Title of Diploma Thesis

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

Authors

Leonidas – Alexandros Vagenas and Maria Panagiotidou

Academic Year

2022-2023

ABSTRACT

Floating Offshore Wind Turbines (FOWTs) play a key role in the renewable energy sector, providing access to deep water depths, where stronger winds exist. Aiming at reducing FOWT costs, the deployment of large capacity WTs is desired. Thus, the design of adequate floating platforms to support those WTs is required. Motivated by this, the objective of this thesis is the design and the preliminary time-domain analysis of a novel 10 MW semi-submersible Floating Offshore Wind Turbine (FOWT).

The semi-submersible platform is designed to support the DTU 10 MW reference WT by upscaling an existing 5 MW FOWT. It is a steel braceless platform with ballast filling capability. A three-leg catenary mooring system for 100 m installation water depth is considered, while the tower of the DTU 10 MW WT has been appropriately modified in order to be adjusted to the new geometry of the floating platform.

The fully-coupled, integrated time-domain analysis of the proposed FOWT is conducted in OpenFAST and aims at: (a) identifying important static and intrinsic dynamic features of the FOWT and (b) assessing the FOWT's performance under various wind and wave load cases. The results demonstrate an efficient design of a new 10 MW semi-submersible FOWT that meets main design requirements of this kind of floating systems (e.g. natural frequencies within required limits, anticipated dynamic responses and power production).

Keywords: Floating Wind Turbine, Semi-submersible, Mooring System, Design, Upscaling, Dynamic analysis