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Experimental study of environmental loads on a monopole-supported offshore wind turbine

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Abstract

Offshore wind turbines are commonly challenged by inconsistent loads of wind, wave and tidal current **Error! Reference source not found.**. It is hence necessary to carefully analyze the effects of environmental loads on these structures to increase their lifetime. In this study, both individual and coupled effects of wind, wave and sea current on integral loading of a bottom-fixed monopole supported offshore wind turbine were studied. The small-scale laboratory experiments were carried out in the Wind-Wave-Current (WWC) Tank at Newcastle University, UK. This facility generally allows the simulation of wind, sea current and waves with controllable amplitude and frequency. The small-scale model of Siemens Sapiens FFA W3 offshore wind turbine was mounted in the test section center via a six-component high-frequency force balance measurement system. The blade tip-speed ratio was controlled through adjusting the rotational speed of the rotor. The dynamic integral loads were measured at different tip-speed ratios and under a variety of offshore conditions. The measured loads were processed using spectral analysis method and the resultant frequency characteristics were used for analyzing the dynamic performance of the wind turbine. The results indicate that the sea current and waves have a significant influence on the integral loads, while the waves contribute more to the dynamic response of the wind turbine.

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References

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