Offshore Wind Cable Protection System Assessment

Overview

PDL supports offshore wind developers, installers and equipment manufacturers in assessing the integrity and long-term performance of subsea power cables and Cable Protection Systems (CPS) used on fixed offshore wind farms. These systems play a critical role in protecting export and inter-array cables as they transition between the seabed and turbine foundations, where environmental loading and structural demands are at their highest.

Using advanced dynamic analysis techniques, PDL evaluates cable and CPS behaviour under realistic operating conditions, helping clients optimise designs, reduce risk and maximise asset life before installation and throughout operational service.

Sector: Renewables

The Challenge

The region between the turbine monopile and the buried section of cable is one of the most demanding areas within an offshore wind farm. In this zone, cables and protection systems are subjected to complex hydrodynamic loading generated by waves, currents and seabed interaction.

Accurately predicting the response of these systems is challenging because environmental loads are influenced by factors such as water depth, wave conditions and flow acceleration around the monopile structure. Excessive movement can lead to increased fatigue damage within cable armour wires, accelerated wear of CPS components and, ultimately, reduced asset life.

For existing wind farms, premature CPS degradation or unexpected movement can create significant operational and maintenance challenges. Developers and operators therefore require robust engineering assessments to understand asset condition, predict remaining life and identify appropriate mitigation measures before failures occur.

Our Solution

PDL developed advanced analysis methodologies to accurately model the hydrodynamic loading experienced by offshore cables and Cable Protection Systems. By combining OrcaFlex simulation software with bespoke in-house tools, PDL can capture complex environmental effects that are difficult to represent using standard analysis approaches.

Our assessments typically include:

- Dynamic analysis of cables and CPS under site-specific environmental conditions.
- Detailed modelling of wave and current interaction around monopile structures.
- Assessment of ultimate and fatigue loading scenarios throughout the asset lifecycle.
- Evaluation of start-of-life and end-of-life performance.
- Fatigue life prediction for cable armour wires and CPS components.
- Assessment of installation tolerances and operational movements.

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- Evaluation of remedial solutions for damaged or degraded systems.
- Integration with installation engineering studies where required.

The approach enables rapid assessment of multiple cable and CPS configurations, allowing design options to be compared and optimised before equipment is manufactured or installed.

Outcome

PDL's assessments provide clients with a clear understanding of the movement, loading and fatigue performance of critical cable systems, enabling informed engineering decisions throughout the project lifecycle.

By identifying potential issues early, clients can optimise cable geometries, CPS arrangements and protection strategies before manufacture, reducing project risk and avoiding costly modifications during installation or operation. For operational wind farms, the analyses support life-extension studies, remedial design development and maintenance planning by quantifying the impact of damaged or degraded components.

The result is improved asset reliability, greater confidence in long-term performance and reduced whole-life project costs through better-informed engineering decisions.

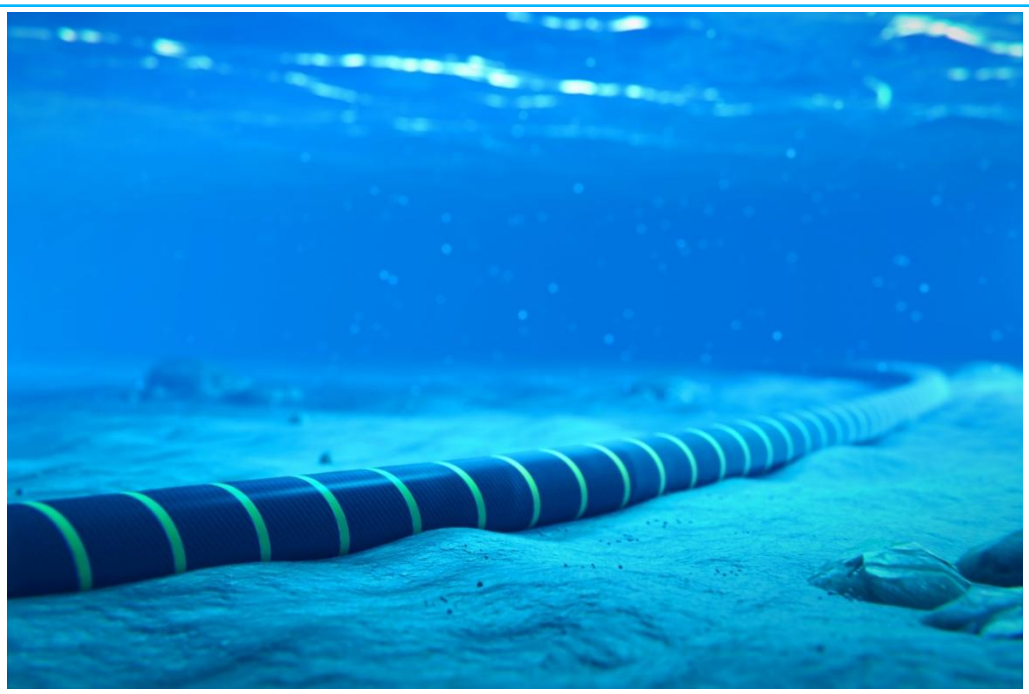

Fig 1: Cable Protection System

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