Model Tests on a novel Side by Side Offshore LNG (off) Loading System

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Increasing worldwide demand for the consumption of natural gas requires new concepts for the import of gas, especially to North America. MARIN puts these new methods to the test.

Single Buoy Mooring (SBM) has developed a Floating Storage & Re-Gasification Unit (FSRU) for LNG to enable offshore importing of LNG. During the development of the LNG offshore terminals, it is preferable to develop solutions which avoid the requirements for dedicated LNG Carriers (LNGC). To achieve this with standard manifold and mooring equipment on the LNGC; side-by-side mooring is the obvious choice.

MARIN was requested to perform a test campaign in a 60m water depth to validate a novel mooring concept and to perform in-depth verifications of the hydrodynamics of two side-by-side vessels. The mooring concept consists of a Soft Quay Mooring (SQM) which can be viewed as a wide, soft yoke quay suspended from the side of the FSRU. The measured motions and loads demonstrated the feasibility of the concept and the results were used by SBM to start the detailed design.

Optimum distance

In the hydrodynamic verification phase five different gaps between the LNGC and the FSRU were tested. The first gap simulates a standard (side-by-side) mooring with spring and breast lines between the vessel and floating fenders to keep the vessel at the initial gap of 4 m. For the remaining four gap widths the turret moored FSRU keeps the LNGC moored in a side-by-side configuration using the SQM. Special attention is paid to the wave action between the two vessels, as their action affects the vessel motions. The spatial distribution of the waves is measured by means of wave probes along the vessel length. These wave motions between the vessels show a linear response with the gap and have a maximum for the smallest gap. The model tests brought valuable information regarding the optimum distance between the FSRU and LNGC for an SQM system.

Vessels freely floating in each others vicinity experience the interaction effects in wind, waves and current. The wave interaction effect can be calculated with wave diffraction programs. These programs have been used to compute global parameters such as motion response. However, it is already known that the wave pattern between two vessels is quite complex. The wave pattern itself influences the motions of the vessels and the resulting feasibility of the offloading concepts. Due to this, a second phase of the Offloading Operability Joint Industry Project has started in which the developed tools will be extended to include the side-by-side mooring. MARIN