



Simulations for Ichthys LNG project CPF installation

Dolphin simulator software for complex offshore operations

Maritime Operations has vast experience with nautical studies to evaluate offshore operations by using bridge simulators. Today, a new generation of bridge simulator software has proven itself in a nautical study for the installation of the Ichthys Explorer Central Processing Facility (CPF).

Dolphin Simulator Software

Since 2015 MARIN has been using the in-house developed Dolphin simulator software in nautical studies and training. Over the past years MARIN has migrated its engineering calculation tools into MARIN's eXtensible Modelling Framework (XMF) platform. The result is that different XMF based tools can be integrated in one another, functioning as one software tool. The simulator software also uses this XMF code so software packages from MARIN's hydrodynamic toolbox can be included in the real-time simulator.

Conceptual studies can be approached from both engineering and operator perspective. Once the design is completed, a Full Mission Bridge can be used to train the operations and fine-tune the operational procedures. The six degrees-of-freedom manoeuvring models in DOLPHIN take into account the influence of all external effects like wind, waves (first-order motions, wave drift), tidal currents, shallow water, bank suction, ship-ship interaction, tug and mooring line forces and collision forces. The models are water depth/draft dependent. The hydrodynamic effects are calculated with the most advanced hydrodynamic software available.



Simulator view



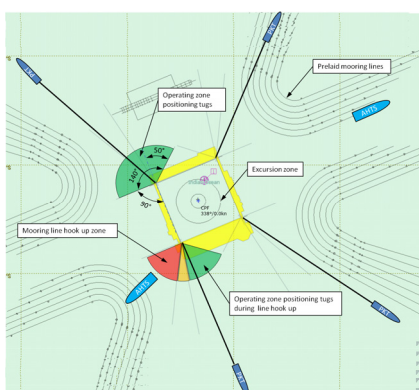
The Ichthys platform

The Ichthys installation project

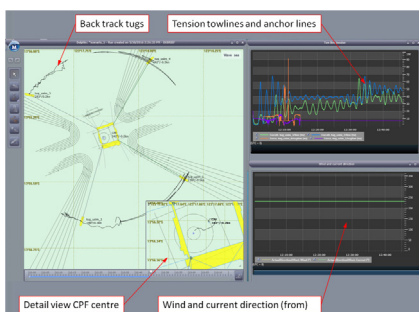
The Ichthys LNG Project Central Processing Facility and a Floating Production, Storage and Offloading vessel (FPSO) will support the development of the Ichthys Field. The CPF is the world's biggest semi-submersible central processing facility. During installation, four tugs keep the CPF in position to allow hook-up of the mooring lines. At the same time, one or two installation vessels pick up the pre-laid mooring lines from the seabed and connect them to the CPF. The most critical phase during the installation is the connection of the first four mooring lines.



Tug simulators



Overview of the installation process



Dolphin User Interface

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Simulations set-up

The verification of the position keeping capabilities of the tugs during the mooring line installation was carried out at MARIN's simulation centre. The positioning master coordinated the operation from a control room and four tug masters operated the position keeping tugs from the compact manoeuvring simulators. The positioning master communicated with the tug masters by VHF. The four positioning tugs were connected to each corner of the CPF. During the mooring line installation, the positioning tugs kept the CPF centre within a certain excursion zone. Meanwhile, the installation vessels hooked up the mooring lines to the corners of the CPF. The positioning tugs had to stay outside the hook up zone in order to give access to the installation vessel, limiting the manoeuvring space. The simulations were setup as workshop in which engineers and nautical experts closely co-operated. POSH Terasea tug captains and positioning masters performed the simulations. Representatives of the participating companies as well as MARIN's nautical experts observed the simulations. The attendance of all these different experts worked out very well. It gave the opportunity to discuss the operation thoroughly, based on the simulation results.

Results of the study

All objectives of the simulations were met. Safe and workable environmental limits were established. The simulations proved that the positioning tugs were able to control the CPF within the excursion zone under the design environmental conditions. The simulations also gave insight in the preferred mooring line hook up sequence and the advantages and disadvantages of simultaneous line hook up. They contributed to a better understanding of the operation and it gave the positioning masters a good opportunity to familiarise themselves with the operation. The workshop facilitated a broad exchange of views on the operation. By observing the simulations the participants gained insight in each other's position and difficulties during the operation.

Advantages of DOLPHIN software

The CPF positioning simulations were setup as workshop, so flexibility and immediate access to recorded data was essential. The new DOLPHIN simulator software allowed additional ships to be entered on the spot, and routes and start settings can be set with a mouse click. The control of ships is intuitive and can be done by automats or using soft screen controls. Of course, it is also possible to couple bridge simulators with hardware controls. Simulations can be set-back in time, re-played and debriefed with immediate access to all recorded data. Any of the parameters, such as line forces, speed, Under Keel Clearance or otherwise, can be put into a time graph for better monitoring over a longer period. This can be done during the run, but the results are also immediately available for debriefing. DOLPHIN incorporates a lifetime of experience with hydrodynamic and nautical research. It is able to simulate the most demanding hydrodynamic phenomena most realistically and it is therefore an extremely powerful tool for both the researcher and the sailor. It can be used to develop 'the operation' from the conceptual phase to the operational phase.