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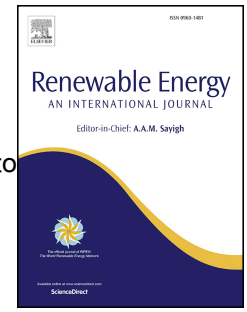


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# Dynamic wake development of a floating wind turbine in free pitch motion subjected to turbulent inflow generated with an active grid

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**Abstract**

Development of wake turbulence of a floating wind turbine model under low and high turbulence inflow was investigated in comparison to the wake of a bottom fixed turbine. In wind tunnel experiments, two inflow conditions were generated using an active grid and the wakes of the model wind turbines were measured using a rake of 16 hot-wires, at downstream positions from one to seven rotor diameters. The flow was analyzed using statistical, spectral and spatial analysis. Under low turbulence inflow, the turbine type has highest impact on the wake, where structures created at the blade tips define substantially characteristics of the wake. Formation of a correlated tip and root vortices, that is found for the fixed turbine, is inhibited by the floating turbine. Under high turbulence inflow, the turbine type plays a subordinated role. Tip vortices are destabilized by large structures created with the active grid, that persist in the wake. Further analysis using proper orthogonal decomposition reveals more complex pattern under high turbulent inflow, that contain high percentage of turbulent kinetic energy, when compared to the low turbulent inflow, where the wake is composed by local point-wise contributions to the turbulent kinetic energy.

*Keywords:* turbulent flow, active grid, wake, floating offshore wind turbine, wind tunnel experiment, proper orthogonal decomposition

## 1. Introduction

With increasing demand in renewable energy resources and more specifically wind energy, offshore wind farms are installed due to steady wind conditions [20]. For areas with water depth >50 m, classical bottom fixed offshore turbines are not feasible and floating wind turbines are considered as a potential solution. Wind turbines positioned on floating platforms are subject to additional degrees of freedom, when compared to a bottom fixed turbine. The additional