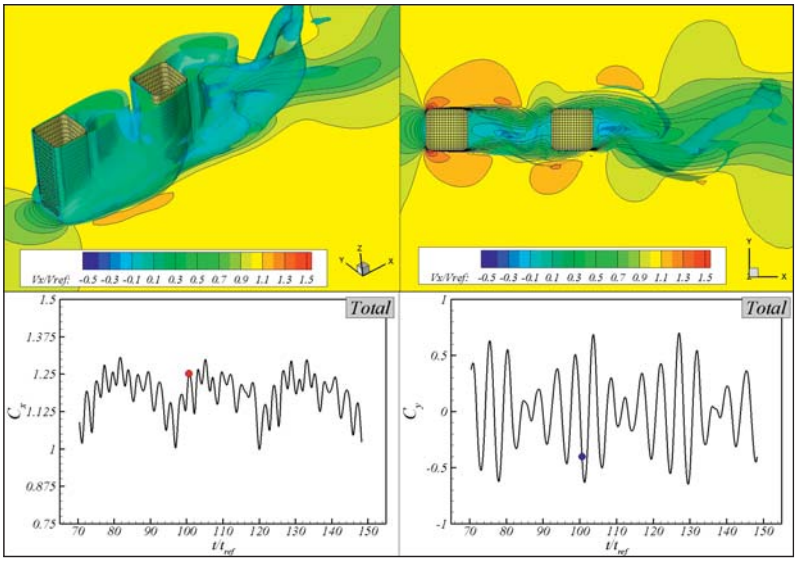

Figure 1: Calculated flow field and forces on a semi-submersible structure. Top: Vorticity iso-surfaces and velocity field contour plot at a specific dimensionless time (t/t_{ref}=100). Bottom: Time history of drag and lift forces.

New code FreSCo reveals what goes on under the surface

FreSCo is a new unsteady, multi-phase, viscous flow CFD code being developed by MARIN's R&D department. FreSCo's most recent findings are presented here.

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Offshore constructions are usually arrays of streamlined bodies, combined with blunt objects, assembled in complicated geometric layouts. Flows are unsteady, highly vortical, with different spatial and time-scales ruling the flow patterns. These structures are often subjected to violent, free-surface flows, motions and/or vibrations. Free surfaces can be seen but the complex flow phenomena occurring underneath, are hidden. Numerical simulations can be used to reveal and understand them and to help avoid the most detrimental ones. Following a long and successful tradition with in-house codes, (e.g. PARNASSOS, RAPID), MARIN chose its new in-house, CFD code FreSCo to predict and understand the offshore-related flow phenomena.

Standing for "Free-Surface-Code", FreSCo was started in 2005 as a joint development by HSVA, TUHH and MARIN, within the EU project VIRTUE. FreSCo is being intensively used in the new 256-processor, Linux-cluster of MARIN and it has already been validated for several offshore/ship viscous flow problems: pipes and risers, impact loads on objects [1], viscous free-surface flows [1], current loads on floaters (see article on Current Affairs JIP in this issue of Report), submarines [2] and ships.

Currently, there is a focus on the calculation of current and wind loads around semi-submersibles and mono-hull structures. Results obtained with FreSCo show several interesting trends, for instance: 1) the flows are highly unsteady, and therefore, a steady simulation will provide a very crude estimate of the loads on the structures; 2) the space and time numerical resolutions and consequently, the computational resources needed, are large; 3) when performed correctly, unsteady simulations can give results with differences to the experiments in the order of 10%; 4) scale effects can be assessed; 5) aspects such as distance between components, draught, shape of the columns, shielding, have a large effect on the flow pattern and forces. These features can be studied easily and economically using FreSCo together with MARIN Linux Cluster, see figure 1.

Loads on LNG carriers and scale effects for semi-submersibles are now under study. Soon, MARIN aims to use CFD to complement tests for current loads done in its basins and to offer this service to clients.

[1] Vaz, G., Jaouen, F., Hoekstra, M. "Free-Surface Viscous Flow Computations. Validation of URANS Code FreSCo". OMAE2009, Honolulu, Hawaii, USA. June, 2009.
[2] Toxopeus, S., Vaz, G. "Calculation of Current or Manoeuvring Forces Using a Viscous-Flow Solver". OMAE2009, Honolulu, Hawaii, USA. June, 2009.