INTEGRATED CABLE SOLUTIONS
FOR OFFSHORE WIND DEVELOPMENT
Offshore wind is one of the most stable sources of renewable energy. Power fluctuations are minimal due to prevalent ocean wind patterns. And the need for standby generator capacity for peak load servicing is largely eliminated through accurate weather forecasting combined with remote databased control and management. This reduces costs, enhances network stability, and contributes to a balanced clean power supply.

In the near future, installed offshore wind production capacity is expected to increase from 20 GW today up to 150 GW by 2030, thus becoming a trustworthy renewable resource for Europe’s integrated supergrids of the future. Indeed, offshore wind is deemed to play a key role in “keeping global warming below 2° C,” the objective of the Paris Agreement 2018.

Recent offshore wind trends include a move towards larger turbines and deep-water floating units. Offshore projects (up to 200 km from shore) require robust cables, precise maritime installation, as well as efficient long-distance transmission, involving innovative cable solutions and reliable accessories.

New industry trends and drivers
- Increased cost-competitiveness: Offshore wind power solutions are getting less and less expensive
- Larger and more efficient turbines: Higher energy capture, increased reliability and lower operating and maintenance costs can generate considerable savings per unit. Next-generation 12-15 MW turbines requires durable, large capacity cables
- Deeper waters farther out to sea: Offshore towers and infrastructure must be able to handle severe ocean conditions. Cables and components need to be salt- and water-resistant and display dynamic maritime qualities
- Upgraded transmission and interconnection infrastructure: Ocean-based turbines, whether fullscale floating devices or grounded on the seabed, require appropriate infrastructure to export energy to land-based grids, and provide telecommunications for remote control
- Improved supply chain, logistics and installation: Optimization could potentially achieve 3 % savings. This demands cable and accessories availability, as well as onsite delivery and installation using specialized cable laying vessels. This requires marine proficiency and cable-laying capability
- Partnerships and trans-regional cooperation: This is especially crucial in research, technological development and training. International projects require specialized cable expertise, shared knowhow, and adherence to world standards
Nexans has the expertise to outfit large offshore wind turbines, interconnect them in complete windfarms, and link them to distant or local grids. For medium and high-voltage cables, Nexans oversee complete installation, from initial pre-qualification, design, customized production, logistics, installation, testing and pre-commissioning. This includes all accessories, a key element in any efficient energy network.

Nexans supply and lay MV subsea cables between wind turbines and the transformer platform, and the MV or HV link to the onshore substation. Nexans also provide power accessories and topside termination on wind turbines and transformer platforms. At the same time, we have been developing cables and power accessories for those OEMs producing a new generation of stationary and floating turbines.

Apart from a full range of energy cables and services, Nexans is also an expert in the telecommunications infrastructure needed to manage offshore wind parks, including control and data cables, copper and fiber Local Area Networks.

**Innovative technologies**

- World supplier of submarine and underground cables, overhead conductors and data/telecom systems
- Close partnership with developers, power utilities, installers and contractors
- Mastery of maritime conditions based on oil & gas submarine energy and telecom cabling experience
- Unsurpassed offshore installation and topside termination experience using advanced equipment, special software for overhead lines, and dynamic cable solutions
- Complete range of power accessories: separable outer-cone T-connectors, bushings, surge-arresters, cold-shrinkable and heat-shrinkable joints and terminations for various types of cables
- A wide range of aluminum based solutions, mechanical connectors, cable lugs and pre-manufactured cable kits for offshore wind turbine manufacturers, ensuring reliable aluminum to copper connectivity
- System solutions in the transition piece where junction frames or cabinets assure the link between an inter array cable and the switch in the basement of a tower. This ensures easy and effective mounting and a clear responsibility border during build-up of the tower
Nexans WINDLINK® offer proposes a full range of reliable, high-performance cable solutions for wind turbines. WINDLINK® contributes to improve wind turbine output and performance and comprises solutions for both towers and nacelles. Fully tested electrical systems and easy-to-install kits considerably reduce installation time. Some of the main product families include:

**Low-voltage loop rubber cables (EPR cable class 5)**
- These cables (up to 1 kV) reliably transmit energy produced in the generator to the transformer
- They come in Low-Smoke Zero-Halogen (LSZH) versions, and are also oil-, abrasion-, UV- and ozone resistant
- Whenever Nexans supplies this type of cable, lifetime tests according to movement and torsion requirements are performed.

**Low-voltage joints**
- Nexans systems use mechanical shear-off-head bolt connector with an innovative rubber sleeve which enable them to withstand thermal cycling and tower vibration throughout the turbine lifetime
- A new connector made of high-strength aluminum alloy (copper to aluminum) with a protective roll-on sleeve is fast and easy to install without special tools
- Roll-on sleeves offer protection, insulation, short-circuit stability and long-term reliability

**Low-voltage fixed installation cables**
- Copper can be single or multicore, with EMC screening
- Aluminium single core are larger but cheaper; their lightness make them easier to handle and install in towers
- Nexans has supplied a wide range of LV installation cables to Alstom Wind, Nordex, Siemens, Vestas, GE, etc.

**Low-voltage loop aluminum cables and accessories**
- Innovative cable design to allow torsion requirements due to nacelle rotation
- 150 mm<sup>2</sup> to 400 mm<sup>2</sup> aluminum replaces 95 mm<sup>2</sup> to 240 mm<sup>2</sup> copper
- Mechanical connectors with shear-off-head bolts tolerate different conductor cross-sections. The force of the screw creates electrical contact between the conductor and connector body
- Factory pre-installed solutions, including cables, lugs and connectors

**Low-voltage kits**
- To facilitate assembly, Nexans provides pre-terminated kits which bundle energy, control and data cables for wind turbine electronics
- Also, cut-to-length, pre-connectorized, all-power cables are supplied to tower manufacturers for generator-to-switchgear-to-main-powerline links

**Medium-voltage loop rubber cables**
- Similar to LV loop cables, they can handle up to 66 kV between the transformer and the switchgear at the base
- We are delivering MV loop cables in 3+1 core or 3+3 core designs to all the major WTG manufacturers using this solution
MV accessories designed to reduce installation time

- A range of offshore junction cabinets (OJC) or frames (OJF) for use in the transition piece of turbine towers and in substations. Pre-terminated leads offer important cost savings.
- For offshore, an OJC can be used as a connection point between tower cables and subsea array cables.
- Cabinets and frames can also be used in offshore substation solutions.
- Our terminations and joints make installation quick, easy and long lasting. Specific training courses in power accessories installation are available.

Medium-voltage connectors

- Nexans safe-to-touch T-shaped standard outer cone connectors are designed for the new generation of compact switchgears and transformers.
- Power accessories can also accommodate larger cross-sections up to 1,200 mm² of large turbines and cable-to-cable connections up to 66 kV (Um ax = 72,5 kV), all in an outer cone version.
- The compact design makes it easy to connect to the transformer’s three phases without female units.

Auxiliary equipment and systems

Mechanical support (hang-off and clamping systems, protective shells/slabs/mattresses)
- Easy-to-install hang-offs to fasten energy cables above sea level, available sealed or non-sealed.
Medium-voltage cables

- Cost-efficient submarine 3-core cables with integrated fiber optic elements and customized armor designs up to 66 kV voltage level

> Nexans has provided the world’s first 66 kV inter-array for the Blyth Offshore Demonstrator Windfarm

High-voltage export cables

- Offshore HVAC transmission: submarine cables ranging from 123 kV to 420 kV with various designs available, qualified for up to 420 kV for both single and 3-core XLPE cables

- Offshore DC transmission applicable for high transmission requirements and long distances: mass-impregnated cables qualified for up to 525 kV and XLPE insulated DC cables qualified for up to 400 kV

- Onshore transmission: HVAC and HVDC Land cables solution qualified up to 525 kV

> Nexans has developed, supplied and installed 2x70 km of 245 kV XLPE 3-core submarine cables and 6x20 km of HVAC land cables for the Beatrice offshore wind farm

> Nexans will supply and install the 320 kV XLPE HVDC export cables for the Dolwin 6 project, connecting German offshore windfarms to the shore

66 kV Power Accessories

With the development of the 66 kV inter-array cable, the full range of bushings, connectors, surge arresters, terminations, joints and special alloy contacts for large cross-sections were developed. The connectors are based on the outer cone standard and the piggy-back principle. Besides the easy mounting conditions of a plug-in connector, they are also easy to use in an environment of 2 or more cables for one phase. Surge arresters can be plugged into the connector.

Power Accessories

Nexans delivers a complete cable system including a full range of power accessories such as GIS termination, outdoor termination, joints, etc. for voltage up to 525 kV.

Export cables at 245 kV and above

In Europe, USA and Asia, Offshore windfarms are being built further offshore with increasing production capacities above 1 GW, requiring higher transmission voltages.

Currently offshore windfarms are connected to shore at a 245 kV voltage level with several cable installed in parallel. With continuous improvement in insulation material, export cables can now be delivered up to 420 kV HVAC in single core or three core configuration.
For deeper and further offshore sites, floating wind turbines need to be used. To connect the wind turbines together and to export power to shore, the use of dynamic power cable is required. With its long experience in dynamic umbilicals, Nexans is a pioneer in designing and manufacturing dynamic power cables systems. Nexans provides a complete solution including in-house dynamic analysis, manufacturing, testing as well as a full range of optimized accessories for the dynamic cable system.

In 2017, Nexans supplied export cable and inter-array cables for the world's first floating offshore wind farm, Hywind Scotland.
Nexans Aurora encompasses more than a century of our experience in submarine cable installation and brings it to the next level with regards to capacity and capability.

**Large capacity**
Nexans Aurora is equipped with a large capacity cable handling spread including a 10,000 tonnes split turntable with dual product lay lines with capacities and features to handle safely and efficiently the full Nexans submarine systems product line.

**High capability**
The vessel also contains a dedicated enclosed cable splicing area offering a controlled environment for performance of all product splicing and termination work to the exact standard as performed in our factories.

**World leading design**
The design is based on the combined experience of Nexans, Skipsteknisk, Ulstein Verft and MAATS Tech, each world leading in their own fields to produce a subsea cable and umbilical systems installation vessel for worldwide operations, covering the full range of shallow and deep subsea activities.

**Highest level of security**
Nexans Aurora offers the highest level of safety and redundancy in design and equipment level to ensure an unsurpassed operational standard and ensured uptime regardless of area of operation.

**Prepared for the future**
Nexans Aurora is prepared for vertical lay operations and complex subsea construction tasks in deep waters in addition to the principle built in structural and system capacities and flexible design features to allow easy adaptation to customers future needs.

**Self contained**
Nexans Aurora is designed and equipped to make the vessel as self contained as possible. This includes capacity for long range and long duration operations without resupply as well as onboard facilities to ensure a high level of independence and reduced need for local support during operations in areas of minimal infrastructure.

**Environmentally friendly**
Nexans Aurora offers environmentally friendly solutions with a high efficiency diesel generator plant using low Sulphur fuel, regeneration of cable lay braking power and use of power from shore during cable loading operations. The vessel design offers inherent separation of work and living areas with the application of the highest work environment standards including exclusive use of single cabins.

Read more and watch video of CLV Nexans Aurora at: www.nexans.com/aurora
Installation services: Capjet® System

The CAPJET® system was developed as a diver-operated system in 1976, and acquired by Nexans in 1987. The CAPJET® 1 MW system, using a 1.1 MW underwater power supply, was developed in 1991. The system has been subsequently enhanced with special features for flexible and steel pipelines, umbilicals and power cables, seismic cables and rock-cutting modules, as well as equipment for covering and surveying for final documentation (pipetracker, multibeam etc.).

Installation services: C/S Nexans Skagerrak

Topographical surveys, design and engineering are done in close cooperation with the customer. Actual installation involves project management and carefully planned logistics. Long after commissioning and testing, Nexans is still present to train personnel and intervene rapidly in case of system failure.

C/S Nexans Skagerrak was the first purpose-built vessel for transport and laying of large submarine power cables. She has a unique service record covering installation of cables and umbilicals including some of the world’s largest power cables. Developments in the laying of long and heavy submarine cables at greater depths, have made it necessary to employ larger and more specialised transport and laying vessels built especially for that purpose.
The world depends on reliable power supplies, but sometimes accidents happen. Major electricity transfer lines can suffer from outages for as long as a year without a proper contingency plan. Sourcing the right experts with availability to fix the problem can be time-consuming and lead to economical loss, while complex engineering and judicial processes block the road to a repair.

A Nexans IMR (Inspection, Maintenance and Repair) agreement not only reduces failure risk to cable systems through proactive inspection and maintenance, but also increases efficiency when dealing with unexpected incidents. We will make sure you are prepared for the unexpected and able to effectively reduce the response time to a cable failure.

Nexans has a long track record within cable repairs all over the world including Asia, Africa, Europe and the North Sea region. During the last 40 years, Nexans has successfully installed over 50 offshore repair joints after external damages on HV submarine cables, often performed in harsh weather conditions.

Read more and watch video of our IMR service at: www.nexans.com/imr
By the year 2020, the installed capacity in Europe will be about 25 GW. Nexans is present with cable solutions in approx. 50% of these windfarms, and plans to further develop this business to extend its presence all over the world with ever higher performing cable solutions.
Nexans brings energy to life through an extensive range of advanced cabling systems, solutions and innovative services. For over 120 years, Nexans has been providing customers with cutting-edge cabling infrastructure for power and data transmission. Today, beyond cables, the Group advises customers and designs solutions and services that maximize performance and efficiency of their projects in four main business areas: Building & Territories (including utilities, e-mobility), High Voltage & Projects (covering offshore wind farms, submarine interconnections, land high voltage), Telecom & Data (covering data transmission, telecom networks, hyperscale data centers, LAN), and Industry & Solutions (including renewables, transportation, Oil & Gas, automation, and others). Corporate Social Responsibility is a guiding principle of Nexans' business activities and internal practices. In 2013 Nexans became the first cable provider to create a Foundation supporting sustainable initiatives bringing access to energy to disadvantaged communities worldwide. The Group’s commitment to developing ethical, sustainable and high-quality cables also drives its active involvement within leading industry associations, including Europacable, the NEMA, ICF or CIGRE to mention a few. Nexans employs nearly 27,000 people with industrial footprint in 34 countries and commercial activities worldwide. In 2018, the Group generated 6.5 billion euros in sales. Nexans is listed on Euronext Paris, compartment A.

Nexans
Immeuble Le Vinci
4 Allée de l’Arche
92070 Paris La Défense Cedex
France

Tel. : +33 (0)1 73 23 84 00
Fax : +33 (0)1 73 23 86 38
www.nexans.com