SIEMENS

Ingenuity for life

Marine • Energy and utilities

Twin Marine Heavylift

Marine contractor uses Simcenter STAR-CCM+ to analyze the effects of buoyancy tanks on vessel stability

Product

Simcenter

Business challenges

Transport extreme-weight offshore platforms

Design new marine lifting systems to help dismantle offshore platforms

Keys to success

Use Simcenter STAR-CCM+ to analyze complex water forces and course stability issues for heavy lifter

Understand interactions between buoyancy tanks and ship's hull

Results

Validated that Simcenter STAR-CCM+ CFD techniques can be used to predict the complex phenomena associated with marine lifting systems

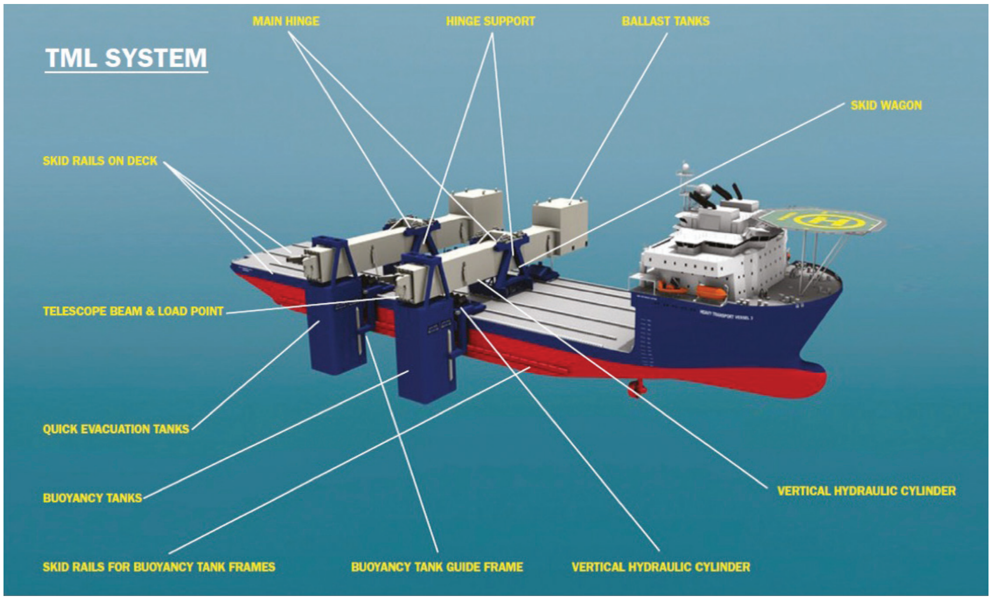
Indicated a periodic pattern of flow around the hull tanks

Siemens Digital Industries Software solution enables Twin Marine Heavylift to predict complex phenomena

Extreme weight lifting

Twin Marine Heavylift AS (TMHL) focuses on cost-effective and safe marine services and operations in the offshore oil and energy industry. TMHL developed the Twin Marine Lifter (TML) system for installing and removing extremely heavy objects, such as offshore platforms, topsides (the part of the platform above the water) and jackets (the part of the platform below the water), for weights of up to 34,000 tons.

Transporting platforms from offshore to onshore locations for dismantling and recycling is cheaper and more environmentally friendly than destroying them offshore. TMHL developed a two-ship system: each ship had four rectangular buoyancy elements on one side, designed to take part of the platform weight as it was lifted. Once raised, the platform could be placed onto a larger transport vessel. Each ship is 435 feet long and 131 feet wide with a transit draft of 17.5 feet. The buoyancy tanks have a



Schematic of a twin lifter vessel.

Illustration of TML in action.

DNV GL used Simcenter STAR-CCM+™ software from product lifecycle management (PLM) specialist Siemens Digital Industries Software, to perform computational fluid dynamics (CFD) simulations on the twin lifter geometry.

rectangular section of 33-by-39 feet. In transit conditions, the draft of the buoyancy tanks is about 29 feet.

The presence of the buoyancy tanks, large blunt bodies at the side of the ship, would have a significant influence on the resistance and course stability during transport. Vortex shedding was certain to be an issue for flow analysis. In addition, the interaction between the buoyancy tanks and the ship's hull was another problem to consider.

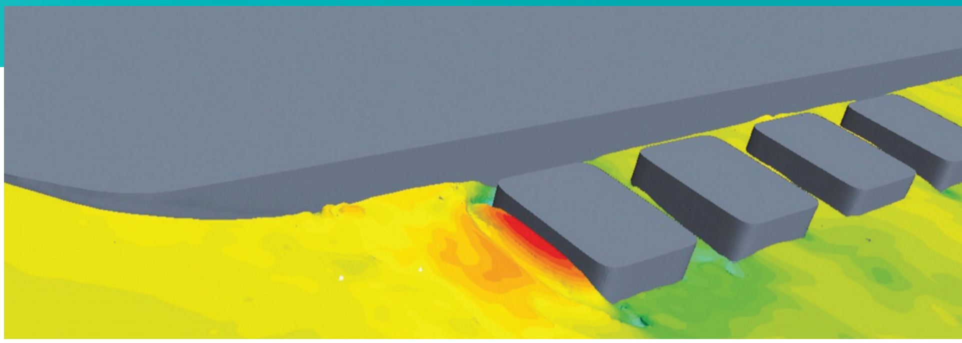
TMHL called on DNV GL, an international certification body and classification society with expertise in technical assessment, advisory and risk management, to assess the viscous resistance in calm water, forces on the buoyancy tanks and course stability.

Computational fluid dynamics simulation

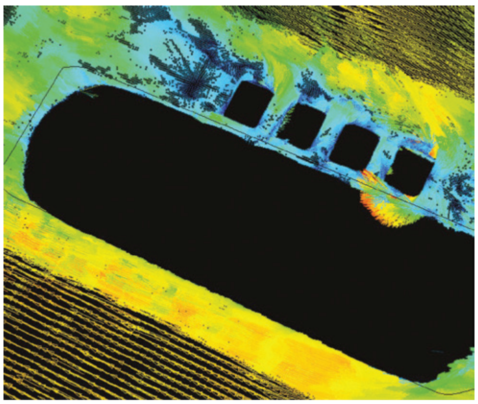
DNV GL used Simcenter STAR-CCM+™ software from product lifecycle management (PLM) specialist Siemens Digital Industries Software, to perform computational fluid dynamics (CFD) simulations on the twin lifter geometry. Simcenter STAR-CCM+ is part of the Simcenter™ portfolio, a comprehensive suite of simulation and test solutions for predictive engineering analytics. Two grids were used to check the sensitivity of the results to grid coarseness, each using around 4 to 5 million trimmed cells with prism layers around the hull and tanks; and increased refinement in their vicinity.

The prescribed ship motion was advancing head-on with no incidence angle to the flow. The simulations were performed for velocities of 3, 5, 7 and 10 knots. The free surface was not considered for the 3- and

DNV GL's analysis validated that Simcenter STAR-CCM+ CFD techniques can be successfully used to predict complex phenomena such as those found in innovative marine designs like the TML system.



Free surface around the hull and tanks at 10 knots.



Velocity vectors on the free surface.

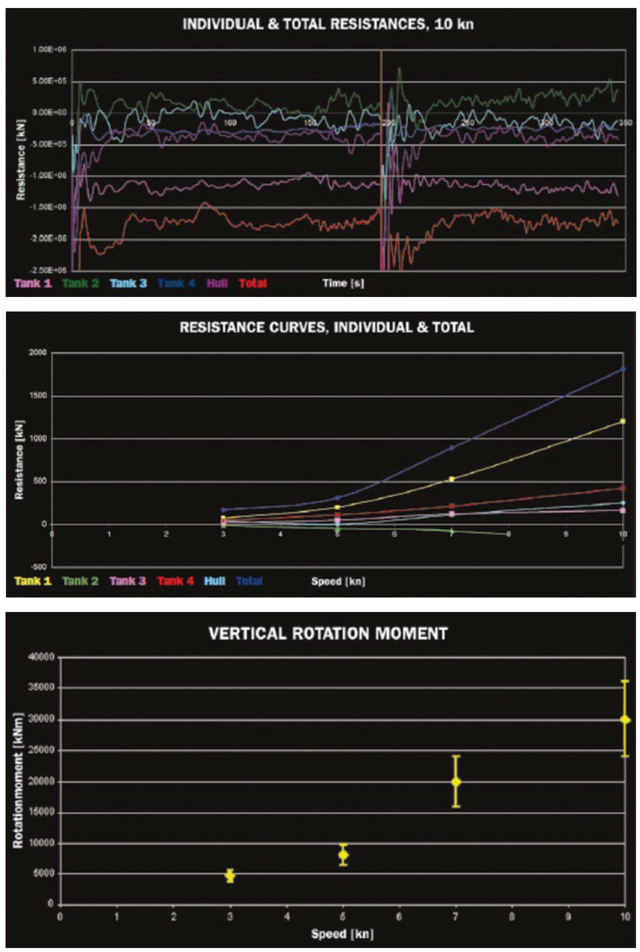
5-knot simulations. The ship and tanks were not allowed to sink and trim; they were considered on even keel.

Assessing results

The presence of the tanks made it difficult to validate the results against traditional hull predictions, so a decision was made to check the methodology by performing a simulation of the bare hull without tanks and with no free surface effects. Therefore, these results referred to the viscous resistance only, and as such could be compared with empirically based calculations using the International Tank Towing Conference (ITTC) 1957 formula.

As the ITTC 1957 formula refers to a flat plate, a shape coefficient must be employed. The value of the shape coefficient was estimated to be 0.35 for a perfect match with the results. But considering that a typical value for very-large crude carriers (VLCC) is about 0.25, and in this case the VLCC bodies were more slender and streamlined than average, the value of 0.35 seemed realistic.

The simulation results showed strong vortex shedding due to the tanks and the flow interaction between them. As a consequence, the individual and total resistance components displayed a highly



Resistance and rotation curves.

Transporting platforms from offshore to onshore locations for dismantling and recycling is cheaper and more environmentally friendly than destroying them offshore. TMHL developed a two-ship system: each ship had four rectangular buoyancy elements on one side, designed to take part of the platform weight as it was lifted.

Solutions/Services

Simcenter STAR-CCM+
siemens.com/simcenter

Customer's primary business

Twin Marine Heavylift AS, based in Stavanger, Norway, was founded in July 2010. The company is a key international player in the marine heavy lift, construction support and heavy transportation markets, and owns and manages Twin Marine Lifter (TML) marine heavy lift systems and DP3 multipurpose transportation vessels (MTVs).

Customer location

Stavanger
Norway

irregular time pattern, as shown as shown below. The jumps in the curves close to 200s were due to the change of meshes.

The most interesting feature is that tank one (the forward-most tank) displayed the highest resistance, accounting for about 66 percent of the total resistance. It is also notable that tank two, which is located right behind tank one, displayed a positive resistance value as it was sucked forward in the wake of tank one. Tank three displayed the expected sign of resistance, though its value was low, whereas there was larger resistance in tank four. The time-averaged, stabilized values of the individual and total resistance showed a regular increase with velocity and confirmed the observations that tank one contributed the most to the total resistance and tank two was sucked forward by tank one.

The rotation moment was rather large, and increased significantly with the velocity. A quick calculation indicated that at a speed of 7 knots the ship should sail at an incidence angle of approximately 9 degrees. About 12 percent of the installed thrust would be required to keep the ship on a straight course. Considering the quick and irregular oscillations of the vertical rotation moment, maintaining a dynamic course was mandatory.

Providing useful results

DNV GL's analysis validated that Simcenter STAR-CCM+ CFD techniques can be successfully used to predict complex phenomena such as those found in innovative marine designs like the TML system. The analysis provided useful results in a reasonable period of time and indicated a periodic pattern of the flow around the hull tanks. The flow was dominated by vortex generation due to the presence of the tanks, influencing the resistance value for each tank and for the ship.

The analysis provided useful results in a reasonable period of time and indicated a periodic pattern of the flow around the hull tanks.

Siemens Digital Industries Software

Americas	+1 314 264 8499
Europe	+44 (0) 1276 413200
Asia-Pacific	+852 2230 3333

siemens.com/software