

Winch system with dedicated software-in-the-loop technology for simulating an operational wind turbine (Hexicon project)



# Software-in-the-Loop provides valuable alternative to traditional offshore wind model testing

Since 2003, MARIN has built up an extensive track record in testing floating wind turbines. To date, the main method for model testing has been based on a dedicated wind setup and on MARIN's stock turbine that was developed at an early stage of these types of model tests. Although we believe that tests with the stock turbine are valuable, a new method has been adopted in which a hybrid solution between simulations and physical model tests has been developed, giving more flexibility in selecting the model scale and shorter preparation time.

**Full-scale floating wind turbine** The so-called software-in-the-loop winch system uses live basin motion measurements, which are fed into a software model that simulates a full-scale floating wind turbine. The software model is based upon FAST, an aeroelastic, computer-aided engineering (CAE) tool for horizontal axis wind turbines developed at NREL. However, other software models such as PHATAS can be implemented.

A hypothetical wind field is loaded in the software, after which aerodynamic loads are determined at the foot of the turbine tower under the influence of the motions and a dedicated turbine control algorithm. These aerodynamic loads include the driving force components such as turbine thrust, drag of the tower and the aerodynamic pitching/yawing moment.

The 3DOF loads are transferred to an allocation algorithm to effectively divide the required loading over a winch system of five lines.

**Valuable alternative** MARIN has performed several test campaigns using the software-in-the-loop system, including floating wind tests for semi-submersibles and TLPs. Recently, MARIN performed model tests for Naval Group to tune its numerical floating wind turbine model, since its recent involvement in floating wind projects in France and other countries. Dedicated tests have been performed using Naval Group's in-house wind turbine software.

The approach has proven its value for each campaign, being able to demonstrate that the wires had limited influence on the system dynamics in all operating conditions.

However, low fidelity wind turbine software has its limitations. In addition a purely software independent test can only be performed in real wind. But certainly, software-in-the-loop is now considered to be a valuable alternative to the stock turbine tests and it opens up new opportunities for wind model testing. MARIN is confident that being able to offer two model test alternatives will serve the industry best. ▢

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