

**Title of Diploma Thesis**

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Analysis of the Dynamic Behaviour of a Spar Buoy Floating Offshore Wind Turbine

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**ABSTRACT**

This diploma thesis deals with Spar Buoy Floating Offshore Wind Turbines (FOWTs) and more specifically, it focuses on the investigation of their dynamic response in the case of accidental operational conditions, like grid loss or other faults, such as fault in the control or safety system, under the action of specific wind and wave loading conditions. The recent trend towards the exploitation of renewable energy sources and, specifically, of offshore wind energy, in deeper waters, where wind conditions are more favorable has triggered the selection of the Spar Buoy FOWT. Considering the advantages of exploiting the offshore wind energy in deep waters, the installation of FOWTs presents an attractive efficient solution in terms of energy production. So, initially, the need for exploiting the offshore wind energy through the construction of offshore wind farms was presented, while general information about FOWTs were given, focusing on Spar Buoy FOWTs.

In the context of this thesis a Spar Buoy FOWT was numerically modeled and its dynamic behavior was analyzed in time domain using FAST software. The analysis was implemented considering random waves and wind conditions based on specific loading cases included in the Germanischer Lloyd Guidelines.

Based on the results of the numerical analysis, the worst loading scenarios were determined in terms of: (a) the mooring lines' tension, (b) the tower base loading and (c) the loading on one blade's root. The response of the floating structure was also assessed in its six degrees of freedom.

The evaluation of the results led to useful conclusions related to the behavior of a Spar Buoy FOWT operating in accidental conditions.

**Keywords:** Floating offshore wind turbines, Spar Buoy, Time domain analysis, Accidental operational conditions, Worst loading cases, Response.