Abstract for DeepWind'2013, 10th Deep Sea Offshore Wind R&D Conference, 24-25 January 2013, Trondheim, Norway

Development of a Combined Operational and Strategic Decision Support Model for Offshore Wind

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Topic: Operation and maintenance, Preference: Oral Presentation

Objective

As offshore wind farms are built in increasingly remote and difficult to access locations, there is an increased cost and risk associated with operations and maintenance. This results from operating in harsher climates, the need to use specialised vessels, large losses associated with down time and greater technical uncertainty from using wind turbines without a significant operating history. There is a need for developers to understand how operational parameters influence overall costs and the exposure to risk associated with different working strategies. By linking a detailed operational model with decision making analysis, it is possible to identify the optimal developer strategy at different times throughout the wind farm life. This paper presents a modelling framework to achieve this objective as well as an illustrative case study.

Methodology

In order to achieve this objective, there are two distinct modelling requirements. Firstly, a model capable of capturing the influence of key parameters on overall O&M costs is required. These key operating parameters include failure rates and distributions, wind farm size, water depth, met-ocean conditions and vessel costs, principal characteristics and strategy. The second modelling element required is a strategic decision support model that can use the outputs from the operational model as inputs.

The developed operational model is a time domain Monte Carlo simulation model which takes the identified inputs and estimates the lifetime cost of operations and maintenance. The outputs from this are then used in a Bayesian Believe Network driven decision tree to determine the most favourable operating strategy for the described site. Due to the time domain nature of the operation simulation it is possible to examine strategy decisions at various points during the wind farm life to develop a dynamic strategy.

Results

A case study has been performed on a hypothetical wind farm representative of those currently at the planning and development stage in Europe. The focus of the case study is on heavy lift jack-up vessel operation strategy where there is a significant application of expert knowledge. However, the developed methodology is applicable to wider maintenance operations. The results demonstrate that there is a significant benefit to using a combined modelling structure; providing a novel insight into wind O&M that is not possible using a traditional modelling approach independently.