Development and design of a semi-floater substructure for multi-megawatt wind turbines at 50+ m water depths

A semi-floater concept as a substructure for multi-megawatt wind turbines is developed herein for installation at 50þ m water depths. The semi-floater concept is a hybrid between a fixed monopile type support structure and a floating spar buoy. The configuration of the substructure is composed of a floating system, a mooring system, and an articulated joint. A case study is carried out under specific design conditions and constraints. The detailed designs of the mooring system and of the articulated joint are iteratively carried out using a hydro-servo-elastic analysis tool for structure response, HAWC2, coupled with dedicated in-house software packages for structural design analysis, and Abaqus. A reliability analysis and fatigue load calculations are made to ensure a desired life expectancy of the structure. The semi-floater concept is shown to maintain acceptable fatigue load levels for all turbine components, and to exhibit low platform displacement at the mean sea level. Finally, the overall performance of the structure related to energy production is similar to that of a reference wind turbine situated on land.

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