A Modular TLP-Design for Offshore Wind Turbines

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Summary
The GICON®-Tension Leg Platform (TLP) has been advanced including new materials and a high modularity. This eases manufacturing and assembling and enables serial production. Together with a lowerable gravity anchor for a so called one-step installation process these features mean a significant cost reduction. Different model tests including a scaled 1:50 model of the structure supporting a 6MW turbine subjected to different wind and wave loads, helped to enhance and verify the numerical models.

1. Enhancement of the GICON®-TLP

Floating substructures for wind turbines are commonly attributed to enable the offshore wind

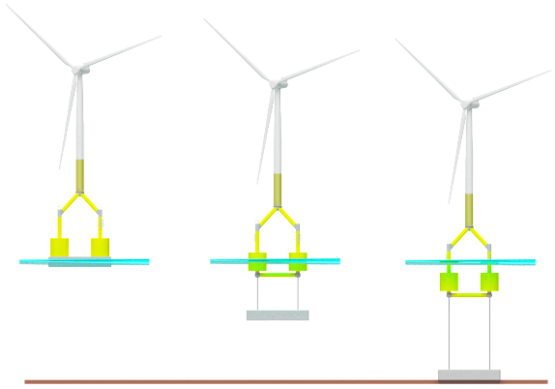

Fig. 1: Installation Procedure

industry which is currently focused on fixed substructures, to expand into deeper waters. 77% of global offshore wind potential is located where waters are deeper than 60m.[1] But still floating substructures do not meet with the market expectations regarding the LCOE. By incorporating new materials and modularity to the design, the costs of the GICON®-TLP have been reduced significantly.

2. New Materials and Modularity

Prestressed Ultra-High-Performance-Concrete (UHPC) pipes will be used for the latticed structure. The buoyancy bodies will be build using concrete shell elements known from tunnel engineering. The use of casted iron for the nodes and the TP means further advantages regarding design and costs. All the components are designed to be transported (e.g. via railway), to ensure a high flexibility within the supply chain.

3. Tank Tests

In October 2017 a scaled model (1:50) of the new substructure design and a respective 6 MW turbine has been successfully subjected to wind and wave loads at the Ocean Engineering Tank of the Ecolé Central Nantes (ECN).

Fig. 2: Ocean Basin at ECN with the 1:50 scale model

Decay tests for all six DOF´s and numerous wind-only, wave-only and combined wind and wave tests have been carried out. By use of an optical motion tracking system the systems motions and accelerations have been measured and computed. The results show a good overall agreement with those from the simulations including NRELs FAST v 8.16.

3. Acknowledgements

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4. References

[1] Arent, D., et al. „Improved Offshore Wind Resource Assessment in Global Climate Stabilization Scenarios“, 1. Oktober 2012. https://doi.org/10.2172/1055364.