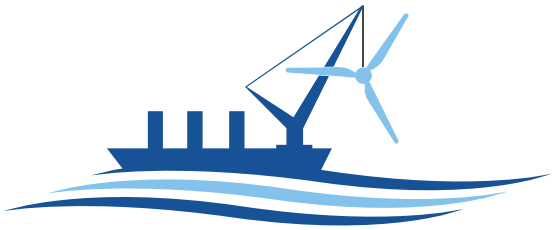

leanwind

Logistic Efficiencies And Naval architecture for Wind Installations with Novel Developments

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Executive Summary

This document outlines the main challenges for operation and maintenance of offshore wind farms. The following key areas are covered:

- Technical integrity
- Operational integrity
- Tools and methodologies
- Standardization
- Lifetime extension
- Climate change

The recommendations are given as a background for the further work to be performed in WP4.

Technical integrity

The technical integrity of an offshore wind farm can to a large extent be assessed through use of condition monitoring. A major challenge today is how condition monitoring data is systemised and coupled to relevant models that may support the continuous improvement processes inherent in maintenance strategies. Automation of data capture should be expanded to cover potentially all activities related to inspection, surveillance and monitoring. The use of automation, robotics and autonomous units will help address the necessary reduction in manned interventions, directly influencing the Levelised cost of energy (LCOE) for offshore wind. Manned interventions should be confined to heavy maintenance work.

In addition to information from condition monitoring also information from inspections can be important to assess the technical integrity. Compared to condition monitoring which typically provides indirect information on the deterioration / damage level of the components, inspections can provide direct information with less uncertainty. Since the cost of inspections are generally larger than costs of condition monitoring a cost-benefit or risk-based approach is needed for cost-optimal decision making.

Operational integrity

Operational integrity is about the challenges to keeping the wind turbines operational that are not directly related to the technical integrity of the wind turbine. Among the various factors that are relevant, a logistics strategy allowing the accessibility that is necessary for the maintenance strategy is crucial for the operational integrity of the wind farm. The requirements for the logistic solution and vessel fleet (as well as the rest of the maintenance strategy) will increase as wind farms are deployed on sites further from shore and in harsher wave climates. Both topics are interdependent on other aspects of O&M. The use of methods such as Reliability Centered Maintenance and Total Productive Maintenance ultimately requires a maintenance organisation to acquire a culture which cultivates the ability to change and adapt throughout the life of the installation. Concepts such as the People-Technology-Organisation (PTO) from the oil & gas industry should be explored with the aim to exploit the value of increased collaboration both within individual companies as well as between suppliers and operators. Such collaboration is crucial to bring down the LCOE.

Support by:

Risk-based approaches for planning of Operation and Maintenance (O&M) activities provide a consistent approach for optimal decision making.

Tools and methodologies

Examples of challenges and developments include

- the improvement in availability expected from improved condition monitoring systems or novel concepts such as remote presence
- the effect of weather conditions and sea sickness on the maintenance work to be done by technicians
- the effect of improved scheduling, grouping and routing on the overall operation of the wind farm
- the interaction between the strategy for spare parts and the strategy for vessel logistics
- the best strategies for chartering of heavy-lift vessels

Standardisation

The wind power industry should adopt international standards for data capture, storgae, communication and presentation. The use of open data protocols encourage development of new and innovative solutions.

Standardization could have two implications. One is standardization of O&M activities / operations used for many different wind farms / wind turbines. This could in some cases imply that that a more optimal site specific process / operation is not sed because it is not part of the standardized tools.

The other aspect of standardization is to develop standards / regulations that specifies minimum requirements e.g. to secure a sufficient safety level for personel. Both types of standardization should be investigated and the potentials for cost savings identified without compromising the requirements to personel safety.

Lifetime extension

The same tools as used for decision making related to planning of O&M can equally be used for decision making releted to lifetime extension (or shortening). Information from condition monitoring provide very useful information for this decision making.

Climate change

Climate change is inherently a slow process on a global scale (climate is defined as average weather patterns over an arbitraily selected 30 year period), but regional and local changes may occur faster. The industry should undertake actions to ensure that changes in wind patterns and othe relevant environmental factors are monitored for the purpose of detecting changes that may impact load factors, energy yield and survivability of a wind farm.