FLUENTNEWS

WORLD LEADERS IN COMPUTATIONAL FLUID DYNAMICS

NEWSLETTER *Volume 10, Issue 2 • Winter 2001*

FLUENT 6.0: Tuned to Your Goals

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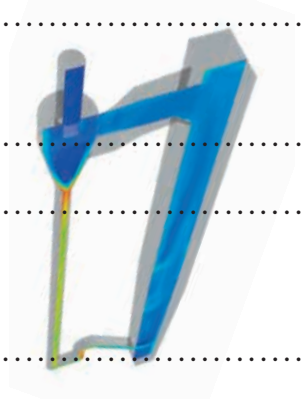

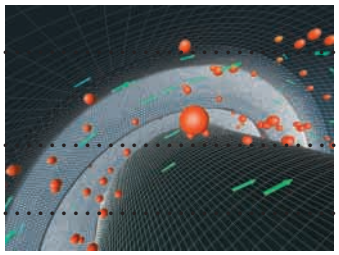

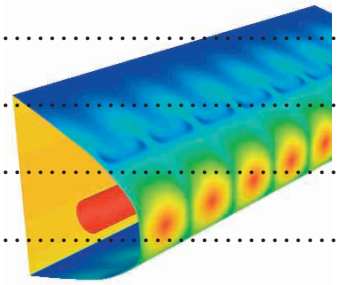

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The site is specifically designed for user discussion of each new story, article, or question, thereby acting as a support resource. The authors have several years' experience in the commercial CFD business with backgrounds ranging from grid generation to solver and model development to post-processing.

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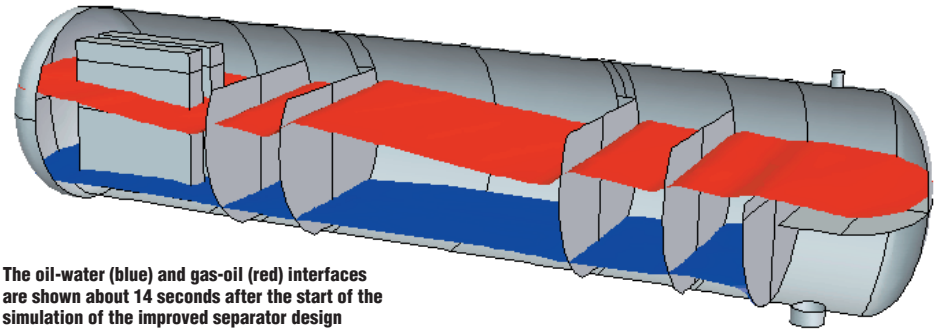
Oil-Gas Separator on a Floating Platform at Sea

Courtesy of Natco Group Inc.



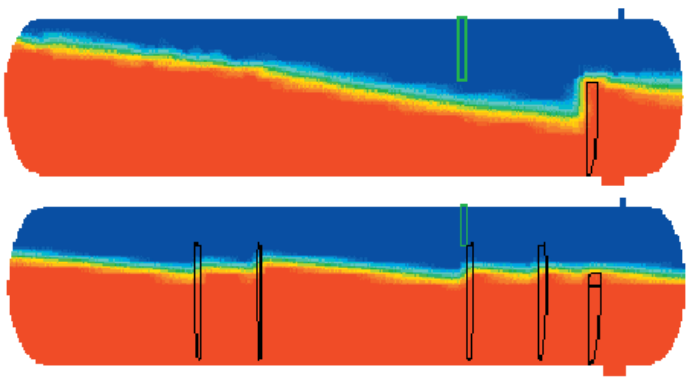
The oil-water (blue) and gas-oil (red) interfaces are shown about 14 seconds after the start of the simulation of the improved separator design

Floating offshore platforms are used around the world for the production, storage, and offloading of crude oil and derivative products. Separation, one component of the production phase, poses a unique challenge on a floating platform because of the inevitable wave motion to be expected at sea, which is present even in calm weather conditions. By simulating the flow inside a gas-oil separator on a production platform, engineers at Natco Group Inc. have been able to understand and improve its performance under different sea conditions.

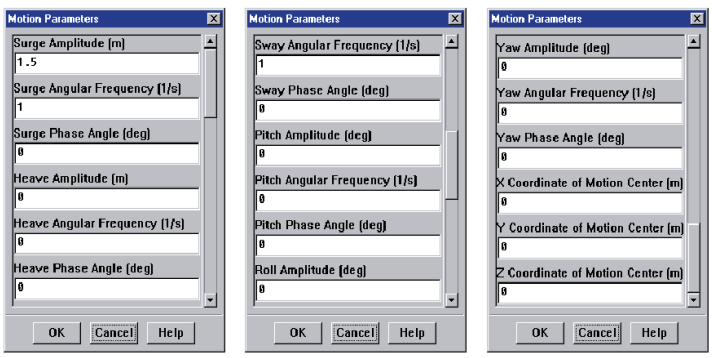
A floating platform can experience six degrees of wave motion. These are known as surge, sway, and heave (axial motions), and pitch, roll, and yaw (twisting motions). When combined, these motions act to mix the gas, oil and water in the separator, which is counter-productive to separation. Since separation occurs as the gas, oil, and water flow through the unit, reduced separation efficiency (resulting from mixing) means that the separator has to be larger in order to allow enough time for optimum separation to occur.

Using the volume of fluid (VOF) model in FLUENT, Natco engineers were able to simulate the transient sloshing motion of oil, gas, and water inside a separator. Both normal and storm sea states were studied. The six degrees of motion were incorporated through user-defined functions. A custom panel was developed that allowed the engineers to input the characteristics of the wave motion using the graphical user interface.

Baffles are normally used inside this type of separator to dampen the sloshing that arises from the complex wave motion, and thereby reduce the mixing of the fluids. CFD simulations were run with and without baffles to study their effect on sloshing and mixing. When the separator was simulated without baffles, severe sloshing was predicted, as expected. When the separator was simulated with a conventional baffle design, it was found that the baffles were not able to substantially suppress the sloshing motion and resultant oil-gas mixing. In fact, if not properly placed, the baffles could aggravate fluid short-circuiting in the separator. A new baffle system was then proposed that included strategically placed perforated plates. When this was modeled, the results showed that the modified design led to a considerable performance improvement for the separator. The improvement was good enough that the separator design could be based entirely on the use of baffles. Other more complex and expensive internals were not required to achieve the goal of suppression of wave-motion induced sloshing. The cost savings resulting from this redesign are now being passed on to Natco's customers.



The sloshing (shown on a vertical plane) is much worse without internal baffles (top) than with them (bottom)



The panels created through user-defined subroutines allow the user to input the six degrees of motion