of wind speed at multiple sites, at a cost per site significantly lower than existing technologies which enable wind farms developers and operators to deploy multiple units at a single site; providing better, more precise wind measurements.
Symphony Plus in tune with wind power

Symphony Plus, the latest generation in ABB’s Symphony family of distributed control systems, continues our tradition of delivering power generation software that helps drive plant productivity and energy efficiency, as well as enhanced operational security, plant safety and lower total cost of ownership.
Commenting on the launch, Franz-Josef Mengede, head of ABB’s power generation business, said, “With the launch of Symphony Plus, we are taking the Symphony success story to the next level, ushering in a new era of total plant automation that is simple, scalable, seamless and secure. With Symphony Plus, we help balance performance objectives like asset availability, operational reliability and production efficiency with business goals like asset life extension, carbon reduction and regulatory compliance – providing plant owners with an essential tool for achieving sustainable and profitable growth.”

**Total plant automation**
Symphony Plus meets a broad spectrum of plant configurations and applications, especially in the renewables industries. It is flexible and scalable; designed to serve the needs of everything from small, serverless applications to large multi-system, multi-server architectures.

Symphony Plus supports the seamless integration of field devices, process and turbine automation systems, electrical and Supervisory Control and Data Acquisition (SCADA) solutions, as well as business and maintenance systems. It provides users with a secure, reliable control environment and built-in security features that prevent unauthorized system access.

Since its introduction over 30 years ago, the Symphony family has gone through several evolutionary changes. Through ABB’s ‘evolution without obsolescence’ life cycle policy, each generation of the family builds on and enhances its predecessors, while protecting the customer’s previous control system investments. There are now more than 6,000 Symphony systems installed worldwide, making it one of the widest deployed process automation systems in the world.

Symphony Plus provides users with a comprehensive view of the plant by integrating data from all plant areas and systems, including turbine control, electrical balance of plant and remote SCADA systems. Through its open architecture, Symphony Plus seamlessly consolidates and rationalizes plant data to improve operator response to changing conditions, so improving plant safety and uptime.

**Transforms data into actionable business decisions**
Information is the key to successful business performance. In Symphony Plus Operations, historical, process and business data is collected from across the plant and stored securely. Transforming data into meaningful information, Symphony Plus Operations presents pertinent, easy-to-understand information in intuitive desktop displays to all levels of the organization.

**Unified engineering workbench**
Short time to production is the measure of engineering efficiency. Symphony Plus Engineering provides a world-class integrated engineering environment, with the functionality required to engineer, configure, administrate, secure, commission and maintain any Symphony Plus component.

**Single control and I/O platform**
Symphony Plus provides total plant automation from a single control and I/O platform that encompasses dedicated interface modules and devices for all turbine types, OEMs and sizes, as well as an unparalleled selection of combustion instruments.

**Electrical and device integration**
Symphony Plus provides process and electrical control from a single platform. Using open standard protocols like IEC 61850 and Modbus TCP, Symphony Plus integrates electrical devices with process control and plant operations. It provides full integration of just about every type of device and enables the monitoring and management of all plant assets at all levels of the plant.

**System security**
ABB understands the need to maintain a secure, reliable control environment while expending minimal time and effort. In addition to the many security features of Symphony Plus, ABB actively participates in several major control system security standards committees. The guidance provided by these committees is designed to increase the integrity and confidentiality of all system functions and help prevent unauthorized control system access.
Transformers reach new depths

ABB has developed a new generation of subsea transformers. Currently, the technology is helping ensure continuous production in a gas field located 400 metres under water off the coast of Norway. However, the concept could offer interesting possibilities for the offshore wind and tidal power sector.

ABB is a leading supplier of subsea electrification solutions, with a range of specialized electric power systems and services for key subsea production sites. At the Norway site, building a new offshore platform near the gas field was too costly. Moreover, the field is 150 km from land and 50 km from the nearest offshore platform. At such distances, the power requirements needed to keep the gas compressor motors running on the sea floor would prove too great for a traditional 6.6 kV transmission link.

But there is another way. ABB began developing subsea transformer technology in 1985 and remains the world’s leading manufacturer in this area. On the sea floor these units convert electricity that operates powerful compressors, which are then used to extract oil and gas from the site and keep wells productive longer.

Rated at 15-30 MVA/50-132 kV/6.6-22 kV, ABB’s newest subsea transformer is rugged, powerful and capable of operating at depths of up to 3,000 metres. With the highest power and voltage ratings and highest operating frequency, it is the most efficient subsea transformer on the market.

The 60 ton transformer had to pass demanding factory tests, followed by a year of scrutiny before installation, including laboratory testing under extreme conditions. Reliability is paramount and is ensured by rigorous quality standards.

With over 15 subsea transformers in operation, ABB has also developed rare expertise in the remotely operated vehicles (ROVs) that install the units.

The largest order so far is for multiple subsea transformers for the Åsgard field in Norway to power the compressors on the sea floor. Electricity is generated on a platform 50 km away where it is converted to the 50 kV transmission voltage by an ABB step-up transformer.

A subsea cable connects the platform to the ABB transformer on the sea floor. This steps the voltage down to 6.6 kV for operating the compressors, pumps and motors.

ABB’s subsea transformers are specially designed to withstand the rigours of water pressure, saltwater corrosion and high temperatures created by its own internal operation.

As market sectors such as offshore wind, wave and tidal power develop it is clear that the application of ABB’s subsea transformers can contribute to the deployment of such technology in a cost effective and reliable manner.

EcoDry transformers cut energy losses by up to 70%

ABB’s EcoDry range of ultra-efficient, dry-type distribution transformers can reduce transformer energy losses by up to 70 percent compared with standard dry-type transformers. This helps reduce energy costs and improve environmental performance.

EcoDry transformers achieve higher efficiency levels through the use of state-of-the-art materials and components, including amorphous metal as the core material, as well as the latest simulation methods for loss-optimized design. They are available in ratings from 100 to 3,150 kVA, with operating voltages up to 36 kV.

The EcoDry range includes three models. Each is designed to meet the different needs of applications where losses are either predominantly ‘no-load’ losses (caused by fluctuating magnetization of and eddy currents in, the transformer core), or ‘load’ losses (which occur in the conductors due to ohmic loss and eddy currents and increase quadratically with the load), or a combination of the two – such as in renewable energy schemes.

Globally, ABB estimates that some two percent of all electricity generated is lost as a result of distribution transformer inefficiency – equating to 25 GW of power. ABB’s next generation of low-loss dry and liquid-filled amorphous distribution transformers can effectively reduce overall losses, contributing to energy savings, lower operating costs and reduced environmental impact.
The majority of the UK medium voltage (MV) power distribution infrastructure dates back to the 1950s or 1960s. It has served us well over this time. However, many operators are now finding that their ageing equipment is simply not up to meeting their changing needs. In particular, it doesn’t have the flexibility or capability to handle additional network loads. This is especially true for the renewable energy sector.

The traditional approach is to either upgrade the existing substation or to build a new one alongside it. This can be an expensive and lengthy process, with the added drawback of considerable site disruption and the possible need for lengthy power outages as circuits are transferred. That’s why a growing number of customers are taking advantage of ABB’s fast-track solution, based on modular systems in the form of containerised switchgear.

Plug-and-play
The key advantage of ABB modular systems is that they are fully pre-engineered units, delivered to site ready to plug-and-play. This approach ensures a more cost-effective overall project, which is some 20 percent faster to complete than the conventional build on site route – typical timescales are 30 to 40 weeks from order to delivery. It also provides a smooth changeover, with only a short outage required, since it is just a question of transferring over the cables.

Reduced risk
One important benefit of ABB’s approach to modular systems is our total focus on reducing customer risk. Rather than dealing with several equipment suppliers and contractors our customers have a single interface with ABB that provides full visibility of the entire project, from procurement to delivery – effectively eliminating the possibility of unpleasant surprises.

A further advantage is that all of the critical equipment is installed and tested under factory-controlled conditions. This keeps the actual work on site to a minimum. With only a few contractors required, health and safety is enhanced and disruption to normal operations is minimized.

Choice of compact containers
Modular systems are offered in a choice of robust outdoor containers in steel, GRP or concrete to meet individual site requirements. They are designed to last as long as the application – at least 40 years.

Growing UK interest
In the UK, modular systems are clearly an idea whose time has come. The consistent feedback we have from customers shows that they value ABB for our innovative switchgear products, the ability to save space on site and our depth of experience in delivering time and cost-critical projects.

Minimal civil works
At site the container is simply craned into position. Civil works and project costs are minimized, since all that is required are basic foundations, either a concrete base or stilts for the container to rest on.

What’s in the box?
ABB modular systems have the flexibility to be tailored to meet customer needs. A typical installation might comprise:

- primary 11 kV and 33 kV switchgear (ZX1.2 gas insulated or UniGear air insulated)
- secondary 33 kV switchgear (SafePlus gas insulated)
- protection relays
- transformer
ABB provides the model answer

Stuart Grattage, Head of Engineering for ABB’s Power Systems business, explains how computer modelling can help utilities and system operators optimize their offshore wind farm projects.

There are several boundary conditions that must be considered to achieve the cost and energy-efficient network connection of offshore wind farms. Capital investment and operating costs have to be minimized, as do transmission losses, while operational reliability has to be maximized. For this complex process, ABB’s globally deployed team of power systems consulting experts has the specialized knowledge and expertise essential to create the optimum customized package, whilst ensuring grid code compliance.

ABB has developed a suite of powerful system analysis tools that use advanced modelling techniques to map the performance and variation of electricity transmission and distribution networks. This approach enables key network characteristics such as:

- load flow
- short-circuit current
- harmonics
- flicker and voltage dips
- transient stability
- protection coordination
- earthing systems

to be assessed on a system wide basis in order to help develop, evaluate and prioritize investment options as well as understand the implications of connecting new generation, such as offshore wind, into the network. These techniques have been proven with utilities both in the UK and worldwide.

Rigorous and credible

The key aim in system analysis is to provide our customers with an independent, rigorous and credible assessment of how their existing network performs, using advanced techniques to identify causes of poor performance or reliability. In addition, modelling can be used to evaluate how the network will perform under various improvement schemes so that customers can target future investment programmes to increase network reliability.

Typically, our team of highly skilled and experienced analysts will build a network model by importing details of hundreds of miles of overhead lines, underground cables and subsea cables, as well as potentially thousands of substations, directly from the customer’s database. By incorporating all the relevant information concerning equipment ratings, cable lengths, switching times and repair times, ABB can construct what is effectively a working scale model of every switch and connection within the network.

Statistical analysis

The ABB team will then take this model that mirrors the electrical, operational and performance characteristics and constraints of the network and carry out advanced statistical analysis to profile how the existing network should be expected to perform over a period of time – within the limits of confidence. This allows a risk assessment of the potential variability in performance to be undertaken.

The analysis can identify potential options for network improvement. In previous studies these have included extending the remote control facilities within the network to enable switches to be reset remotely without an engineer having to visit the site, as well as network reinforcement, such as the upgrade of existing switchgear and the construction of new substations.

Modelling will confirm if these measures can produce significant improvements in network performance as well as helping quantify the degree of improvement expected.

Demonstrating value and efficiency

The advantage of computer modelling an electrical network is that it enables ABB to provide a rigorous, fully auditable and quantified assessment of its performance over the complete range of operational scenarios as well as suggesting options for improvement. This type of independent analysis is not only essential before any form of new generation can be connected into a network, but it also helps support customers in demonstrating to regulatory authorities the value and efficiency in any proposed investment schemes.
Transforming the power of wind into electricity, integrating it efficiently into the grid and maintaining network reliability are key challenges. They drive the evolution of more flexible and intelligent power systems, aiming to balance unpredictable and intermittent supply with demand. ABB’s HVDC Light® technology plays a central role in enabling long-distance transmission and cross-border grid connections, underground and underwater, to deliver reliable, high-quality power supplies with minimal losses. www.abb.com/hvdc

Harnessing the power of wind?
Naturally.

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