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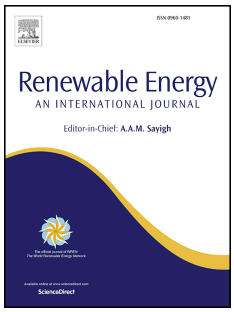

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EXPERIMENTAL MODELLING OF THE DYNAMIC BEHAVIOUR OF A SPAR BUOY WIND TURBINE

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Abstract

This paper summarises the experience gained from wave basin experiments aimed at investigating the dynamic response of a spar buoy offshore wind turbine, under different wind and wave conditions. The tests were performed at the Danish Hydraulic Institute within the framework of the EU-Hydralab IV Integrated Infrastructure Initiative. The Froude-scaled model was subjected to regular and irregular waves, and to steady wind loads. Measurements were taken of hydrodynamics, displacements of the floating structure, wave induced forces at critical sections of the structure and at the mooring lines. First, free vibration tests were performed to obtain natural periods and damping ratios. Then, displacements, rotations, accelerations, and forces were measured under regular and irregular waves and three different wind conditions corresponding to cut-in, rated speed and cut-out. RAO, Statistical and spectral analyses were carried out to investigate the dynamic behaviour of the spar buoy wind turbine.

The results show that most of the dynamic response occurs at the wave frequency, with minor contributions at the first and second harmonics of this, and at the natural rigid-body frequencies. In addition, in many cases a non-negligible contribution was found at the first bending frequency of the structure; this suggests that Cauchy scaling of the model cannot be neglected.

According to the EU-Hydralab IV programme 'Rules and conditions' (www.hydralab.eu), the raw data are public domain, and therefore they represent a unique dataset of measurements, possibly useful for further analyses, for calibration and validation of numerical models, and for comparison with full scale observations.

Keywords: floating wind turbines; spar buoy; dynamic analyses; public datasets; hydrodynamic damping.

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