Power under the sea

The drive for more renewable energy has seen rapid growth in the number of offshore wind farms. Underneath the waves, submarine or subsea cables play a vital role in ensuring this newly-generated power is transported ashore. But repairing any damages to such critical infrastructure can be both a challenging and costly endeavor...

However, around 70% to 80% of insurance pay-outs for wind farms relate to cable damage. And as the drive for more wind capacity increases, so does the possibility of more incidents of damage, potentially resulting in high-value insurable claims.

Subsea cable damage most often arises from two areas: faults caused in the open sea by anchor strikes, dragging fishing nets, and erosion; and poor planning and building at the start of the project, coupled with inadequate risk identification, sub-standard design, and deficiencies in how procedures are applied.

Although information on cabling faults can be hard to come by, with little available in the public domain, insurers are only too aware of the risks involved.

For example, subsea cables only account for 7% to 10% of the total capital costs of an offshore wind farm, according to RES Offshore.

Physical challenges
The offshore wind business is still relatively young, but a study by the international association of electrical power experts Cigré of offshore interconnectors (with electrical capacity of more than or equal to 60 kV) which link the electricity transmission systems for wind farms found that there were 49 reported damages between 1990 and 2005 worldwide.
Around 80% of these incidents occurred in shallow water depths of less than 50 meters. The same research found that while internal faults are relatively rare, external damage is the key reason for repairs: 41 reported failures were the result of external impact by third parties — namely, the aforementioned anchor dragging and fishing nets.

Physical challenges also play a significant role in delaying laying of the cables. Offshore wind farms in the UK tend to be quite close to the coast, so the water may only be around 10 to 20 meters deep. Whereas further East the North Sea can be around 40 to 80 meters deep. Also, in Germany, windfarms can be located about 80km offshore, which makes the logistics and operations more difficult for installation and repairs.

Weather is also a massive factor affecting cable installation. For example, between November and March very little installation work can be done in the North Sea or the Baltic Sea due to ice, increased wave heights, and lack of daylight hours. Furthermore, both areas contain minefields and unexploded ordnance, and — in the Baltic Sea in particular — a wide variety of soil types, which makes cable laying and burial more difficult. Experts warn that natural hazards — such as shifting sediment or rock — account for around 5% of all external cable faults.

Construction issues
The majority of existing offshore wind farms have experienced some cable problems, most frequently during the construction stage. Robert Maurer, Global Head of Renewable Energy and Regional Head of Engineering at AGCS, says that this is partly because there are relatively few companies that are capable of carrying out the work to proper specification and standards.

"There are few construction companies with the depth of knowledge, experience and resources to lay the cabling properly," he says. "This means that there are not enough qualified and experienced people available on some of these projects and contractor negligence can be a factor. Also, in some cases, contractors are using second or third class vessels — which are either too small or are inappropriate for the job — to do the work as a way of reducing costs. These ships are not just capable of handling the kind of weather conditions they can face out at sea or the weight of the materials they will need to use."

Maurer adds that another key problem is that there can be inadequate knowledge-sharing between the contractors at the start of a project. For example, project developers may draw from cable manufacturers’ data and recommendations, but do not consult cable installers sufficiently during the design process, so they do not
incorporate their practical input or expertise into the project at the outset.

Also, the installation parties – as well as shipping vessels – can be contracted relatively late in the project, which means that they may not be able to carry out sufficient checks at an early stage, and may not be given appropriate instruction regarding the cable route.

“We have seen incidences of bad planning and workmanship,” says Maurer. “There are a lot of crossing cables where engineers have simply laid their cables over existing cabling, which not only increases the risk of damage to both sets of cables, but makes any future repair work more difficult and expensive. Apart from property damages subsea cable claims may cause significant financial losses due to delays in start-up for projects or business interruption to operational windfarms respectively. The daily indemnity for a midsize offshore windfarm can easily reach €250,000 to €300,000.”

**Turnaround for repair work**

Due to the challenges involved the turnaround for repair work is not quick. A typical subsea cable repair and replacement can take around **50 days** or even more (however, there are a few companies offering service agreements which help to reduce the downtime), which means that access to equipment such as remote-operated vehicles to carry out visual checks on the seabed become paramount.

These machines can help pinpoint a fault within a section totaling **2.5%** of the cable length, which means that in a **100km** cable engineers would only need to check **2.5km** of it for faults.

As cable system lengths can now be manufactured at **1,500km** – nearly double the length of the previous standard – and carry higher voltages more efficiently, locating and repairing line faults quickly is a necessity.

**Minimizing delays and reducing risk**

Maurer believes it is important that there is more involvement between all parties – including insurers – in the project planning phase in order to minimize delays and to reduce risk.

“Contractors need to discuss the scope of the project at the initial planning stages so that the type, length and strength of cable needed and the cable route can be agreed upon,” says Maurer.

“Delays to these multi-billion euro projects can be very expensive, so the more planning that can be done between all parties from the start will help resolve potential risk areas during the construction phase.”

Furthermore, as service and repair issues may prove to be significant cost factors (particularly if the contractors do not have service care agreements in place), experts say that contingency planning is a key issue to consider.

“Cable faults can obviously happen, but it is how parties prepare for these problems and how they respond to them that is really important,” says Philip Schöpfle, Area Sales Manager (Germany) for leading power and automation technology group ABB’s cable service. ABB has produced and installed cables for more than 140 years and has a proven track record in cable repairs and offshore service operations.

“Contractors need to provide assurance that they have the necessary expertise on hand to deal with any incident, and that they can obtain replacement cabling and parts immediately as any operational down-time can result in substantial losses. For example, as part of our service agreements, we can provide pre-engineered parts for our customers immediately, which obviously helps reduce insurable losses.”

“We always ask contractors if they have access to spare cable, and where these spares are kept. For example, jointing a cable offshore can be realized in two to three days, but only if spare parts are kept onsite so that the engineers with the relevant expertise can be put to work installing them quickly,” he adds.
Cable facts and faults

- The first submarine cable to carry electricity was laid across the Isar River in Bavaria during 1811.
- Submarine power cables can be anything from 70mm to, exceeding, 210mm in diameter and can be either High Voltage Alternating Current (HVAC) or High Voltage Direct Current (HVDC). Which type of cable is used is dependent on route length, voltage, transmission capacity and grid synchronization.
- On average, there are 0.5 – 2.0 faults per year per 1,000 km of installed subsea cable. According to a European Offshore Grid Infrastructure Study, there will be 20,000 km of HVDC cable installed in Northern Europe by 2030, which means that there are likely to be between 10 and 40 large HVDC cable repair projects in the North Sea per year by that date.
- ABB has successfully developed and tested a 525 kilovolt (kV) extruded HVDC cable system to make renewable energy installations more efficient and cost-effective. This latest innovation will more than double the power capacity to about 2,600 megawatts (MW) from 1,000 MW and will also expand the cable’s reach by 50% to distances of 1,500 kilometers.
- ABB’s experience is that around 50% of external cable damage is caused by fishing nets – however, damage is usually limited to just one cable. One-fifth of damage incidents (20%) are caused by anchor drag, while 5% of cable damage is caused by natural hazard, such as shifting sediment or rock fall.
- Though historically rare, the International Cable Protection Committee says during 1901 – 1957 – a period dominated by submarine telegraphic cables – at least 28 cables were damaged by shark and fish bites, which also contributed to 0.5% of all cable faults between 1959-2006. The latest analysis covering 2008 – 2013 recorded no cable faults attributable to sharks: this is due (in part) to improved cable design and protective coatings.

Additional sources: ABB, Pelagian Ltd, The University of Manchester, RES Offshore, Subsea Cables UK, The International Cable Protection Committee

Maurer notes insurers are asking for more assurance on how the project will be carried out, by whom, and what contingencies are in place should a fault occur during installation or while the wind farm is operational.

“When we underwrite subsea cabling work for offshore wind farms, we ask for details about the scale, scope and timeframe of the project, and when and where it will start and finish,” he says.

“We also look at which contractors will be carrying out the particular parts of the work, including servicing repairs; what types of cabling are going to be used; what kind of vessels will be used; and how frequently an appropriately-qualified risk engineer will be onsite to oversee the project.”

Best practice

Establishing what constitutes “best practice” and applying it consistently has become a priority. In February this year, DNV GL, the world’s largest resource of independent energy experts, announced the launch of its 145-page guideline Subsea power cables in shallow water renewable energy applications, which provides a comprehensive review of subsea power cable practice and advice for managing the risk commonly associated with the cables. It defines minimum requirements, but overall promotes a risk-based approach whereby risks are reduced to acceptable levels as defined for each individual project.

Schöpfle says: “Only by working together, the customer – insurer – supplier, can we create products that will safeguard everyone’s bottom-line and overcome the issue of increasing costs.”

Maurer adds: “It is important that all risks are properly identified and that appropriate controls and procedures are put in place from the outset. As the costs of these projects are increasing, so too are the insurable claims.”

ROBERT MAURER
Global Head of Renewable Energy and Regional Head of Engineering, Germany and Central Europe, AGCS
robert.maurer@allianz.com

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