Quantifying O&M savings and availability improvements from wind turbine design for maintenance techniques

Abstract

- Wind turbine manufacturers, owners and operators all aim to reduce the cost of energy (CoE) from wind turbines.
- Operations and Maintenance (O&M) costs can make up to 30% of the CoE for offshore wind turbines.
- With these high costs O&M has been identified as an area of possible cost reductions to improve the CoE.
- This analysis focuses on cost savings on two turbine types from inbuilt lifting mechanisms, reduced repair times from design for maintenance techniques and redundancy.

Introduction

- This paper shows the results of an analysis carried out to determine the value added to two wind turbine types when design for maintenance techniques, redundancy and in built lifting mechanisms are utilised for drivetrain variations.
- The two turbine types are DFIG turbines and PMG turbines.
- Whether value is added is based on O&M cost saving and availability improvements.
- This analysis was carried out for a site hypothetical offshore site located 50km offshore using wind and sea data from the FINO offshore site.

Offshore O&M Model and Analysed Population Overview

O&M Model

- Strath-CW-O&M model developed by the University of Strathclyde [1].
- In this analysis the model is used to determine O&M costs and availability.
- The model provides the outputs based on the inputs detailed below and through calculating accessibility and power production of the wind farm by using a Markov chain Monte Carlo failure model and multivariate auto-regressive climate model.
- The inputs required to obtain these outputs are detailed below.

Model Inputs

- Failure rates, repair times, repair costs, required technicians, and empirical power curves are obtained from the analysis of the population detailed in the next section.
- The operational parameters for the vessels were obtained from [2]

Analysed Population Overview

The following population was analysed to obtain the inputs required for the model detailed in the previous section:

- Population of ~350 offshore wind turbines
- From between 5-10 offshore wind farms
- Modern multi MW turbines between 2 and 4 MW
- Gear driven turbines
- 68% of population has been operating for between 3-5 years
- 32% for over 5 years
- For the 2nd turbine type the population was adjusted based on [3]

Results

In the following graphs the "Baseline" are the modeled results obtained from the empirical data. "Redundancy Only" ("Redundancy Gen") and "Redundancy Both" are the modeled results from adjusted empirical input data to simulate redundancy in the converter, generator and both combined. "Repair time 10%" and "repair time 20%" are the modeled results from adjusted empirical input data to simulate reduced repair time from design for maintenance techniques "HLV reduced" is the modeled results from adjusted empirical input data to simulate reduced requirement for HLV due to the use of in-built lifting mechanisms. "All Improvements" are the modeled results from adjusted empirical input data to simulate all of the above improvements with repair times reduced by 10% and HLV usage by 50%.

Discussion and Conclusions

References and Acknowledgement


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