

Joint Industry Project

Offshore LNG Offloading System



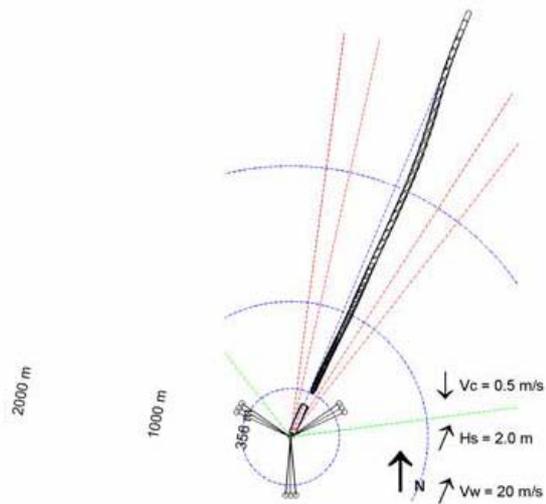
Manoeuvring simulation of crude oil tandem offloading

Some marginal oil fields are situated in regions where flaring of gasses is no longer environmentally acceptable, and where piping the gas to shore is prohibitively expensive. At the same time it is anticipated that in the near future the demand for LNG will increase. Marginal fields become economically viable using floating production and offloading LNG to shuttle tankers for transport to the market. The offloading from an FPLSO (Floating Production, Liquefaction, Storage and Offloading unit) to a tanker is considered to be one of the major challenges in developing a new floating production technology for LNG. This view was shared by a large number of operating oil companies, resulting in a Joint Industry Project (JIP) for the development of a safe and reliable system for offloading LNG from an FPLSO. The JIP focussed on the Boom to Tanker concept of loading arm manufacturer FMC with the FPLSO and tanker in tandem arrangement, and was participated by BHP, BP, Chevron, Eni, Agip, Gaz de France, Shell, Statoil, Texaco and Woodside. The marine operations during tanker arrival and departure were considered to be a vital factor in defining the required minimum distance between FPLSO and tanker. In this context MSCN, with its

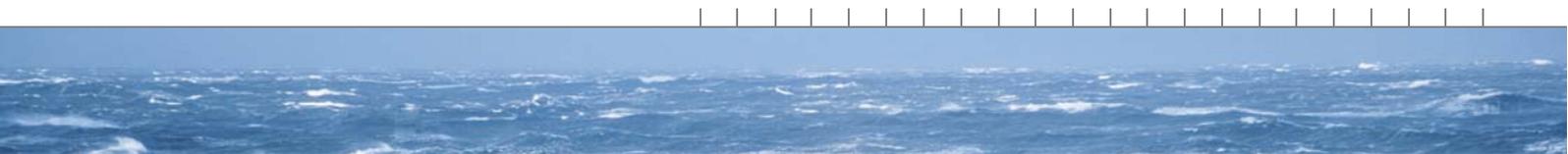
capabilities in the field of manoeuvring simulations, played a significant role.

Operational procedures

MSCN started with a survey of the tandem offloading of oil, based on information in literature and the operational experience from the participating operating companies. Possible operational differences between the offloading of oil and LNG were also identified. The windage areas of LNG carriers are, for instance, significantly larger than those of typical oil tankers. This has an effect on the approach and departure strategies, especially in environments with wind, waves, and current coming from different directions.



Approach for tandem offloading



Fast-time simulations

Based on these types of considerations, various approach and departure strategies were checked by means of fast-time computer simulations with the MSCN ship manoeuvring simulation program. Essentially, the fast-time simulation program is the same as the full-mission, real-time simulation program; the important difference, however, is the fact that the fast-time simulation program is not manoeuvred by people, but through an advanced auto-pilot. These fast-time simulations represent a cost-effective and powerful tool for analysing a large set of strategies and environmental conditions, which is very important in the first phase of the system's development. It also creates the possibility of selecting a limited set of important scenarios to define a future full-mission bridge training program.

With the results of the fast-time simulations it was possible to determine the optimum strategies for various conditions and to define the minimum requirements for the equipment on board the LNG shuttle tanker. Both the type of equipment and required power levels were evaluated. Finally, the simulations gave information about the minimum distance between shuttle bow and FPLSO stern during the approach.

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