Offshore Wind – An Investigation of Installation Strategies to Ensure Growth at Acceptable Cost Levels

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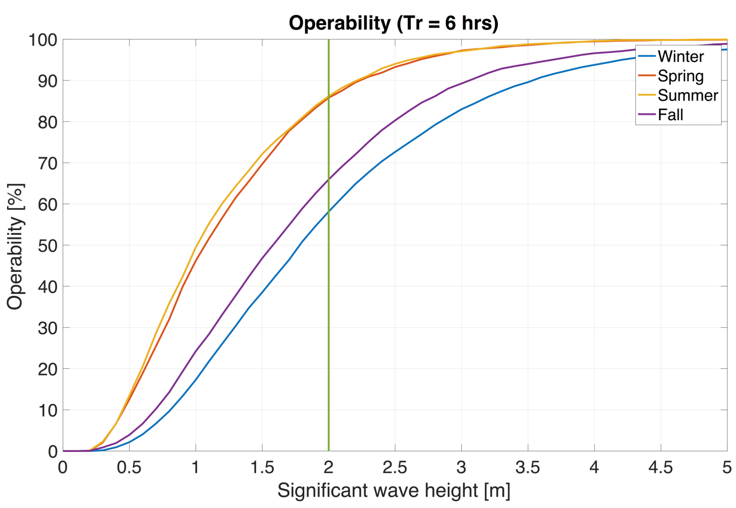
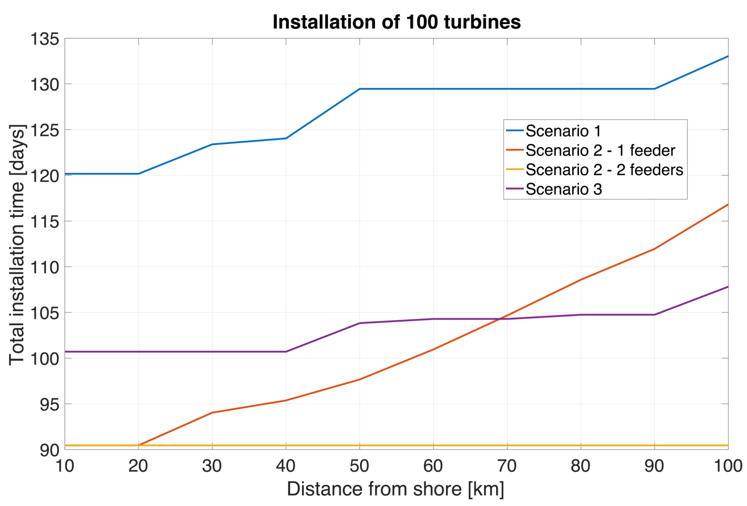
The offshore wind industry has seen an immense growth during the past decade, with a development from less than 1.000 MW installed capacity in Europe in 2006 to almost 13.000 MW in the start of 2017 (EWEA, 2017). The industry is novel compared to its equivalent onshore, and in many ways a better alternative due to improved wind conditions offshore and less visual pollution. However, new challenges are introduced when moving an industry offshore. Not only does installation- and maintenance operations include increased risks and requires proper planning to ensure safe operation, but the costs levels also increase. It is assumed that installation costs accounts for almost 20% of total life cycle costs (Stålhane, 2016), and while investment costs increase for larger projects, optimizing the installation strategy to reduce total costs will be vital for future development. This will be necessary to ensure growth at acceptable cost levels.

Through simulation, it is possible to investigate installation strategies prior to project execution, which provides validation of the efficiency of the method chosen. In this master thesis, three simulation models have been made to provide basis for the analysis, modelling three different installation scenarios for the installation of jacket foundations. Two of the scenarios include only one vessel, either a self-propelled jack-up vessel or a DP-vessel, where the vessel performs all tasks related to installation. The third scenario includes a jack-up vessel performing installation, while a feeder vessel provides constant flow of components offshore by transporting the jackets to the installation field.

The simulation models were created in the discrete-event simulation tool Matlab SimEvents. To properly model the system behavior, hindcasted weather data from the FINO1 weather station was used to create the input weather states for the models, by Markov Chain simulation of states. The weather states in the model included both forecast for significant wave heights and wind speeds. The weather data was also used to create an operability analysis, in order to predict the probability of being able to complete an activity during a given season.





Analyses of the models were executed by using case-studies, where distance from shore and the number of turbines in the offshore wind farm were altered repeatedly. The results show that installation with the use of feeder vessels will be the most efficient method of installation when distance to shore increase, but it is necessary to have enough feeder vessels to provide constant flow of components. All instances where the installation vessel needs to wait for the feeder vessel to arrive with components will reduce the utilization of the installation vessel, which is the most expensive asset during installation. However, this installation method will have higher chartering costs as more vessels are introduced, including the supply of consumables for the installation vessel. The decision of what installation strategy that is the best for each project must therefore include a cost-benefit analysis of the possible strategies, based on the financial benefit of early completion.