FULLY VS. SEQUENTIALLY COUPLED LOADS ANALYSIS OF OFFSHORE WIND TURBINES

INTRODUCTION

The design and analysis methods for offshore wind turbines must consider the aerodynamic and hydrodynamic loads and response of the entire system (turbine, tower, substructure, and foundation) coupled to the turbine control system dynamics. Whereas a fully coupled (turbine and support structure) modeling approach is more rigorous, intellectual property concerns can preclude this approach. In fact, turbine control system algorithms and turbine properties are strictly guarded and often not shared. In many cases, a partially coupled analysis using separate tools and an exchange of reduced sets of data via sequential coupling may be necessary.

In the sequentially coupled approach, the turbine and substructure designers will independently determine and exchange an abridged model of their respective subsystems to be used in their partners’ dynamic simulations. Although the ability to design optimization is sacrificed to some degree with a sequentially coupled analysis method, the central question here is whether this approach can deliver the required safety and how the differences in the results from the fully coupled method could affect the design. This work summarizes the scope and preliminary results of a study conducted for the Bureau of Safety and Environmental Enforcement aimed at quantifying differences between these approaches through aero-hydro-elastic simulations of two offshore wind turbines on a monopile and jacket substructure.

REFERENCES


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CONCLUSIONS

This study revealed how a sequentially coupled approach to the loads analysis of offshore wind turbines with fixed-bottom substructures can perform reasonably well (especially for monopiles), if attention is paid to the details of the modeling implementation from actual differences in the results.

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