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Experimental and numerical study of the stability of barge-type floating offshore wind turbine platform

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The global wind energy has developed over 30 years. However, as the offshore wind power installed within 50 to 60 meters of water depth is gradually saturated. Offshore wind power installations are progressively shifting from nearshore to offshore. With the increment of water depth, the difficulties and the cost of the offshore wind power installations are also increased, makes the fixed-bottom type of structures less favorable in deep water areas and accelerate the development of the floating type offshore wind platforms. Floating offshore wind platforms can be classified into main three types: spar buoy, semi-submersible, tension-leg platform (TLP) according to reaching stability. In addition to these types, a barge-type floating platform, a new design concept, can reduce the dynamic motion of the platform by its moon pool. In this study, the hydrodynamic performance of a floating barge platform with a moon pool supports an NREL 5MW wind turbine and with a mooring system at a water depth of 50 meters was investigated. This numerical simulation was applied to analyze the hydrodynamic performance of the platform using ANSYS Aqwa software. Experimental tests in a flat water tank were conducted at National Cheng Kung University, Tainan Hydraulics Laboratory (THL). The model is a 1:64 scaled barge platform and the turbine is scaled down from the NREL 5MW. Three tests of the platform were conducted, including the free decay test, regular wave test, irregular wave test with wind operation and parking. The experimental data was analyzed to get the natural period through the free decay test. The numerical simulation results were compared with the 1:64 scaled experiment to observe the motions and Response Amplitude Operator (RAO) of surge, heave and pitch motions on the barge platform with moon pool. The floating barge platform, designed in this study, will be tested in the open sea to ensure it can withstand - extreme wave conditions such as typhoons.

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