

Wind Turbines and Farms

Special cables for on- and offshore wind applications
General catalogue



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Linking the Future

As the worldwide leader in the cable industry, Prysmian Group believes in the effective, efficient and sustainable supply of energy and information as a primary driver in the development of communities.

With this in mind, we provide major global organisations in many industries with best-in-class cable solutions, based on state-of-the-art technology. Through two renowned commercial brands - Prysmian and Draka - based in almost 50 countries, we're constantly close to our customers, enabling them to further develop the world's energy and telecoms infrastructures, and achieve sustainable, profitable growth.

In our energy business, we design, produce, distribute and install cables and systems for the transmission and distribution of power at low, medium, high and extra-high voltage.

In telecoms, the Group is a leading manufacturer of all types of copper and fibre cables, systems and accessories - covering voice, video and data transmission.

Drawing on over 130 years' experience and continuously investing in R&D, we apply excellence, understanding and integrity to everything we do, meeting and exceeding the precise needs of our customers across all continents, at the same time shaping the evolution of our industry.





What links global expertise to the wheels of industry?

High-performing cable solutions to keep the wheels of industry turning

On every continent, in applications that range from air and rail transport infrastructure to heavy duty and renewable industries such as on- and offshore wind turbines, Prysmian's specialist cable solutions sit at the heart of significant international projects; supporting the work of major customers, with high-performing, durable and safe technology.

As the world leader in cabling, we draw on global expertise and local presence to work in close proximity with our customers, delivering products and service platforms built on easy contact, bespoke solutions and effective supply chain, meeting their specialised requirements, to help them drive the wheels of industry and achieve sustainable growth and profitability.

Wind Turbines

Linking sustainable ideas to real-world results

To meet an ever-growing need for power, the world is increasingly turning to renewable and sustainably-sourced energy.

In response to this demand, Prysmian's cables are helping wind turbine manufacturers around the globe to harness the true potential of this natural power source.

Always aware of our responsibility to the planet, we're constantly aiming to help renewable industry partners by delivering cables that benefit the future of both our world and their businesses.

And so, reflecting this commitment to sustainability, we offer premium quality products for wind turbines, proven in the field with long-lasting and trouble-free attributes

Our certified quality management with a world-wide focus ensures that product quality is always at the highest level, from the procurement and production processes, right through to the delivery process. With a focus on sustainable and environmentally friendly production processes, the Prysmian Group ensures that the fundamental principles of sustainable energy concepts are also implemented in its own company.

Our integrated management system complies with DIN EN ISO 9001, IRIS, ISO/TS 16949, KTA 1401, DIN EN ISO 14001, DIN EN ISO 50001 and OHSAS 18001. These are regularly monitored by independent experts.

As a world leader in special cables for wind turbines, we are able to manufacture products for the wind industry for all voltages or, if required, fully assembled cable sets in our German and international production sites:

Nacelle /Loop

Special cables (optional halogen-free and flame retardant) with increased oil, heat and ozone resistance, as well as optimized torsion properties.

Tower

Special cables (optional halogen-free and flame retardant) for fixed installation with copper or aluminium conductors with excellent installation properties.

Wind farm cabling

From the low- and medium-voltage cables for the wind farm infrastructure, through to the high-voltage grid, we supply all cables for onshore and offshore applications.

In addition, we are able to supply cables as pre-assembled cable sets, as well as a service for fitting and commissioning or maintenance and turbine monitoring.

What we offer

Our cables – used in wind turbine and tower operations – are hard at work across the renewables sector, supporting the work of turbine manufacturers, contractors and developers.

We provide a range of cables, accessories and services for all wind power generation applications – from the generator, to the grid („One-stop-shop“).

Applying our many years of expertise and global capabilities, Prysmian offers one of the world's most proven and comprehensive product ranges for wind power generators:

Medium voltage cables

For voltage classes of power from 6 kV up to 55 kV - we offer single and four core Medium Voltage flexible cables. They are optimized for torsion twist in the tower down to -40°C.

Low voltage cables

For the connection from the generator to the transformer down the tower. Fully optimised for twisting at high and low temperatures in accordance to various standards.

Control cables

Copper and fibre optic data cables for use in fixed and flexible installations. Designed for data transmission in low and high temperatures in accordance to various standards.

Customised cable set solutions

Prysmian Group is specialized in the design, manufacture and delivery of customized cable sets with various terminations. Including low and medium voltage cables, data cables as well as fibre optic cables.

Specialty cables

Different applications require different designs. For special application like EMC or hot oil we have specially designed cables.

Fibre optic

We have a comprehensive and specialized program of pre-fabricated cable kits, customized solutions and accessories, for within or between towers, and grid connection

Click-Fit® Accessoires & Components

All products within the Click-Fit® range (including outdoor terminations, joints, Y (branch) joints and GIS/Transformer connectors) are based on the Click-Fit® Plug&Power™ concept for high voltage extruded cable accessories that enables optimum ease and speed of assembly, maximum reliability and maintenance-free operation, by ways of factory prepared (identical) cable ends.

To minimize offshore installation times, cable ends can be prepared onshore and then installed and clamped inside the offshore turbine.



Our Products and Brands

TOWERFLEX™

Comprehensive low voltage cabling solutions with excellent handling and bending properties for fixed installation in wind turbines.

(For detailed information see page 8/9)

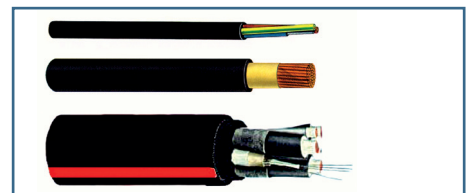


WINDFLEX™ / TECWIND™

Full range of low voltage and medium voltage cables, with high resistance to torsion, oil, ozone and flame.

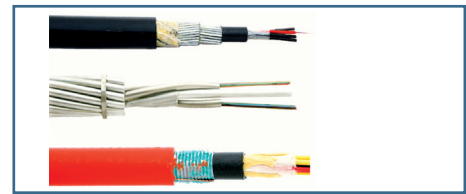
For flexible installation in wind turbines.

(For detailed information see page 10)



FIBERCONNECT™

Comprehensive and integrated fibre optical cabling solution for industrial Ethernet application in wind turbine towers.



CABLE SETS

Wide range of low voltage and medium voltage pre-assembled and customized cable sets, for wind turbine and nacelle application.



PROTODUR / PROTOTHEN-X

Low voltage PROTODUR cables and medium voltage PROTOTHEN-X cables for power distribution.



POWER TRANSMISSION

High voltage and extra high voltage underground cable systems for power transmission.



ACCESSORIES

Network components and accessories.



MV SUBMARINE CABLES

Medium voltage submarine cables for inter-array and platform connection.



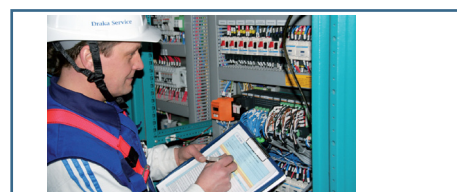
HVAC/HVDC EXPORT CABLES

Submarine export cables with extruded insulation.
HVAC up to 220 kV, HVDC up to 320 kV.



SERVICE

Supporting the wind power industry through all realisations' phases from production and put in service of wind turbines to maintenance and monitoring.



PRY-CAM™ GRIDS

Integrated and autonomous monitoring systems for partial discharge and temperature management of medium voltage components in wind turbines.

(For detailed information see page 11)



FELTOFLEX®-RC

Cables for use as flexible connection between offshore platforms as well as in switch-gears and transformers where very small bending radius and/or very low temperature is required.

(For detailed information see page 14)



TowerFlex®

The cable solution for fixed installation in towers

TowerFlex® Global product family is comprised of two basic cable constructions with several subordinate cable types.

TowerFlex® is specifically designed for fixed installation in towers to replace insulated power cables like NYY and bus bar systems. TowerFlex® program is extensive and include both copper and aluminium conductor versions. With lower weight the latter design allows for easier installation.

TowerFlex® is available with various approvals such as UL Recognition and UL Listing.

Standards and Approvals

It's important to understand the difference between a Recognized cable UL 758 and a Listed TC cable UL 1277 & UL 44.

The basis of TowerFlex®-S Global is standard IEC 60502-1, which has specified the construction, dimensions and test requirements.

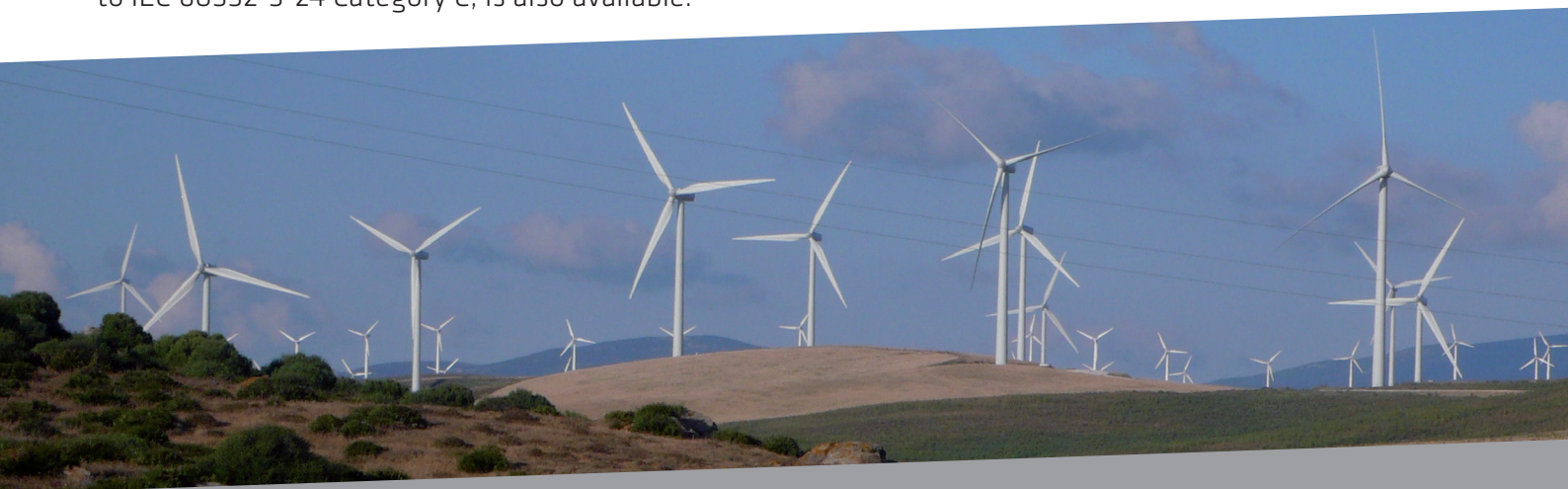
Various options for approvals are available, such as UL Recognition (UL 758) and UL Listing (UL 2277, UL 1277 & UL 44).

Additional enhanced flame resistance according to IEC 60332-3-24 Category C, is also available.

At Prysmian Group we listen to our customer's needs. For that reason we produce TowerFlex®-S in different versions, depending on the wind turbine manufacturer's requirements for a UL Recognized vs UL Listed approval. Just ask us, if you're in doubt!

Main points to consider when choosing which UL approval to use:

- Recognized cables can only be installed in machines. Fixed and flexible mounting allowed. Listed tray cables are allowed for horizontal as well as vertical installation in buildings.
- Flammability requirements are much less severe for a recognized cable. Whereas, Listed Tray Cables are required to resist large scale flame tests.
- Recognized cables can be lighter, due to different design requirements, that allow the use of thinner insulation and jackets. As
- Listed tray cables are meant to be more "tough", thickness requirements are higher - so that the construction can withstand more severe flame tests.



TowerFlex®-S Global

Low voltage cable concept applicable for fixed installation in nearly all sections of the wind turbine. Besides a standard version it's optionally available in halogen free, EMC-screened and extra flame retardant version.

Range and Rated Voltage

TowerFlex®-S Global is available with copper or aluminium conductor, screened or unscreened, for rated voltage of 0.6/1 (1.2) kV and optionally 1.8/3 (3.6) kV. TowerFlex® single core cables are available from 1.5mm² up to 630mm². Multi-core cables are available from 1.5mm² up to 300mm².

Pliability

The TowerFlex®-AS Global with aluminium conductor is extraordinary pliable and has excellent bending behaviour. This makes it as easy to install as the copper version.

Streamlined Version

TowerFlex®-S Global cables are designed with a thinner insulation and sheath thickness specified in IEC 60502-1. Due to their reduced weight they are easy to transport, store and install. The application of advanced compound materials means, that they adhere to the same stringent demands as our existing range of low voltage cables, without compromising safety.

Conductor Materials

TowerFlex®-S Global is a comprehensive cable program. You can choose between a standard conductor design employing copper or an aluminium version. With lower weight the latter design allows for easier installation.

Design Strengths

The TowerFlex®-S Global design is based on existing and proven WindFlex® technology, which offers an effective combination of both rubber insulation and sheathing. TowerFlex cables are robust due to a special high quality thermoset insulating and jacketing compound, a -40°C to +90°C temperature range, plus a special 120°C version.

Oil and Chemical Resistance

TowerFlex®-S offers excellent resistance against mineral and synthetic gear oils, cooling fluids as well as hydraulic oils. We are committed to upholding this standard, by constantly testing the cable range against the latest industry oils.

An Economic Alternative

TowerFlex®-S Global is more cost efficient to use for fixed installation than standard WindFlex®. The use in a fixed application allows us to design a cable that is less bulky, with lighter weight and smaller diameter. The results is an easier and less costly installation.

WindFlex®

The cable solution for flexible installation in towers

The WindFlex® product family is comprised of two basic cable constructions with each four subordinate cable types.

WindFlex® Cable Portfolio

WindFlex® is an extensive low and medium voltage cable program applicable for flexible installation in wind turbines. Besides the standard version, available as options are halogen free, EMC-screened and extra flame retardant versions.

Design Strengths

The WindFlex® design is based on existing and well proven WindFlex® technology, which offers an effective combination of both rubber insulation and sheathing. WindFlex® cables are robust due to the special high quality thermosetting insulating and sheathing compounds used in their manufacture. They have a -40°C to +90°C temperature range as standard, however a special +120°C version is also available.

Torsion Capability

WindFlex® cables are tested for torsion during the toughest possible conditions. The test is carried out at -40°C and the cables are twisted 4 x 360° each way over 10 meters for a minimum of 5000 complete cycles, to simulate 20 years lifetime.

Oil & Chemical Resistance

WindFlex® offers excellent resistance against mineral and synthetic gear oils, cooling fluids as well as hydraulic oils. We are committed to upholding this standard by constantly testing our cable range against new industry oils. By doing this we are confident that the cables we offer have passed the most extensive fluid resistance test program in the industry.

Standards & Approvals

The basis of WindFlex® is standard HD 22, which specifies the construction, dimensions and test requirements. Various options for approvals are available, such as UL Recognition (UL 758) and UL Listing (UL 1277 & UL 44). Additional enhanced flame resistance according to IEC 60332-3-24 category C, is also available.

Conductor Materials

WindFlex® is designed for maximum flexibility and the conductors are always made of class 5 annealed copper.

An Economic Alternative

The WindFlex® program is the complete solution for wind turbine application. With a wide range of designs and approvals, Draka ensures that there is a tailor made solution for all wind applications. With our wide Draka WindFlex® Global range of cables, we even ensure that one cable can be used throughout the world. The end result is simpler designs, simpler logistics and reduced costs.

WindFlex® S (N)TSCGEHXOEU/3 36/60-69 (72,5) KV

These halogen-free high voltage cables are intended for use in wind turbines with medium mechanical effort in a temperature range from -40°C to +90°C. The cables can be installed free moveable, free hanging or fixed. For free hanging operation the cables are twistable.

The cables are used for economic power transmission of large energy rates with high voltage.

Pry-Cam™ Grids

Fixed monitoring system for increased wind farm reliability

Wind turbines are key strategic assets, and so, any power outages can cause a significant reduction in profitability and return on investment, and unplanned additional high costs for reactive maintenance.

Today wind farm reliability can be increased with Prysmian's innovative fixed monitoring systems for Partial Discharge (PD) and temperature measurement.

Pry-Cam™ Grids are integrated, autonomous PD monitoring systems for electric components, based on exclusive Prysmian Pry-Cam-sensing technology.

They allow the monitoring of conditions of medium-voltage components of a wind turbine by continuously tracking PD activity and local temperatures.

PD measurements are effectively used to predict and prevent faults on medium- and high-voltage electrical systems and components, such as transformers, generators, cables, joints, etc.

Thanks to Prysmian's exclusive sensing technology, the system is easy to install – even during wind turbine operation – without service interruption.

The system performs periodic measurements that are locally analysed, stored and sent to a remote server. Thanks to an exclusive algorithm, background and inverter noise is automatically identified and rejected in order to maintain the highest levels of PD-diagnosis accuracy.

All the information can be shared and/or integrated with any kind of existing monitoring system (SCAM for example) or asset management software.

In addition, measurements can be remotely viewed and controlled from any location via an Internet connection thanks to the Prysmian Web Infrastructure.

Product features

- High-resolution acquisition of entire PD pulse waveforms, providing enhanced diagnostic capabilities
- Robust noise-filtering and advanced-alarming algorithms available
- Innovative sensors able to remotely detect small PD pulses
- PD synchronisation does not require additional sensors (i.e. no need of CTs, Rogowski coils or capacitive couplers)
- Local storage and automatic processing of acquired data intuitive control software for live acquisition and data post-processing
- Web-based interface for monitoring control

Main benefits for customers

- Ideal for preventing failures and the associated costs of critical component replacement
- Suitable for PD and temperature monitoring
- Easy and quick installation – even during wind turbine operation
- Maximum safety for operators thanks to galvanic isolation of equipment undergoing testing
- Online measurements without wind turbine outage
- Advanced alarming algorithms based on the complete PD pattern
- Maximum flexibility to monitor several components with one device (e.g. cables, transformers, generators, etc.)

Offshore Wind Farms

Linking the power of nature with future energy demands

Renewable energy resources are abundant and inexhaustible. They have the potential to meet global energy needs while reducing emissions and mitigating climate change.

Offshore wind applications are fundamental in meeting this increasing demand for greener energy.

As a world leader in this area, Prysmian Group has a long-standing track record of offering our customers proven, cost-effective cable designs and operating systems.

We're committed to investing in new and upgraded manufacturing and installation assets. We do this so we can offer the broadest possible range of innovative products and technologies, strengthening our services and capabilities in production and project execution for the offshore wind market.

As a trusted and dedicated partner we continue to support the needs of this growing industry, offering medium voltage inter-array cables, High-Voltage Alternating Current (HVAC) and High-Voltage Direct Current (HVDC) export cables.

As well as supply and turnkey solutions, we also offer monitoring and maintenance services. And we've developed a wide range of tailor-made accessories to meet even the most demanding customer requirements.

Inter-array Cable Systems

We offer the full range of inter-array cables and with a comprehensive portfolio of supply and installation services. We undertake fully project managed turnkey projects with a complete EPCI approach, offering our customers an unparalleled service with the benefits of efficient and cost optimised solutions.

We lead the way in technological development, being the first to market with 66 kV inter-array cable systems under a Carbon Trust program in UK, meeting the requirements of offshore wind park developers and enabling reductions of up to 15% in capital expenditure for their projects.

In other fields, our systems specifically designed and constructed for use with non-anchored wind turbines in deeper waters, using our rigorously tested dynamic cables, which have an enhanced ability to withstand mechanical fatigue over the entire expected life of a system, are changing the game for wind farm development.

In short, we provide the means to ensure the future sustainable and reliable supply of renewable energy to consumers today.

High Voltage Grid Access

Prysmian high voltage submarine AC and DC cables form an integral part of power grids across the globe, including the links from offshore installations known as export cable systems.

We deliver a comprehensive and fully managed EPCI service to provide cable system solutions and services, considering innovative approaches and utilising our extensive engineering, manufacturing, and turnkey installation capabilities, with complete project management, to provide the necessary cost effective high power cable connections from offshore platforms and islands to national grid networks

Thanks to the high reliability of our solutions for high voltage networks, we continue to forge ahead in the sector, maintaining long and successful relationships with our valued customers.

Prysmian not only offer the export cable systems, which today typically operate up to 220 kV AC and 320 kV DC respectively, but continue to develop and prove our product range to the highest voltage levels.

With our end-to-end service, utilising our range of manufacturing, installation and engineering assets, we are a single source provider offering full EPCI turnkey cable system solutions to meet our customer requirements

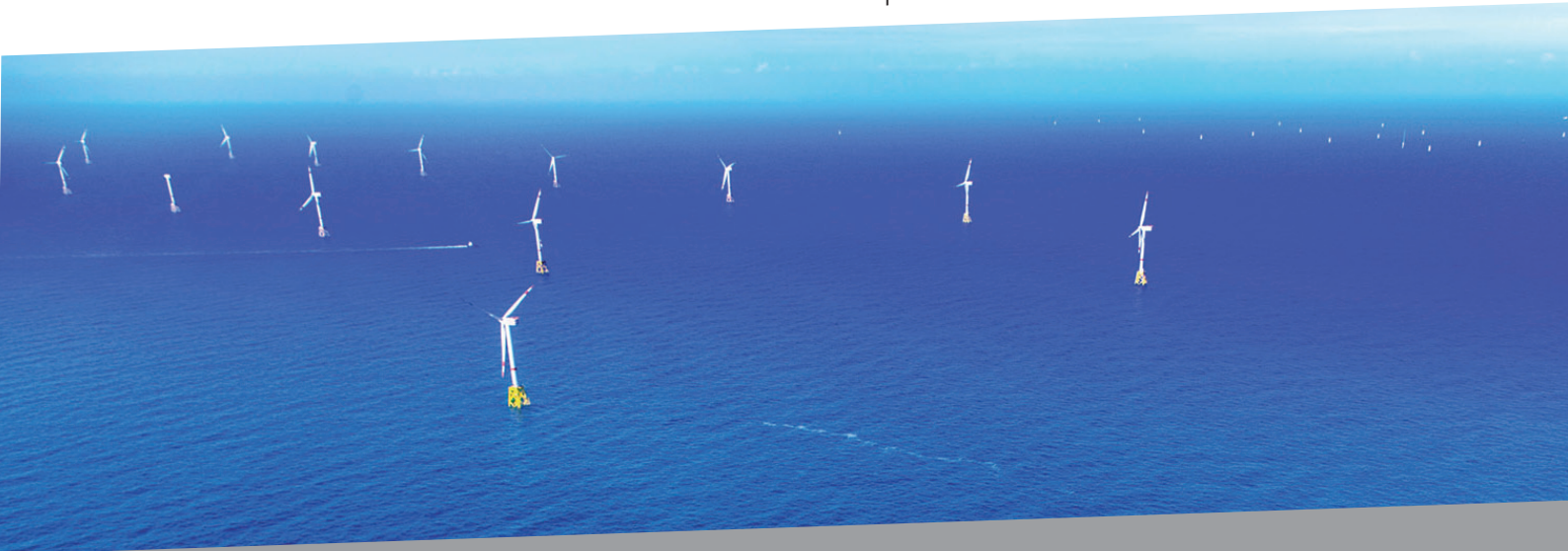
Our full value chain sets us apart, giving our customers a hassle-free single point of contact for all their project needs.

Specialties

Prysmian designs tailor-made specialty solutions for a wide range of application fields.

Among the specialties designed for the offshore wind farm segment is Feltoflex HV cable system for moveable interconnection between platforms (e.g. topside and bridge), developed for voltages of up to and including 155 kV, and featuring enhanced technical and installation characteristics including the use of the Group's technology range of Click-Fit® joints and connectors for easy and fast installation.

Prysmian has also a product portfolio of high temperatures cables, called SINOTHERM. They are suitable for installation in the nacelle up to temperatures of 110°C or 180°C.



Felftoflex[®]-RC

Ultra flexible high voltage cable system

Felftoflex[®]-RC cables are intended for use as flexible connection between offshore platforms as well as in switch-gears and transformers where very small bending radius and/or very low temperature is required, in dry or damp areas and outdoors. The flexibility of the cable allows operating equipment to be moved while running.

Where flexibility counts

- Ultra bendable also in cold conditions
- Extremely small bending radius
- Easy handling

Cable design

- Felftoflex HV - 155 kV ultra-flexible cable system
- High quality and fully qualified HV cable systems solution
- Flexible Cu conductor up to 800 mm² (mobile use)
- HEPR insulation, high gradient design, super clean, extra flexible
- Copper wires screen, 100% coverage
- Outer EVA/EPDM sheath (HFFR), oil and ozone resistant (+UV)
- Optional external semicon cold strippable skin, HF rubber
- Flame propagation (incl. semicon skin) IEC 60332-1/IEC 60332-3-22/24

Main application

- Moveable interconnection cable between 2 platforms (topside – bridge)
- Design based on outstanding experience with MV crane festoon cables transferred to HV
- Extremely low bending radius: 5x OD in fixed installation, 10x OD in mobile use
- Moveable while running
- Easy to lay
- Projects delivered: Borwin 2, Helwin 2, Edvard Grieg, Ivar Aasen, Dolwin 3

Installation

- Dry installation, open air, with weather shields, free hanging in the interconnection portion
- Installation laying during winter/cold weather- Cold flexible min. operating temperatures during mobile use: - 50 °C (FR IEC 60332-1-3)/ - 25 °C (FR IEC 60332-3-22/24)

Benefits for the customer

- High quality and fully qualified flexible HV-cable system solution
- Save construction/building cost (structure weights/space)
- Installation/laying during winter/cold weather
- Tailor-made and wet design variants available
- Full Turn-Key from Design to Monitoring

Proposed accessories

- Click-Fit connector
- Click-Fit joint



Application Overview

	Nacelle	Rotor/ pitch system	Generator/ Loop	Rectifier/ Loop	Transfor- mator/ Loop	Tower (fixed installation)	Tower (flexible installation)	Service lift	Base	Grid connection	Offshore
TOWERFLEX™	●					●					
WINDFLEX™	●	●	●	●	●	●	●	●	●		
TECWIND™	●		●	●							
Cable Sets	●	●	●	●	●	●	●	●	●		
PROTODUR/ PROTOTHEN-X										●	
HV + EHV underground cables										●	
MV submarine cables											●
HVAC/HVDC cables											●
Pry-Cam Grids™	●	●	●	●	●	●	●			●	●
Felftoflex®-RC											●

Further cables for special applications are available on request.

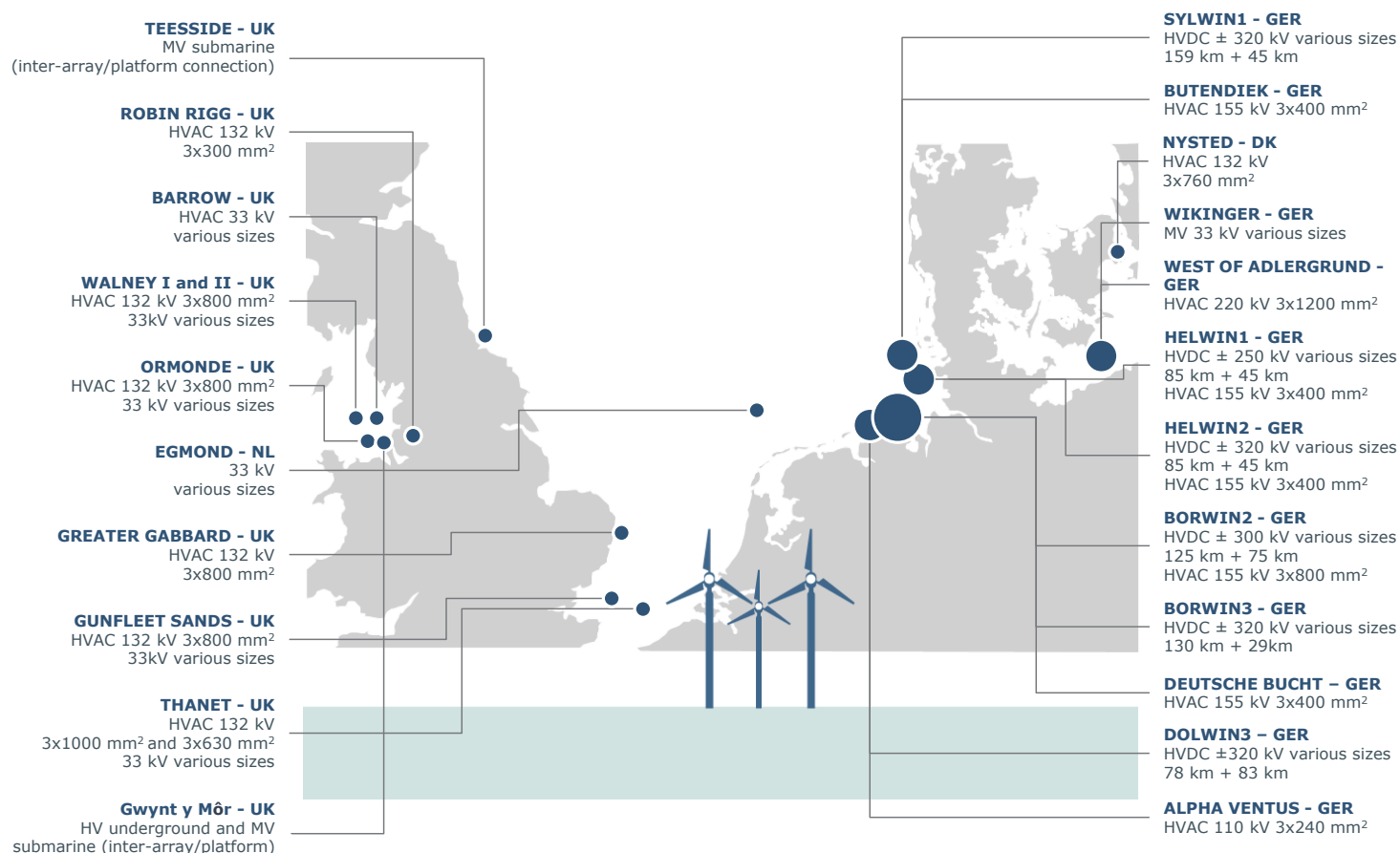
A track record of success

Our track record in the renewable energy sector includes projects working alongside some of the best-known names in the sector, including many ground-breaking industry milestones.

Our customers

Vestas, Siemens, Enercon, Senvion, Suzlon, Gamesa, Acciona, Nordex, Alstom, Guodian, Minyang, Envision, Sinovel, Goldwind, GE Wind, EDF, Enel-Endesa, RWE, Western Power, E.ON, SEAS, DONG Energy, Vattenfall, Tennet Offshore, Fluor.

OUR KEY PROJECTS IN EUROPE



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This image shows a full page of blank, lined paper. It features approximately 20 evenly spaced horizontal grey lines across its entire width, providing a template for writing or drawing. The background is a clean, solid white color.

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AND BEST IN CLASS R&D
STRONGER PLATFORM TO ENHANCE CUSTOMER SERVICE
LINKING THE FUTURE LEADING TECHNOLOGIES
WORLDWIDE LEADER

Prysmian
Group

