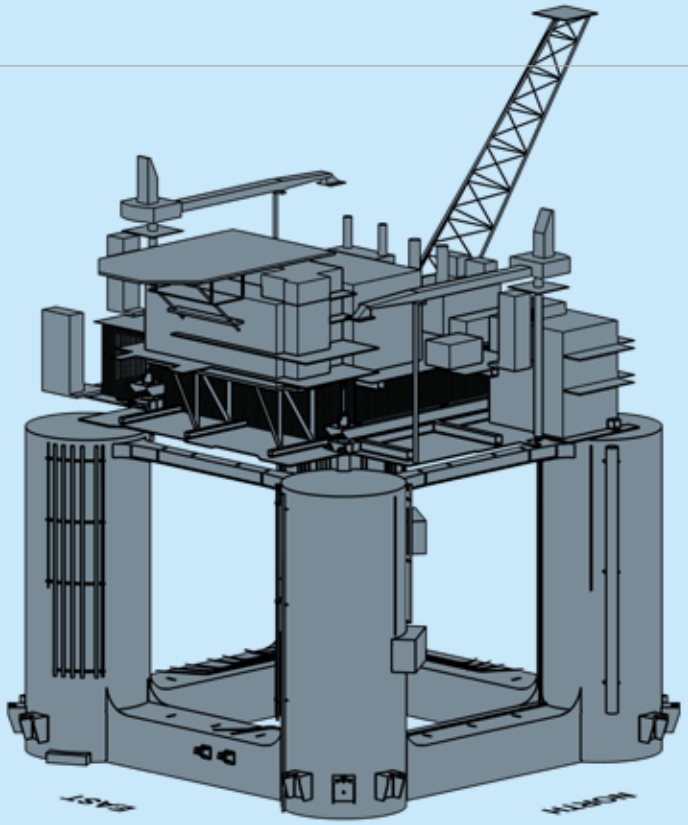

3D model of the platform

Model after construction

Highly efficient Tension Leg Platform design, testing and analysis

MARIN tested Hess' Stampede Tension Leg Platform (TLP) in the Offshore Basin in waves, wind and current in 2014. A thorough, 30-day test programme was put together in close cooperation with HESS, its contractor MODEC and MARIN.

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MARIN continuously optimises its modelling, testing and data analysis approaches in order to provide clients with efficient, highly accurate results. This article describes how a detailed TLP model is created with the aid of 3D computer modelling, how an extensive set of environmental conditions is calibrated efficiently and how the use of high-speed video recordings provides detailed insight into the impact of high and breaking waves on a platform. Finally, all the measured data was analysed and delivered directly after each test thanks to a detailed data analysis plan put together before the project got underway.

Model design Every project at MARIN starts with a CAD design of the vessel or platform. Nowadays, it is usual to make 3D CAD designs of the complete model, including detailed appendages on the hull and internal structural members. This approach gives the advantage that the displacement can be checked and the weight distribution of the model is known before manufacturing.
For TLPs and semi submersibles, the weight distribution can be challenging to realise at model scale. The 3D CAD model assists the engineers to optimise the model design in order to realise the correct weight distribution of the platform. Additionally, this approach means that the model manufacturing is very efficient. In a similar way to a shipyard, all plates and elements are pre-cut and delivered to the assembly place, in this case MARIN's model manufacturing workshop. All the pre-cut plates are assembled like a building package.

Environmental modelling An extensive set of more than 150 waves was calibrated,

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Wave impact at wave ward column

Wave impact at mid columns

Wave impact at leeward column

representing various operational and storm conditions and consisting of variations in wave direction, wave height (Hs), peak period (Tp) and peakness parameter (γ). To make maximum use of the available basin time for effective model testing the majority of the waves were calibrated automatically, unmanned during the nights and weekends. This strategy of unmanned wave calibration has proven to be an effective approach during the last few years to reduce the basin time required for environmental calibration in order to have more time left for effective model testing.

A second time saver in the environmental calibration was through the use of a 3D numerical model of the topsides received directly from the wind tunnel facility. The model was imported in the 3D engineering software and built accordingly. Once installed in the basin, the wind loads (in 6 degrees of freedom) were spot on with the target wind loads based on the wind tunnel measurements!

High-speed video recordings High-speed video recordings with 200 frames per second were made to register wave impacts on the TLP in precision detail. The high-speed video recordings were triggered by a wave measurement probe, which was positioned at the waveward side of the TLP, in order to capture only the most extreme and interesting events. The video recordings did give valuable insight into the interpretation of the wave height measurements and understanding of the physical phenomena of impacts of steep and breaking waves onto the platform. The research topic of the impacts of high and breaking waves on platforms will be further studied in the upcoming BreaKin JIP (see page 14).

Data analysis Prior to execution of the tests a detailed data analysis plan was worked out by the partners. MARIN prepared its data analysis software based on this plan prior to the tests. As well as the analysis of almost 100 direct measurement signals another 50 derived signals were added. All data was provided fourfold: unfiltered, low frequent, wave frequent and high frequent. In total, almost 300 GB of analysed data was produced during the test programme! And thanks to the data analysis plan all data could be analysed and delivered directly after each test.

For more information about HESS' point of view regarding the success of this project and others MARIN has carried out over the years, please turn back to page 6 where we interview Joel Witz, Global Engineering Advisor of Hess Corporation.