Floating Wind Turbine Maintenance Requirements, Strategies and Floating Crane Design

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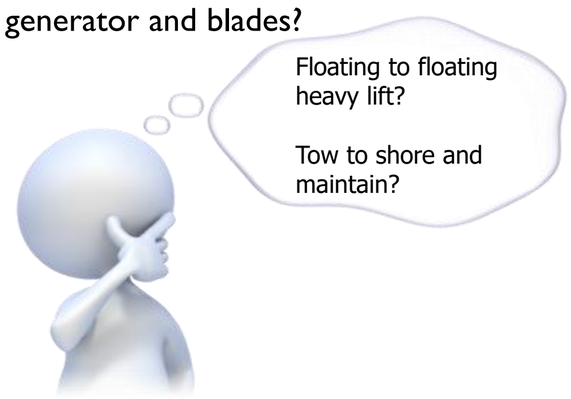
Introduction and Motivation

As of 2018 there was 58MW of floating wind installed worldwide – by 2030, this could be as high as 4.3GW (Hannon et. al, 2019).

The next round of Scottish offshore wind farm leasing is expected to include sites that, due to the water depth, are only suitable for floating wind.

To achieve a competitive levelized cost of energy (LCOE) many O&M questions must be answered.

How will heavy lift operations be optimally completed for main turbine components – gearbox, generator and blades?



Aims and Objectives

Working in collaboration with ORE Catapult, TU Delft, Huisman and the University of Strathclyde Management Science Department to -

Determine the heavy lift requirements, optimum heavy lift maintenance strategy and initial floating crane requirements for large, floating offshore wind turbines (10MW).

This will be done through the following four objectives -

1. Determine the heavy lift vessel requirement rates for the latest generation of wind turbines.
2. Determine the rating of the cranes and vessels required for the maintenance of the latest generation of wind turbines.
3. Based on outputs from Objectives 1 and 2, investigate floating crane design capable of carrying out floating wind turbine maintenance.
4. Create O&M heavy lift vessel access and cost model to compare different floating O&M strategies and carry out comparison.

Current Work – Failure Rates for a 10MW Turbine

Currently the only published rates of major component replacements (gearbox, generator, blades) in an offshore wind turbine are for 2-4MW, DFIG turbines (Carroll, McDonald & McMillan, 2015).

But are these failure rates really applicable to the current offshore wind turbines?

- Walney East – 7MW direct-drive & 8.25MW medium-speed
- Kincardine (floating) – 9.5MW medium-speed
- Dogger Bank – 12MW direct-drive

We are currently working with the University of Strathclyde Management Science Department on using expert elicitation techniques to determine how the replacement rates of major components for large, floating wind turbines differ from the currently published data.

What is Expert Elicitation? When the true value of something is unknown, expert knowledge is often the best available alternative.

Expert elicitation gives a framework to capture and express expert knowledge as a probability distribution representing the inherent uncertainty in the values the expert provides.

Expert elicitation has been used extensively in a wide range of applications – from assessing product reliability in the aerospace industry to assessing antibiotic resistance.

Future Work

Floating Crane Concept

There are some major challenges to overcome when carrying out floating to floating heavy lift operations – for example, the motion between the vessel and the turbine.

Future work will include working with TU Delft and their industrial partner Huisman to identify and investigate some of the challenges when carrying out floating to floating heavy lift operations.

Optimum Floating Turbine Heavy Lift Strategy

From the previous work we will have a much better understanding of the likely failure rates of modern, floating wind turbines along with a better understanding of the capabilities and challenges of the floating crane concept for floating to floating heavy lift operations.

The final piece of work is to use this information, along with offshore O&M models previously developed at the University of Strathclyde to determine the optimum heavy lift strategy for floating offshore wind turbines.

Further Information

If you would like any further information on this work after the conference, would like to be kept updated on any key findings, or would be interested in collaborating on future work, please feel free to contact me at: brian.jenkins@strath.ac.uk.

Supervision, Partners & Support

The project supervision team are Dr James Carroll, Dr David McMillan & Dr Alasdair McDonald. The project is also supported by The University of Strathclyde Management Science Department, ORE Catapult and TU Delft and their industrial partner Huisman.