H2020 LC-SC3-RES-19-2020 call: Demonstration of innovative technologies for floating wind farms

CEA (French research organism) has been working for more than 10 years on **methods and systems for the inspection, detection and location of defects and structural health monitoring (SHM) in electrical interconnection systems for many application domains**. Our technology was validated by Airbus up to TRL5 and tested in many other application domains, such as high voltage energy distribution, by several industrial partners.

Based on the use of reflectometry and other additional innovative techniques, these systems can monitor the state of health of a cable or network of cables under stress, estimate its ageing, or provide the accurate location of a defect (hot spot, corrosion, insulator degradation, bending, etc.).

We believe that the integration of cable monitoring in a predictive maintenance strategy can lead to a **drastic reduction of outage, maintenance and insurance costs, thus further lowering the Levelized cost of energy** (see below for more information). This can provide a real added value to a research project, as there are not many research teams or industries working on this topic in Europe.

If you think this technology could be interesting for your project, please contact : fabrice.auzanneau@cea.fr or +33 6 3000 6260.

Electrical connection costs

The principal costs of offshore wind farms are the turbines, the foundations and the **electrical connection to the shore**. Construction costs are followed by maintenance costs.

Roughly 25% of an offshore wind farm's capital expenditure (**CAPEX**) is spent into cable installation and grid connection. It was estimated that for a 500MW farm, more than €70M is spent on export cables, and an additional €25M on inter-array conductors. These costs are augmented by precautionary measures, estimated around €1M for seals, bend restrictors, stiffeners and cable mats, to help prevent premature deterioration and failure. This cost rises exponentially for more powerful farms.

Export and inter-array **cables** are exposed to **hostile environment** during a wind farm's operational life. The lifecycle and reliability of subsea cabling have a significant impact on operational expenditure (**OPEX**) as well. Seabed conditions, wave action and tidal effects, coupled with ship transit and fishing activity heavily affect the underwater conductors. As an example, in 2002, during the construction of Horns Rev I, a vessel's anchor hit an export cable on the seabed, resulting in an unexpected additional cost of €2M. Nowadays, bottom trawl fisheries represents the greatest threat to export cables.

Cable failures

Cable failures have a dramatic impact on both the availability of the energy and farms insurance costs. In 2015, subsea cable faults contributed to 77% of the financial losses of global offshore wind projects and led to **insurance claims** totaling 25% more than in 2014 (source: GCube Underwriting). 90 subsea cable losses occurred in the past 7 years, totaling over €350M insurance claims.

Cable issues can also delay projects or interrupt production by many days. There are annually around 10 declared cable failure incidents, which induce an average cable downtime of 100 days. These financial consequences can be reduced with improved quality control during cable laying, as well as condition-based monitoring and the implementation of reliable data collection and analysis platforms.

Condition-based maintenance

The knowledge of the **state of health of the cables** used in an offshore wind farm is critical to ensure an optimal service. Compared to Bottom-Fixed Offshore Wind (BFOW), Floating offshore wind (FOW) turbines add **specific constraints to the cables**, due to the fact that the structure is not fixed and is subject to wave motion, inducing additional mechanical constraints on the cables and connectors. This **accelerates the aging** of the interconnection system, which consequently reduces its useful lifetime or its Mean Time To Failure.

For FOW, cables structural health monitoring is then even more important.