TU Delft

Offshore & Dredging Engineering

Technische Universiteit Delft

The Floating Future: An optimisation of the GustoMSC Tri-Floater, aimed at serial production

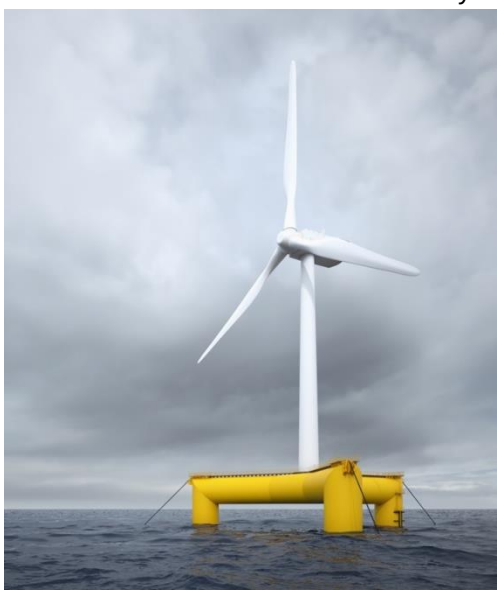
Over the last two decades, sustainable energy has started to play a role within the energy supply and demand. Especially the contribution of wind energy has grown significantly. Governments are forced to decarbonize and diversify their energy portfolios and the public opinion on climate change has changed. This resulted in a rapid development of the power efficiency, fabrication and installation of offshore wind farms.

Floating support structures are expected to be cost competitive with conventional bottom-founded support structures from 50 meters of water depth. This makes floating wind energy an interesting solution, because constant high wind velocities are often found in deep water. This will increase the power output efficiency of a wind farm significantly.

GustoMSC has developed a semi-submersible wind turbine foundation, the Tri-Floater. The hull consists of three columns equipped with damper boxes. The columns are connected by a deck structure, which supports a wind turbine in the middle. The system is designed to be braceless. This way all fatigue sensitive points are located above sea level, what will result in less maintenance costs. The hull is designed from a conventional semi-submersible point of view and consists of stiffened steel plates. This requires a lot manual work, making the construction time consuming and costly.

This research describes a possible optimisation of the GustoMSC Tri-Floater, aimed at serial production. In order to compete within the offshore wind sector, serial production is an important criterion. This way the design becomes more interesting to clients as the return period of their investment is shorter. The new design is based on the favourable hydrodynamic behaviour of the Tri-Floater in combination with the experience from the wind sector in the serial production of large tubular sections. The spokes, columns and centre piece of the new floater consist of large diameter tubulars, representing 80% of the primary steel mass of the floater.

This research describes the overall structural strength verification of the new concept, assessed against the 50-year extreme environmental conditions. In order to verify the hydrodynamic behaviour of the design, a panel model is made for the submerged floater parts. Since the verification is assessed against survival conditions, the turbine is parked. Therefore, it is assumed that the dominant loads in the analysis consist of first order wave loads only. The wave loads are determined using the design wave approach. In this approach a set of regular waves is found that represent the extreme response in a section of interest due to irregular waves. Based on these load sets the design criteria for yield- and buckling-strength are verified and a simplified fatigue analysis has been performed. Despite a little increase in primary steel mass, a cost estimation shows that the efficiency in production of the new concept will decrease the costs significantly.



Based on the results it can be concluded that the tubular concept of the Tri-Floater is potentially a big improvement if serial production of the system is required.

Student
Niels Harent
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Sponsor
GustoMSC B.V.

Thesis committee
Prof.dr. A. Metrikine
Ir. P. van der Male
Dr.ir. K.N. van Dalen
Ir. F. Huijs