Operation control room with towmaster

Aasta Hansteen - Bridging engineering to operations

An impressive operation and an impressive project! Aasta Hansteen highlights MARIN's strategy of linking the engineering phase to the operational phase.

Noël Bovens,
Persijn Brongers &
Dimitri van Heel
n.bovens@marin.nl

In addition to the main feature on Aasta Hansteen, where we interview Dockwise, this article provides more details about MARIN's simulation services for this special project. These cover time domain and full mission bridge simulations. Report addresses the verification study that was undertaken as a preparatory step, plus the various stages of the full mission simulations.

Advance training of the marine operations' team using real-time simulation will take place at MARIN's own facility, which consists of multiple, interactive simulators. MARIN's Nautical Centre MSCN is being used for pilot and tugmaster training, port design studies and for offshore operation studies. Prior to the real-time simulation, a verification study is conducted where the individual components for the simulation are prepared. This study is done with the fast-time simulation tool aNySIM (based on XMF – see related article on page 20), which is specifically suited for conducting desktop multi-body time domain simulations.

Verification study One of the objectives of the verification study is to make sure that

Tug master in action during tow-out manoeuvre

there is an optimal transfer of knowledge from the earlier engineering phase by Dockwise to the operations phase.

A second objective is to model and test all the simulation components and to verify and document their hydrodynamic behaviour. The individual components for the float-over simulations consist of the spar, its asymmetric mooring system (three anchor pontoons, four tension barges, seven mooring lines), the S-Class vessels, assisting tugs and the topside itself. The simulation model of the spar with the mooring system used for the verification study is shown.

aNySIM can accurately simulate the behaviour of multiple floating bodies in conditions of combined swell, wind-seas, current and wind. The combined low frequency and wave frequency motions of each body are calculated in 6 degrees of freedom in the time-domain, using a retardation function approach. During the verification study, aNySIM is used to verify the properties of the complex composition of lines and fenders between the spar, the S-Class vessels and the topside during the mating operation in detail to ensure the realistic behaviour of the complete system. An accurate simulation model is essential for this type of training programme.
The hydrodynamic behaviour of the components of the simulation model is reflected in natural periods and damping of the moored spar and the stiffness of the fender system between the spar and the topside. By means of numerical decay and static load tests, the hydrodynamic behaviour of the components is calculated.
Results of the verification study are documented in a preparation report, which enables Dockwise to verify the simulation model against its design calculations, prior to the full mission simulation training.

Full mission simulations Following the verification study a workshop was carried out, in which the towmaster of Dockwise Hans Bosch, and a team comprising the superintendent, winch operators and tugmasters performed the operation on a set of MARIN bridge simulators. The newly developed DOLPHIN simulator system uses the same modelling technology as aNySIM. This means that the components, which were validated in the verification study, could be imported directly into the simulator database. The workshop programme was jointly developed by MARIN and Dockwise. During meetings the input data was agreed and database development was coordinated. This resulted in a carefully thought-out simulation programme and corresponding set of scenarios. The database was also made available to the towmaster, who could simulate parts of the operation on his laptop using the same simulation software.
In a four-day simulation session the crucial parts of the operation were executed under various weather conditions. Using the DOLPHIN software, scenarios could be amended at very short notice, allowing the programme to be adjusted whenever necessary.

The operations included the composition of the so-called 'catamaran vessel', consisting of the topside of Aasta Hansteen and two S-Class heavy lift vessels. Additionally, the transit with the catamaran vessel was practised with different tug combinations. But in the end, most attention was paid to the positioning of the topside on the spar.

In this phase of the operation the towmaster and superintendent coordinate the use of 10 winches and four tugs to align the two objects. Six bridge simulators were used together to simulate the different stations involved in the operation. This being a one of a kind operation, the simulator proved to be a tool that enabled the operators to get acquainted with the task at hand and to try out different strategies.

The final part of the simulation programme was executed with the topside in place.
In this stage of the operation the two S-Class vessels are manoeuvred away from the spar using tugs.

The objectives of the workshop was to familiarise the Dockwise team with the operation, find best practices and assess the feasibility of each step of the operation. Lessons learned will be used to determine the preferred tug configurations, refine the operation and to prepare an optimum training package for the crews involved. At least two more training sessions are planned before the actual operation is carried out.

On the last day of the workshop, representatives of CB&I (front end engineering and design work), HHI (platform builder) and Statoil (owner and operator) witnessed the simulations. Henning Selstad, Statoil's platform marine operation manager of the Aasta Hansteen, emphasised that these kinds of simulations are the way to prepare for such a complex task. He was very impressed by the capabilities of the simulator and the work done by Dockwise and MARIN so far.

Catamaran approaching spar

Underwater view catamaran and spar