MARIN has the wind in its sails pledging commitment to offshore wind sector

With the growth in renewable energy, there is an increasing focus on offshore wind. The offshore wind industry is maturing and going further offshore into deeper and more challenging waters. MARIN too, is actively participating in the development of the offshore wind energy sector.

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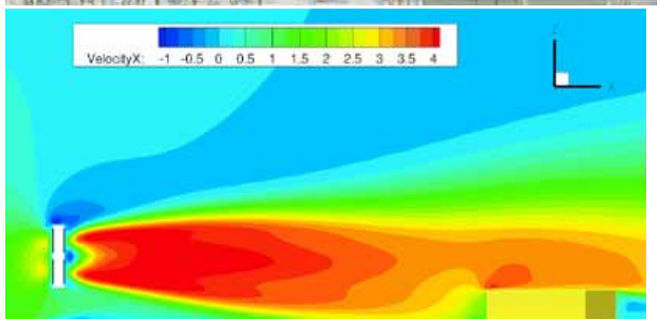
Breaking wave on a wind turbine scale model with realistic flexibility in the MARIN facilities during the Offshore Wind Seminar

Larger and more efficient wind turbines are being installed offshore due to the higher wind energy potential. Nowadays, fixed offshore wind turbines are being installed in shallow water. However, technology is improving and the wind turbines are expected to move to deeper water where the wind is more frequent and stronger. The challenges of fixed and floating offshore wind turbines are very similar to those of the offshore industry: safe and economic design, production, transportation, installation, maintenance, repair and removal. Therefore, MARIN is committed to the investigation, design and development of these new fixed and floating offshore wind turbines.



New wind set-up to test floating offshore wind turbines in Offshore Basin

CFD results for existing wind set-up in Offshore Basin

Model tests for floating wind turbines In 2011, MARIN's Renewable Energy Team (RENT) will test three different floating wind turbine concepts for the University of Maine-led DeepCwind project. The floaters include a spar buoy, a tension leg platform and a semi-submersible. The model tests are being conducted to calibrate and validate simulation codes for floating wind turbines. Therefore, great attention will be paid to the coupling between aerodynamic and hydrodynamic behaviour. For example, the modelling and documentation of the wind field in the basin will be given special attention, as well as the relation between turbine behaviour and wind loading on the rotor.

From 2010 to 2014, MARIN will participate in the FP7 project "Future Deep Sea Wind Turbine Technologies" (DeepWind). The hypothesis of this project is that a new floating vertical axis rotor concept, specifically developed for offshore applications, has the potential to offer better cost efficiencies than existing offshore technology.

Simulation code for floating wind turbine Designing an Offshore Floating Wind Turbine (OFWT) brings new mechanical constraints to the nacelle and the rotor. The motions of the floater affect the performance of the wind turbine and vice-versa. As wind turbines get taller even small pitch or roll rotations can result in large motions at the location of the nacelle. To properly predict the motions of the floater, rotation of the rotor and the flexible nature of the blades and tower, the structural response of the wind turbine on the floater needs to be taken into account. MARIN and Energy Research Centre of the Netherlands (ECN) are working together to tackle the many challenges of the design of an OFWT. Therefore, the aero-elastic code PHATAS of ECN is being coupled to the multi-body, time-domain simulation code, aNySIM of MARIN. This facilitates a simultaneous calculation of all the aspects of an OFWT in one numerical simulation.

High quality local wind field in MARIN's Offshore Basin To assist in the testing of floating wind turbines, MARIN is presently working on a high quality, local wind field setup in its Offshore Basin. The wind field is generated by a square bed of 5*5 wind fans with guides and stators (straighteners). By controlling the RPMs of the different rows, the vertical profile of the wind can be controlled. CFD calculations are being carried out to assist in the design of the final, dedicated wind setup as illustrated in the figures.

Wifi JIP At the end of 2010 more than 60 representatives of the international offshore wind industry gathered at the Offshore Wind Seminar organised by MARIN and ECN. This seminar provided a unique opportunity to see model tests being carried out at MARIN's facilities that showed the impact of breaking waves against an offshore wind turbine. This pilot series of model tests was carried out with a special model of an offshore wind turbine with realistic flexibility. The tests confirmed that breaking waves can induce significant oscillations and accelerations in the turbine, resulting in extreme fatigue loads on the foundation, tower, turbine blades, shaft, gearbox and generator. To further study this subject, MARIN and ECN, together with a number of other partners, are in the process of starting up a Joint Industry Project (JIP) with the acronym 'WiFi': Wave impacts on Fixed turbines. The objective of this WiFi JIP is to improve the manner in which the effects of steep (and breaking) waves are taken into account in the design methodology of fixed offshore wind turbines, so that optimized offshore wind turbines can be developed.