Title of Diploma Thesis

Mooring System Design and Dynamic Analysis of a 10 MW Semi-submersible Floating Offshore Wind Turbine

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ABSTRACT

The present Diploma Thesis focuses on the design of the mooring system for an innovative Floating Offshore Wind Turbine (FOWT) with a semi-submersible floater and a rated power of 10 MW, as well on the time-domain dynamic analysis of this system under extreme environmental conditions. The research aims to assess the ability of FOWTs to withstand the extreme wave and wind conditions prevalent in the marine environment and demonstrate that these structures can be safely utilized to meet the ever-increasing energy demands.

The design of the mooring system includes the selection of all mooring lines' characteristics (material, nominal diameter, total length of the mooring lines), the determination of mooring system layout/configuration (e.g. angle of mooring lines on the horizontal plane, anchor points positions, as well as the calculation of the new ballast height to be placed in the platform to achieve the required draft. Specifically, following a step-wise process the proposed mooring system, designed fo 100 m water depth, consists of three catenary mooring lines made from studless chain, symmetrically positioned on the floating platform at an 120° angle between them.

The dynamic analysis of the entire FOWT system is carried out in time domain using the OpenFAST simulation software. This analysis focuses on recognizing the dynamic characteristics of the FOWT and evaluating its dynamic behavior under extreme loading scenarios, corresponding to the ultimate limit state, in accordance with DNV-GL guidelines. The simulation results indicated that the behavior of the FOWT aligns with the expectations in various wave and wind loading scenarios, thus confirming the successful design of the mooring system.

Keywords: Floating Offshore Wind Turbine, Semi-submersible, Mooring System, Design, Ultimate Limit State, Dynamic Behavior.