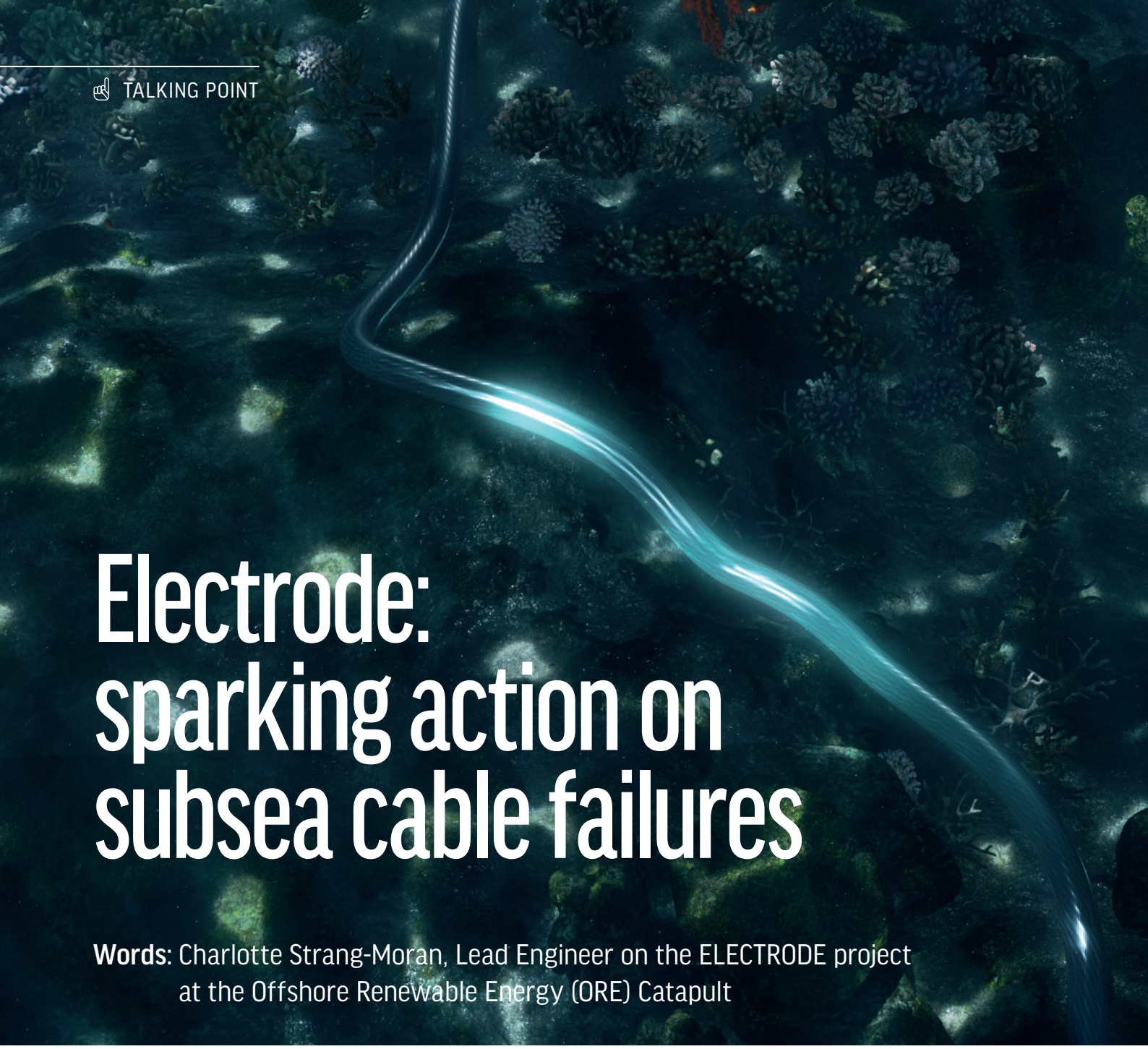


Electrode: sparking action on subsea cable failures

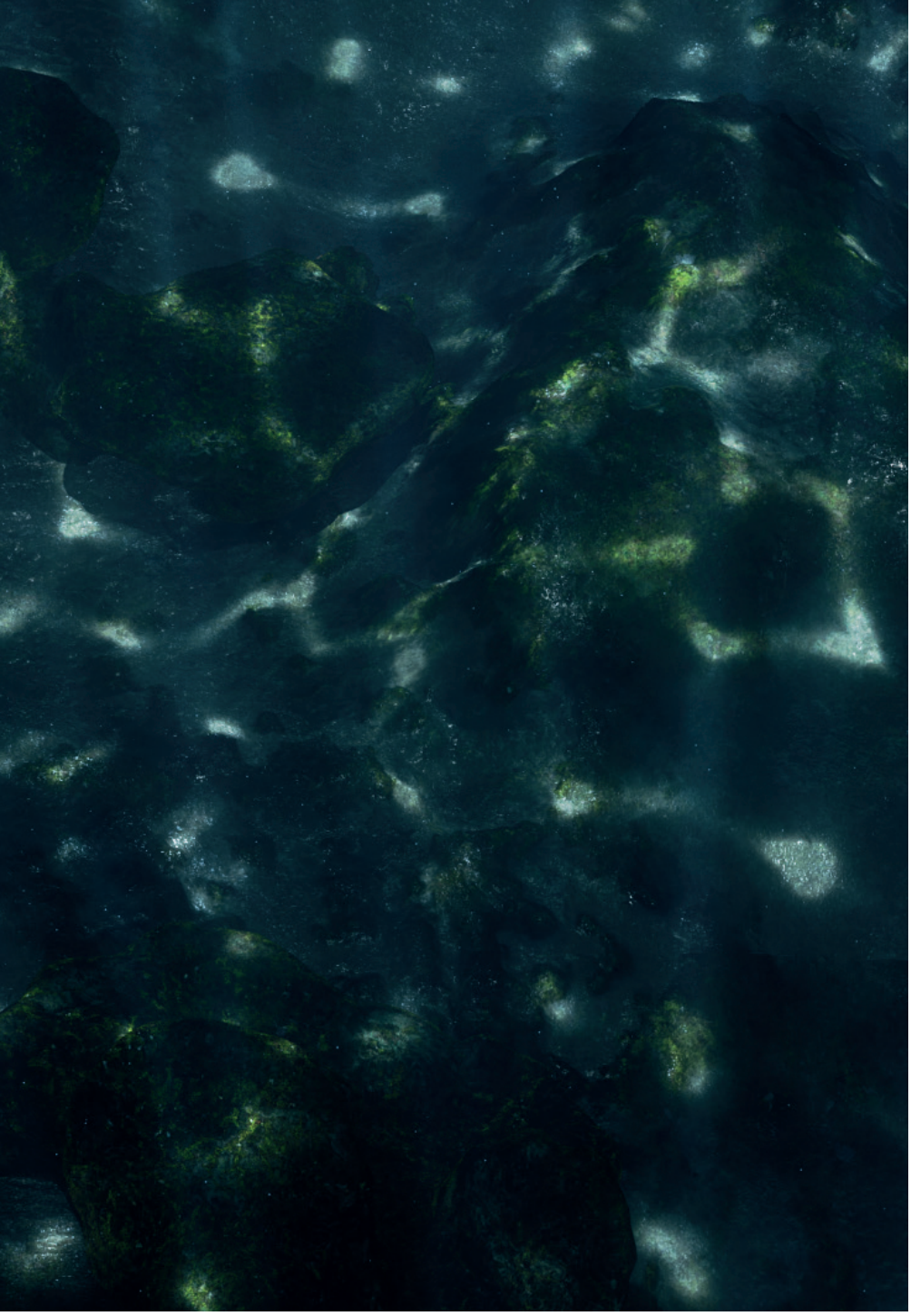
Words: Charlotte Strang-Moran, Lead Engineer on the ELECTRODE project at the Offshore Renewable Energy (ORE) Catapult

Thirty years ago, there was not a single megawatt of offshore wind capacity on the planet; now, there are more than 29GW installed globally, and offshore wind is seen as a vital clean energy source with which to tackle climate change and reduce our carbon footprint. The next 30 years will see an even more spectacular rate of expansion with 1,400GW credibly achievable by 2050.

There is an 'if' and a 'but' coming, though: such rapid growth in capacity will only be possible if the industry is sitting upon a much more reliable subsea cable network than today. Tomorrow's cables will need to cope with more wind power and achieve reliability over longer distances, too, as operations push further and deeper offshore. Looking ahead to the future, we will also see the commercialisation of floating wind platforms using dynamic cables, a switchover to high-voltage direct current cables (HVDC) across the offshore wind industry, offshore hydrogen charging stations coming online, and the meshing all of these into the 'Supergrid' of the future.

That is why stabilising and reducing cable failure rates is one of the crucial innovation challenges for the wind industry in the here and now. Cables have proven to be somewhat of an Achilles heel to date, accounting for 75-80% of insurance claims. It is not uncommon for a single outage to result in costs exceeding £10 million in lost energy output and repairs.

Technology innovation can and is tackling these cable failures. As part of our mission to support UK companies' creation and growth in the offshore wind supply chain, we have worked with exciting new technologies on the cable arena, including Synaptec's



Charlotte Strang-Moran

light-speed cable failure prediction and detection solution that utilises a cable's existing optical fibres.

While companies like Synaptec stand out, innovation overall is being held back by the lack of good data and insight into how cable failures occur in the first place and where improvements should be targeted. That is why this spring, we are launching the ELECTRODE project with support from the Offshore Wind Innovation Hub (OWIH). ELECTRODE is an industry world-first database that will collect cable failure data anonymously while allowing trend analysis to develop.

We believe that this industry-backed system will quickly enable us to start identifying significant and recurring problems, which will bring considerable benefits to the whole industry.

How we are spearheading change

While the industry has been eager to see a cable failure database set up, the biggest hurdle has been concerns about the high commercial sensitivity of the data we require. That is why our experience of running the UK wind industry's SPARTA benchmarking service has been crucial: it is a good example of how we have been able to process sensitive data anonymously and securely over many years. SPARTA collates offshore wind performance data and has become a trusted source for operators when formulating future strategy. Today, SPARTA's trend analysis covers 98% of the UK's installed offshore wind capacity, with overseas players poised to join the fold too.

Now we come to the type of data that we need. Over the past few months, we have held a series of workshops with representatives drawn from across the industry to design how ELECTRODE will work. Results of the consultations are available in our first project report. The topics of most interest include the annual failure rate per kilometre of cable and failure rates per component, mean time between failures, the effectiveness of monitoring and repair approaches, and the use of new technologies in addressing failures.

The crucial point is that we will capture inter-array faults across the whole cable system, including the terminations and joints, classifying the data as granularly as possible to cable type. Broader industry insight into fault location will provide valuable and important data that could support condition monitoring tools and aid O&M decision-making on which monitoring equipment is best suited.

While our initial focus will be upon inter-array cable reliability, we plan to extend our scope to include export cables in the future. We are also only tracking data for fixed-bottom offshore wind sites, but dynamic cable failures will become an increasing focus as more floating offshore wind farms come online in the next few years. These moving cables carry unique challenges of their own, being subject to high mechanical loadings, swell and current, as well as the risk of wear due to friction or scraping.

Understanding failure modes and mechanisms

Through industry engagement, we found that the word 'failure' was being used to apply to quite different cable events and sometimes being misused entirely. We worked with stakeholders to agree on common definitions that will govern all the work that we do under ELECTRODE and hopefully become the standard definitions for the offshore wind industry in the future.

Tracking failure modes and mechanisms will be crucial for informing future innovation, investment strategies and operational approaches in the offshore wind industry. For example, a recurring failure mode may be an imperfection in cable insulation. In this case, our trend analysis would trigger

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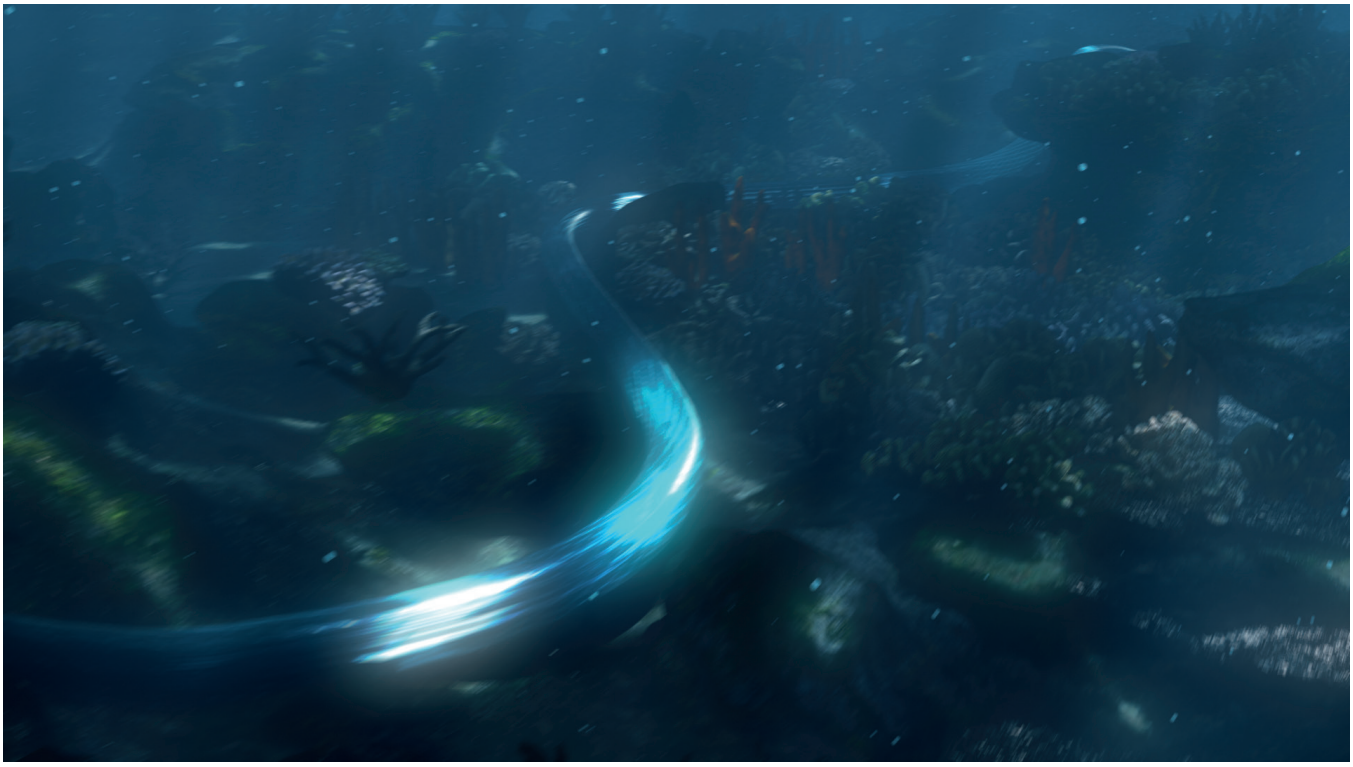

Subsea cable failures in numbers

- 75-80% of wind industry insurance claims stem from subsea cable failure
- ORE Catapult is aware of costs exceeding £12 million for a single cable failure
- Average downtime is 38 days for inter-array cables and 62 days for export cables
- The cost ratio between an onshore and offshore cable failure is 1:10
- Cables failure causes are:
  - 46% - installation
  - 31% - manufacturing
  - 15% - design flaws
  - 8% - external damage

improvements at the design stage, sourcing alternative insulation materials or improving the outer armour, or could fuel new concepts and procedures for identifying impurities at the manufacturing stage. The chain of innovation could even extend to better training for hauliers and vessel crews when handling cables to prevent nicks and damage or even prompt automation of some handling processes.

About Charlotte Strang-Moran

Charlotte joined ORE Catapult in January 2018 as a Graduate Electrical Engineer after completing her BEng Hons in Electronic and Electrical Engineering at the University of Strathclyde, Glasgow. In her current role as Electrical Engineer, Charlotte is actively involved in the delivery of a number of projects in different disciplines within the electrical infrastructure team, specialising in subsea cable failure and improving technology reliability. She is now is the primary lead on the ELECTRODE project.

How you can get involved

There will be two tiers of membership for the ELECTRODE programme. In Tier 1, owner/operators will contribute data, which is anonymised and have access to data provided by other unidentified owner/operators. The supply chain, OEMs, the insurance industry and academic researchers will be in Tier 2 and will be able to access trended analysis for their own market and underwriting insights.

If you would like to join up, or if your company is looking for technology innovation support in the subsea cables sphere, you can contact the ELECTRODE team ELECTRODE@ore.catapult.org.uk

www.ore.catapult.org.uk