



## UNIQUE TO THE WORLD

scale models in some of their basins for several international clients. Maritime Holland spoke to Erik-Jan de Ridder, Project Manager at MARIN.

De Ridder: "To date a significant amount of the floating turbine structures have been tested at the MARIN facilities, including over ten commercial projects." Their clients are mainly from outside Europe, for example Japan and the United States of America, where floating wind is a more convenient solution. MARIN also has an office in the US and a joint venture in China (SSRI-MARIN Co. Ltd).

### History

MARIN's first involvement in floating wind dates back to 2003 when they worked in partnership with other Dutch companies, the research companies ECN, TNO and the offshore engineering and designing company Gusto, on an R&D project on floating wind offshore structures, 'Drijfwind' (FloatWind). From 2010 ECN, MARIN and Gusto worked on the project 'Floating Wind Offshore Structures' as part of the Maritime Innovation Programme (MIP) funded by the Dutch Government. For this research project tests were being done on a Tri-Floater foundation, designed by Gusto who has a long track record in the design of semi-submersibles. The foundation consists of a steel three-column, slender braceless hull and can be designed as to fit all types of turbines and wind farm locations.

The completion of this test was followed by a period of non-activity with floating wind structures, only to be picked up again some five, six years later when the well-known Sway floating foundation was tested at MARIN. A 1:50 scaled model was created and tested in MARIN's basin. A 1/6 prototype was later installed off the Norwegian coast.

### Unique wind generator simulates realistic offshore environment

In the meantime MARIN continuously looked at improving their testing capabilities. As wind seemed to be the main factor affecting floating wind turbines, more than with floating structures for oil and gas where waves and currents most of the time play a more dominant factor, they developed a high-quality wind generator which could test the behaviour of floating turbines with even greater accuracy. This generator, which is installed in MARIN's offshore basin, consists of multiple large fans in a box with small holes to streamline the wind.

This new addition was unique to the world and attracted the attention internationally. In 2011 MARIN was contacted by the US University of Maine. The university ran a US Government sponsored research project DeepCWind which involved the testing of several floating wind structures such as a TLP (tension leg platform), a spar and a semi-submersible.

## Testing future foundations

There is a lot to write on the role of the Dutch industry concerning the development of offshore wind, both nationally and internationally. However, when it comes to floating wind turbines the list of company names is significantly shorter. With relatively shallow waters it is currently more efficient to install wind turbines on fixed foundations in the Dutch section of the North Sea while floating turbines tend to be more efficient for installation in waters deeper than 60 metres.

It is, therefore, not surprising that most of the Dutch offshore industry players are largely concentrating on activities related to the different stages in developing offshore wind farms using turbines on fixed foundations. This however does not mean that we can close the chapter on floating wind in this renewable section as there are some Dutch companies that, perhaps not as their main activity, still play their part.

These are mainly engineering and research companies. One of these companies is the Dutch Maritime Research Institute (MARIN). MARIN provides commercial hydrodynamic design and verification services to industry and governments. The research centre had already large experience in testing scale models of floating structures for the oil and gas industry which is still the main focus. However, for over a decade now MARIN has also facilitated test programmes on floating wind

### Timeline

<b>2003</b> First involvement Marin Floatwind	<b>2010</b> ECN, MARIN & gusto work on Floating Wind Offshore Structures	<b>2011</b> MARIN part of US DeepCwind	<b>2013</b> Successful tests on Gusto's Tri-Floater foundation	<b>2014</b> European Consortium- launched for SPINFLOAT
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# 2014

*In November 2014, at an open day, MARIN presented a 40:1 scale model of the Offshore Basin with wind and waves completely built out of 2,500 LEGO® bricks! The scale model included a real movable floor, wind fans, deepwater pit and 26 LEGO® wave flaps.*

Together they also developed an in-house turbine scale model of five megawatt with a rotor diameter of 126 metres. Where previously only foundations had been tested MARIN was now able to test complete floating wind turbine scale models. This was quite a challenge as De Ridder explains: "The blades especially show different behaviour when they are scaled down. In turbines on fixed foundations the pitch control systems inside the turbine adapt quickly on changes in wind direction and speed. With floating turbines different pitch control systems are needed, and the working can now be tested in the basin."

In March 2013 new tests were successfully completed on Gusto's Tri-Floater foundation, now equipped with the five megawatt turbine, which had been further developed in the meantime. MARIN and Gusto worked together with ECN on this. In 2014, a European consortium was launched to develop SPINFLOAT, an innovative concept of a six MW vertical axis floating wind turbine which will use GustoMSC's Tri-Floater foundation.

For the Glosten Associates they ran a test programme on a 1:50 scaled PelaStar tension leg platform which was completed in June 2013. A full-scale 6 MW model is to be installed in the North Sea. Also in June MARIN's facilities were used for German Gicon semi-submersible floating wind foundation, GICON® SOF, a full-scale prototype which will be used in the German Baltic Sea.

In 2014 the research centre completed a test programme of a vertical axis floating turbine for the Deepwind consortium, consisting of several European research institutions and technology companies. This floating foundation concept is now ready for the next step – presenting it to the market.

## Full services

When it comes to testing floating wind turbines MARIN can offer the whole service package; designing and building the scale model, testing the concept and analysing the output, and even training future crew. De Ridder: "All except for the control systems – as these are very complicated we leave it

up to the turbine manufacturer themselves as they have the experience and knowledge." The testing of floating turbines can vary between one to four weeks.

When asked about the future developments for MARIN De Ridder replies that fixed foundations will remain the leading offshore wind foundation type but floating wind will become more accepted. MARIN will continue focusing on further improvement of the tools, such as further integration of software simulations and calculations, and sharing knowledge with other industry players and research centres such as ECN. For the latter MARIN is starting a Joint Industry Project (JIP) aimed at getting a better understanding on the level of data capturing for floating wind turbines, and this JIP is still open to join.

**Sabine Lankhorst**

