# **Title:** Power Output Assessment of TetraSpar Floating Demonstrator: A Comparative Analysis between Actual Performance and Model Predictions

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**Program**: MSc Sustainable Energy Technology

**Background:** Floating wind farms are being developed throughout the world and the number of megawatts under development is growing rapidly. Floating wind presents many challenges, structural, logistical and operational. For a Resource Assessment department, the primary challenge is to understand how power production will differ from a bottom fixed turbine. The industry has identified a variety of effects which could change power production and have developed a collection of tools to model these effects, ranging from modifications of existing wake models, to simple excel sheets. Various groups have done validations of these tools with both higher fidelity models and scale testing in wave tanks. Validating on full scale operating turbines has not been done to any large extent. As RWE is a partner in the TetraSpar Demonstrator Project, validation of one or more tools is needed.

The TetraSpar Demonstrator Project is the world's first full-scale demonstration of an industrialized offshore foundation. The project is carried out in a partnership between Shell, RWE, TEPCO Renewable Power, and Stiesdal Offshore. The TetraSpar Floating Offshore Wind Turbine (FOWT) platform consists of a total of 13 cylinders, including 10 arranged in the main structure and additional 3 located at the keel. These cylinders are interconnected to create a tetrahedral shape and are anchored to the seabed using three catenary lines attached to the ends of the radial elements, as can be seen in Figure 1 and Figure 2.

Figure 1: The TetraSpar concept (Stiesdal, 2021)

The design incorporates a 3.6 MW Siemens Gamesa turbine for power generation and it is expected to offer important competitive advantages with its potential for lean manufacturing, lean assembly and installation processes, and low material costs.

**Objectives:** This master's thesis will consist of three parts. The first is to create a model of the Tetraspar in the floating version of FLORIS (FLOw Redirection and Induction in Steady State). This will involve determining Response Amplitude Operators (RAOs) for sea state, mooring stiffness parameters and various other inputs that will be fed into the FLORIS model. The RWE sponsor will facilitate contact with the relevant subject matter experts to access this data.

The second part will be to find suitable test cases at a variety of windspeeds and sea states in Tetraspar data, where all relevant instrumentation is working and the turbine is not curtailed. The data from this will be processed to determine power output.

The third part will be to compare the test cases to prediction of the same conditions from the FLORIS model. A critical analysis and interpretation of the results will be conducted.

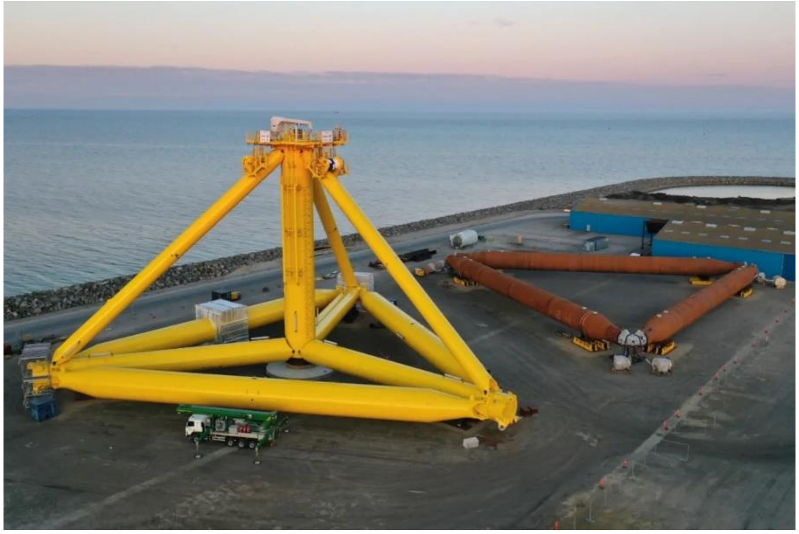

Figure 2: Completed foundation and keel (Stiesdal, 2021)

## References


Stiesdal. (2021). *The TetraSpar full-scale demonstration project*. https://www.stiesdal.com/offshore/the-tetraspar-full-scale-demonstration-project/