NREL Highlights

RESEARCH & DEVELOPMENT

New Modeling Tool Analyzes Floating Platform Concepts for Offshore Wind Turbines

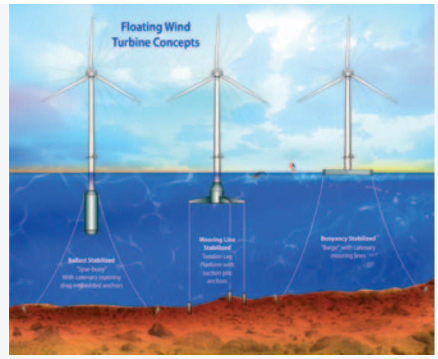
Researchers at the National Renewable Energy Laboratory (NREL) develop a new complex modeling and analysis tool capable of analyzing floating platform concepts for offshore wind turbines.

The new modeling tool combines the computational methodologies used to analyze land-based wind turbines with the comprehensive hydrodynamic computer programs developed for offshore oil and gas industries. This new coupled dynamic simulation tool will enable the development of cost-effective offshore technologies capable of harvesting the rich offshore wind resources at water depths that cannot be reached using the current technology.

Currently, most offshore wind turbines are installed in shallow water, less than 30 meters deep, on bottom-mounted substructures. But these substructures are not practical for the deeper waters where a vast amount of wind resource potential is located. For these waters, floating support platforms will be the most economical type of support structure.

Land-based wind turbines are designed and analyzed using simulation tools that are capable of predicting a design's dynamic response to wind conditions and calculating the extreme and fatigue loads the system can endure. Land-based wind turbine analysis relies on the use of aero-servo-elastic design codes that incorporate wind-inflow, aerodynamic, control system (servo), and structural-dynamic (elastic) models in a simulated environment. Until now, dynamic wind turbine models that account for the wind inflow, aerodynamics, elasticity, and controls while simultaneously considering waves, sea current, hydrodynamics, and platform and mooring dynamics did not exist.

Although numerous floating support-platform configurations are possible, NREL used its new model to analyze three primary concepts: NREL's tension-leg platform, the OC3-Hywind spar buoy, and the ITI Energy barge system. Using a 5-MW baseline wind turbine, NREL presented the impacts of the dynamic coupling between the turbine and each of the floating platform concepts. All of the floating wind turbines showed increased loads on turbine components as compared to the land-based system, but the modeling showed that some performed much better than others.



Key Research Results

Achievement

NREL developed a new complex modeling and analysis tool for offshore floating wind turbine concepts.

Result

Offshore wind turbine designers can use the new simulation tool to resolve the fundamental design trade-offs between the floating system concepts and help developers determine the most reliable and cost-effective floating platform system.

Potential Impact

NREL's new simulation tool will enable wind turbine designers to develop competitive offshore technologies capable of harvesting the vast offshore wind resources found farther from shore. This research will also help resolve the fundamental design trade-offs between the floating system concepts.

NATIONAL RENEWABLE ENERGY LABORATORY

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