Tug in pull mode, shielded partially by LNG carrier.

34384

An important factor in

Tug behaviour in

With the uptime levels of new offshore terminals now expected to be nearly 100%, there has been plenty of research into dedicated mooring and offloading systems in waves and swell. But what has been underestimated, is that the operation of assisting tugs can limit the uptime of the terminal significantly. MARIN has been examining the role of tug operations.

Bas Buchner
B.Buchner@marin.nl

The demands of the offshore industry are well-documented, it is now the norm that requirements for the uptime of new offshore LNG terminals extremely high – typically 95-99%.

This requires dedicated mooring and offloading systems so that the offloading of LNG can proceed in significant waves and swell. Mooring to dedicated Gravity Based Structures or jetties and side-by-side or tandem mooring to FSRUs (Floating Storage and Regassification Units), are all used in this process.

But the operation of assisting tugs in these wave conditions can hamper the uptime. Operations with assisting tugs have mainly been carried out for sheltered conditions in harbours or other more shielded conditions around terminals. But for new offshore LNG terminals, these operations should be carried out in a real offshore environment with the related waves. Experience with tugs assisting crude carriers during lightering operations has shown that waves may hamper operations significantly.

Model tests on push and pull modes

Scale 1:35 model tests were performed for the push and pull mode. Realistic weather conditions were used and the tugs worked on the unshielded and shielded sides of the LNG carrier. Results revealed that motions of tugs in waves can be significant, even in wave conditions that are considered mild for the berthing and offloading LNG carriers. The resulting push or pull loads can hamper tug operations significantly.

Simulation model

Further research is certainly needed to come to an optimum solution for the problem. Optimising the tug size and a further improvement of fenders and mooring lines could be considered. Based on the present model test results, MARIN is developing a simulation model for the prediction of tug behaviour. This model can then be used to determine an optimum tug design, as well as the operational limits of certain LNG berthing and offloading concepts.

For more detailed information

Bas Buchner, Pieter Dierx and Olaf Waals, "The Behaviour of Tugs in Waves Assisting LNG Carriers during Berthing along Offshore LNG Terminals", OMAE conference, Haldikiki, Greece, July 2005.

MARIN

Offshore LNG operations

waves

The findings

- Optimum wave headings for the berthing and mooring of LNG carriers (close to head waves) are in fact critical beam wave conditions for the assisting tugs. This results in large roll motions of the tugs (up to 26.7 degrees for an Hs of 1.9 m).
- Slack tow lines and peak loads often occur, especially when the pull tug is in unshielded conditions. A maximum tow-load of 1870 kN is found in the unshielded Hs of 1.9 m.
- For the push mode the fender loads are high as well. In the Hs=1.9 m condition, the maximum fender load at the LNG carrier hull is 1820 kN when the tug is on the unshielded wave side. Compared to the bollard pull of 500kN this is a dynamic amplification of almost four times. This can be critical for the hull of the LNG carrier. Special measures are necessary for the tug fender design and LNG side construction to account for these type of loads over a large area of the side shell.
- Roll motions, fender loads and tow loads, are influenced by the LNG carrier. If the tug is in shielded conditions, these motions and loads are smaller then in unshielded conditions in which wave amplification can occur (waves higher than the incoming waves due to the combined incoming waves and waves reflected on the LNG carrier).
- Due to the large roll motions and relative wave motions (wave run up and down and the side of the tug), the dummy thrusters of the model were coming out of the water regularly. In reality this will affect the thruster efficiency considerably due to thruster ventilation.
- Crew performance can clearly be influenced by the motions of tugs. Roll motions can be especially critical here. Roll reduction devices such as bilge keels can improve this situation.

34165

Tug in push mode, shielded partially by LNG carrier.

Experience with tugs assisting crude carriers during lightering operations has shown that waves may hamper tug operations significantly. Courtesy PS&PS/M.Scholma.