Engineering study and design of a submarine dynamic cable installation for the first floating windmill in Spain continental shelf

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ABSTRACT

This paper describes the engineering study and design of a submarine dynamic cable installation for the first floating windmill in Spain continental shelf; a demonstrator placed onto the existing BiMEP infrastructure located on the coast of Bilbao.

The final cable design and dynamic laying configuration was a result of a local analysis (cable mechanical properties determination and stress estimation in metallic components) and a global analysis (cable installation configuration, on-bottom stability, static analysis, extreme events and fatigue evaluation, marine growth and interference analysis with mooring lines).

KEYWORDS

Dynamic cable; submarine; local analysis; global analysis; mechanical stress; fatigue; on-bottom stability; marine growth; interference analysis.

INTRODUCTION

With higher and more reliable wind speeds and less constraints on site locations, offshore wind is expected to grow gradually and steadily. In addition, floating wind turbines give access to abundant wind resources over deep water (at least four times as much ocean surface space compared with bottom-fixed wind).

Currently and in the next years, a significant technology development is expected in floating wind to scale production, reduce cost, and broaden applicability.

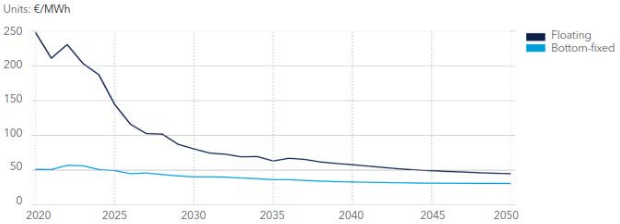

Fig. 1: World average LCOE of offshore wind (Floating vs. Bottom-fixed) [1]

The dynamic cable design and laying configuration (including ancillary equipment) are to be designed considering motions induced by water currents and imparted by the moored floating platform.

Therefore, designing and verifying a dynamic cable configuration requires extensive engineering, software and computational resources and it typically needs to be repeated for each floater type, water depth, local environmental conditions and cable design [2].

The engineering study is mainly split in:

- **Local analysis**: Study of the dynamic cable cross section including all layers, its materials mechanical properties and interaction between those (e.g. friction). Main results are the determination of the overall cable mechanical properties (axial, bending and torsional stiffnesses), all cable components stress factors (stress distribution between different cable components under axial load and curvature) and stress estimation in metallic components in extreme event cases.
- **Global analysis**: Study of the complete system including the dynamic cable, floating structure, ancillary equipment, mooring lines, environmental conditions, etc. That is accurately represented in the model with the main objective of verifying the proper fulfilment of the design / project mechanical requirements criterion considering the installation configuration, extreme events and fatigue evaluation, on-bottom stability and interference analysis with mooring lines.

PROJECT DESCRIPTION

The floating windmill demonstrator is to be installed in BiMEP facility (open sea test site with grid connection) located at Armintza; near the city of Bilbao in the Basque Country. The test site covers a total surface area of 5.2km² with water depths between 50-90m.

It is a 2MW full-scale demonstrator with a Single Point Mooring which allows the platform to rotate around the stationary moored part (method commonly used for the FPSO in the Oil & Gas industry).

Fig. 2: 2MW full-scale floating windmill demonstrator