Hybrid Mooring Systems for a Spar FOWT under regular waves: a numerical and experimental study

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ABSTRACT

With the continuous technical development of floating offshore wind turbines (FOWTs), new challenges regarding stationkeeping arise. Novel and cost-efficient mooring solutions are desired for deployment in various water depth. In order to study the complexity of platform dynamics under such mooring designs, the accuracy and reliability of computational simulations and scaled experiments need to be evaluated in order to achieve the EU objectives relating to offshore wind.

In this work, the studied FOWT geometry is the 5MW OC3-Hywind. A realistic catenary mooring system is proposed considering a deep-water site. A two-segment mooring design is considered in which the upper segment is made of steel wire, and the lower segment is made of studless chain. Based on that mooring system, two novel mooring configurations with the inclusion of Clumped Weights at two different locations are proposed. The three mooring systems are tested under wave-only conditions with two regular wave cases: one operational and one extreme case. In this study, the different mooring systems are compared in 1:47 seakeeping model tests carried out in CEHIPAR ocean basin. This set of experiments are validated with a series of simulations performed in OpenFAST with MoorDyn as the mooring dynamics numerical tool.

The performance of the OpenFAST with MoorDyn is notably accurate when compared with the experimental data in terms of mooring tensions and platform motions. The addition of the clumped weights reduced the maximum tensions of the lines in the extreme condition as well as the mean platform surge offset. The results of this work help to improve the understanding of mooring line dynamics and platform motions when inertial devices are attached to the line.