Aerial view. Simulation of the complete operation

Dockwise pushes the boundaries in remarkable Aasta Hansteen T&I project

Several years of preparations are supporting the incredibly complex Aasta Hansteen Transport & Installation project, which will culminate in a unique catamaran float-over operation. In light of this MARIN has been contracted by Dockwise, a wholly-owned subsidiary of Royal Boskalis Westminster N.V., to carry out a whole range of simulation services. The two are working closely together to create a dedicated training programme for the Dockwise team.

Hans Bosch (left) and Bas Polkamp (right)

With a length of 198 m, diameter of 50 m and operating displacement of approximately 150,000MT, the Aasta Hansteen platform will be the world's largest spar hull and the first of its kind on the Norwegian Continental Shelf. The Statoil operated platform is a spar-FPSO with gas production through SCR risers and 25,000m3 of storage capacity for condensate. The Aasta Hansteen gas field is owned by Statoil, together with Conoco-Phillips, OMV (Norge) and Wintershall.

Being built at Hyundai Heavy Industries (HHI) in South Korea, the platform is set to be transported by two of the world's largest heavy-lift carriers, the Dockwise Vanguard (spar) and Dockwise White Marlin (topside), and installed in water depths of more than 1,300 m.

Bas Polkamp, Dockwise Senior Project Manager and Towmaster Captain Hans Bosch, outline the importance of simulation exercises, especially for the intricate catamaran float-over operation.

Aasta Hansteen has to be one of the most complex offshore projects ever carried out, pushing the boundaries in every sense. The topside (100 x 50 x56 m) alone weighs 25,000MT, while the spar hull weighs 47,000MT and is 198 m long and 50 m wide. Additionally, the location itself is in challenging waters, with depths of a staggering 1,300 m plus. The 52,183MT Dockwise Vanguard is also a unique vessel and has been designed to be able to handle a spar hull in a horizontal position.

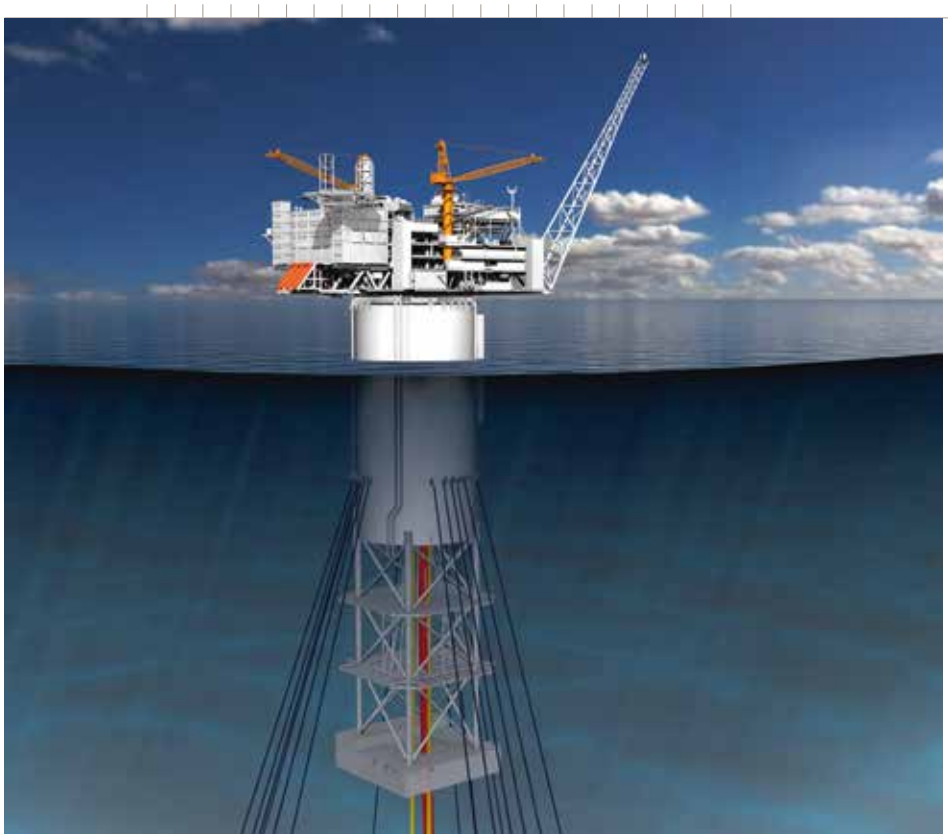
Unimaginable forces Mr Polkamp explains that Dockwise's core activity involves moving large production platforms or floating structures using its fleet of semi-submersible transport vessels and installing large topside facilities on fixed jackets and floating structures so it is well used to handling these immense structures. But despite decades of experience, this project is still in a league of its own.

"Given the huge structure, moving and installing it involves almost unimaginable forces. And when it comes to installation, the sea state, currents, wind and waves are major factors and this makes the need for simulation exercises an absolute necessity." He explains how the T&I will be carried out. A key part of the project is the catamaran operation, and although Dockwise has performed this delicate procedure in the past, the Aasta Hansteen takes it to another level. Dockwise has to transport both the topside and spar hull to an inshore location near Stavanger, Norway and combine the two elements in a state-of-the-art float-over operation. "The location was chosen because the fjord gives protection against swell, waves and other environmental actions and at the same time provides sufficient depth for the spar hull." As well as this, Dockwise has to transport the living quarters from the Netherlands to Ulsan, South Korea.

Following on from the transport of the living quarters, Dockwise Vanguard firstly has to carry out the horizontal transport of the spar hull from the yard in Korea to the fjord near Stavanger. This hull will be upended and submerged (the spar hull will have a free-board of 6 m when 'ready for mating' with the topside and will eventually be submerged 198 m) by Technip and installed in an anchor spread to fix it to the seabed. The hull is then ready to accommodate the topside. Dockwise will then carry out the next phase and transport the topside from South Korea. Dockwise' new vessel and one of the larg-est in its fleet, White Marlin, will carry out this transport and then the topside will be installed on the hull.

Topside mating operation However, because Dockwise cannot sail its ship over the spar hull, an alternative approach had to be designed for the installation of the topside. "We will be using two of our smaller, Swan (S-Class) vessels. Large steel nodes will be mounted on the topside and once White Marlin arrives in Norway with the topside, the two S-Class vessels will manoeuvre alongside. The two vessels will have been fitted with four enormous support structures for the nodes, which include leg mating units. They are tailored precisely to manage the weight of the topside and the prevailing dynamic of wind, weather, waves and currents."
Once the two ships have been positioned either side of the White Marlin, they are raised and Dockwise will retract the White Marlin to create the 'catamaran configuration' by ballasting the White Marlin down and the two Swan Class vessels up. This results in a catamaran structure with the topside linking the two hulls. Dockwise then deploys tugs to move the topside into position above the spar hull and couple them together. "Although this is not the first time we have deployed this catamaran configuration, it is the first time we have been doing it with such a huge 25,000MT unit," stresses Mr Polkamp.

12 vessels Captain Bosch explains that some 12 vessels will be involved, including the Dockwise Vanguard, two Swan Class, White Marlin and then four tugs will be rigidly connected and two auxiliary tugs will assist, alongside smaller line handlers and personnel transfer vessels.



Artist's impression. The entire structure — the upper and lower parts — make up the spar. The lower part is the spar hull — the upper part is the spar topside.

"This is precision work. We first have the transfer from the White Marlin onto the two S-Class, we take the White Marlin out of the catamaran phase and then there is the moment when we are physically moving over the spar. It is the combination of physically bringing her over the spar by manoeuvring but also by connecting all the mooring lines to fix it in its final position."

Years of preparation, precision calculations and simulation excercises are all vital to the success of the project, they both stress. MARIN is involved in several aspects of the project. The scope ranges from a motion verification study, to ensure the proper transfer of findings from the engineering phase to the operations phase to simulating the transfer of the topside from the White Marlin to the two Swan vessels, to create the catamaran configuration. MARIN and Dockwise will also simulate towing the catamaran vessels to the spar using the tugs and installing the topside on the spar via the float-over method. Crucially, the simulations will look at various ways about how all the procedures can best be done given the operational parameters (wind, wave, current) and the available catamaran and tug capabilities.

Matching reality Mr Polkamp says that it is vital that engineering matches reality. "We feel that MARIN is better than competitors at creating reality in its simulations and at engineering the environmental parameters into models.

"Essentially, we wanted MARIN to help us examine three critical aspects – manoeuvrability, the feasibility of the marine spread and how the team behaves. It is all about risk mitigation, we wanted to assess the configuration with the rigid-connected tugs, manoeuvrability and how we can best position the vessels - the whole dynamics of the configuration."

Simulations are also important as a marketing tool, adds Mr Polkamp. "This project has many of the major players involved. We are keen to show them that we deliver state-of-the-art engineering and show them what we are capable of operationally. Both HHI and Statoil are very keen to see the simulation exercises and will be attending some of the training days at MARIN."

Creating the team The simulation exercises are also very important when it comes to building the right team, Captain Bosch emphasises. "With any project there is the added complexity - people. We want to find the best team. We have learnt from other projects where we carried out simulations at a much later stage, that the earlier they take place, the better. Simulations make things run a lot easier. You need to have good cooperation and understand each other. If you simulate in the preparation stages it is possible to get a very good team at an early stage of the project. Everyone involved has to know exactly what they are doing."

Several different workshops and dry runs will take place at MARIN's headquarters. In May, a Demonstration Day was held for the captains, superintendents, marine engineers and the first workshop took place in October for the four tug captains and winch operators. The simulation training exercises will eventually include the captains from the heavy lift vessels and the S-Class, winch operators, the superintendent, tugmasters, marine engineers, ballast engineers and Captain Bosch as lead towmaster.

"The many simulation exercises at MARIN are a vital part of our preparation and good preparation is 90% of the success of any project. We should do this a lot more in our industry!" they stress.

Transport of the hull of the Lucius spar (2013).