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DYNAMIC RESPONSE ANALYSIS OF A 5MW OFFSHORE WIND TURBINE IN INTERMEDIATE WATER DEPTH DUE TO WIND AND REGULAR WATER WAVES OF SIGNIFICANT HEIGHT

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Abstract. This research work presents a strategy to analyze the dynamic response of the NREL-5MW monopile offshore wind turbine subjected to both wind and water waves actions, assuming that the turbine is placed in intermediate water depth. The action of the waves on the pile of the turbine is computed with OpenFoam using a high-order non-linear wave model which allows to simulate waves of significant height with respect to the water depth. Waves are generated with a static boundary condition and a dynamic wave absorption technique is used to avoid wave reflections back into the computational domain. Turbulent flow is solved with a finite volume technique, and a volume of fluid strategy is used to solve for the free surface position. Since different discretizations are used for the fluid and the pile, a non-matching mesh algorithm is used to transfer the wave loads to the pile. On the other hand the wind action on the rotor and nacelle are computed with the FAST simulation tool from National Renewable Energy Laboratory. Finally, the dynamic response of the pile and its foundation, taking into account the soil-foundation interaction, is computed with codeBlue, which is a parallel scientific code based on coupled FEM / SBFEM strategy. The FEM is used for the discretization of the tower-foundation system, while the SBFEM is used to discretize the surrounding soil. The displacement and stress at specific locations of the tower and its foundation are analyzed and compared with reference data in order to assess the capabilities of the proposed strategies and their implementation.

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