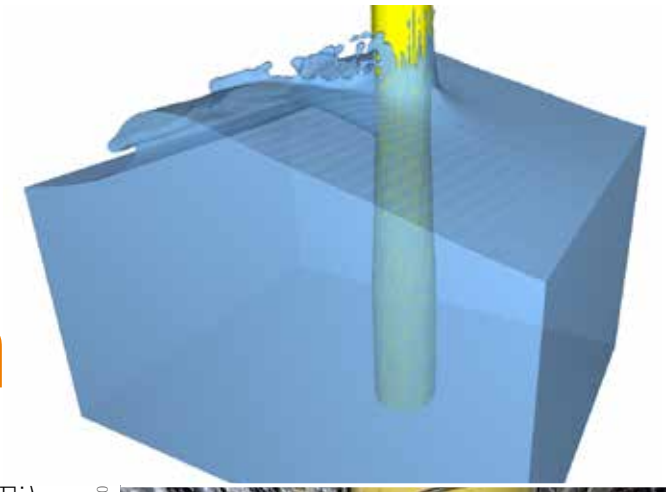
WiFi JIP makes it possible to take the next step in foundation design



The aim of the Wave impacts on Fixed turbines (WiFi) JIP is to better understand the influence of steep and breaking waves on the foundation and secondary structures of offshore fixed wind turbines. To that end, a combined experimental and numerical study was performed at MARIN within this Joint Industry Project.

During the experimental stage, a flexible offshore wind turbine was subjected to extreme (breaking) waves in the model test basin. By scaling the natural frequencies and mode shapes of the monopile foundation model (the structural properties), the interaction between the structure and the waves was realistically modelled. This resulted in a better understanding of the loading and response of the wind turbine in extreme wave events. Accelerations and loads on the structure were measured, providing a valuable basis of validation material for simulation techniques.

In the simulation stage the outcomes of the model tests were used for validation of the numerical model. The research topic of simulating extreme breaking waves impacting flexible offshore structures is further studied in the ComMotion JIP (see page 14). From the model test results a focusing wave group was selected which broke just aft of the wind turbine.

An iterative wave calibration technique was developed within the CFD method to ensure a good match between the measured and simulated incoming wave profile. This makes a deterministic comparison between simulation and measurement possible. The iteration loop is carried out in a 2D CFD domain (long-crested wave restriction) and is therefore relatively low cost. The calibrated CFD wave is then simulated in a (shorter) 3D CFD domain including a (fixed) wind turbine. The resulting wave pressures on the turbine were used to compute the modal excitation on, and subsequently, the modal response of the wind turbine. The horizontal accelerations at different locations along the monopile resulting from this one-way coupling concur with the measured accelerations, illustrating the effectiveness of the numerical model.

The WiFi JIP has a broad-ranging industry mix of 20 participants. A considerable amount of knowledge is available for and distributed within the consortium, making it possible to take the next step in foundation design and classification.

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Wave impact on a monopile foundation modelled in the basin and in CFD within the WiFi JIP