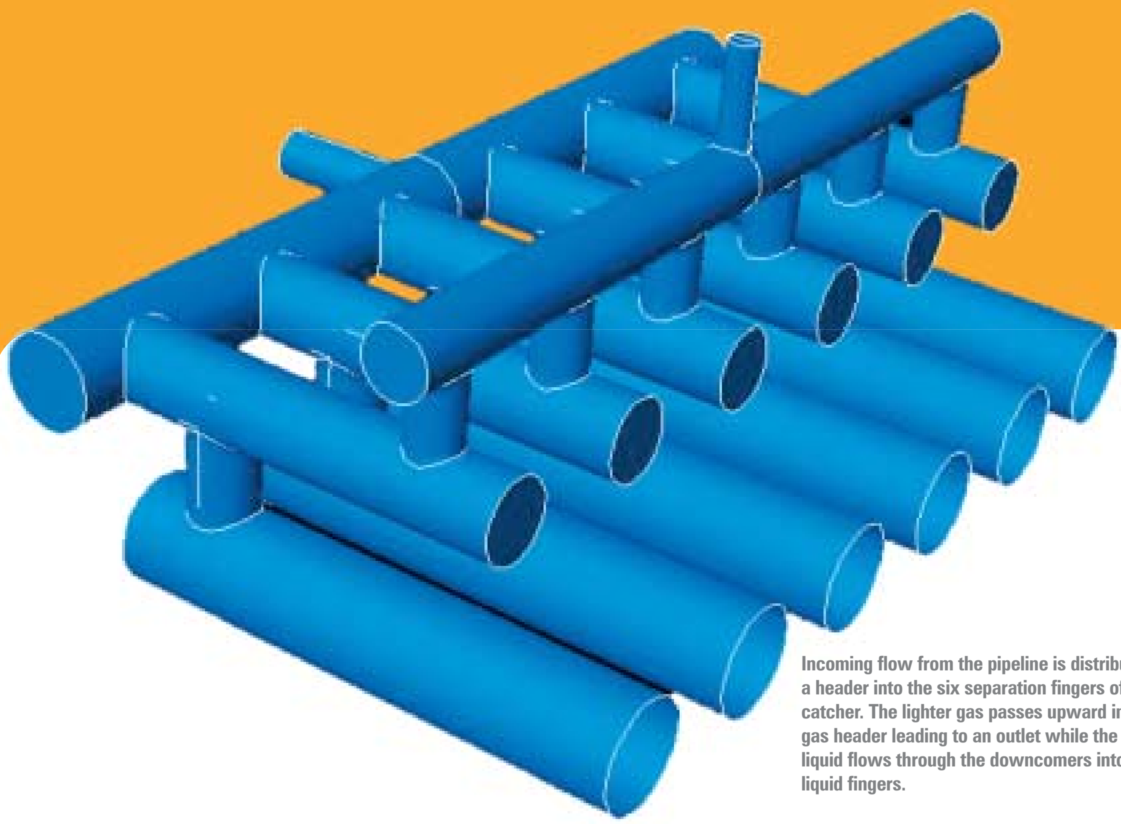

Incoming flow from the pipeline is distributed by a header into the six separation fingers of the slug catcher. The lighter gas passes upward into a gas header leading to an outlet while the heavier liquid flows through the downcomers into the liquid fingers.

Debottlenecking the Hannibal Slug Catcher

ANSYS CFX simulates transient two-phase flow in a complex pipe network.

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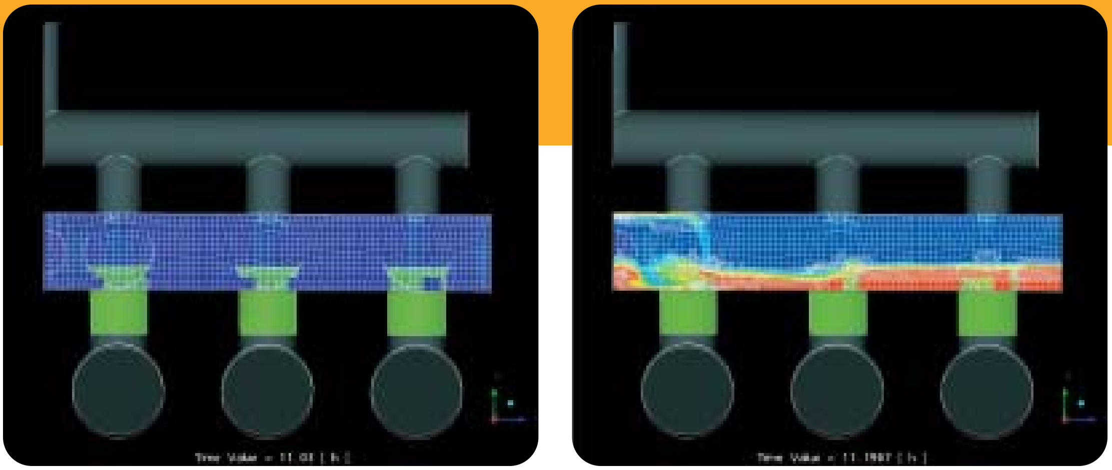
When petroleum company BG Group commissioned Genesis Oil and Gas Consultants to study the feasibility of increasing gas production from their Miskar concession off Tunisia, it became apparent that a major bottleneck could be the slug catcher at the end of the Miskar pipeline in the on-shore Hannibal terminal.

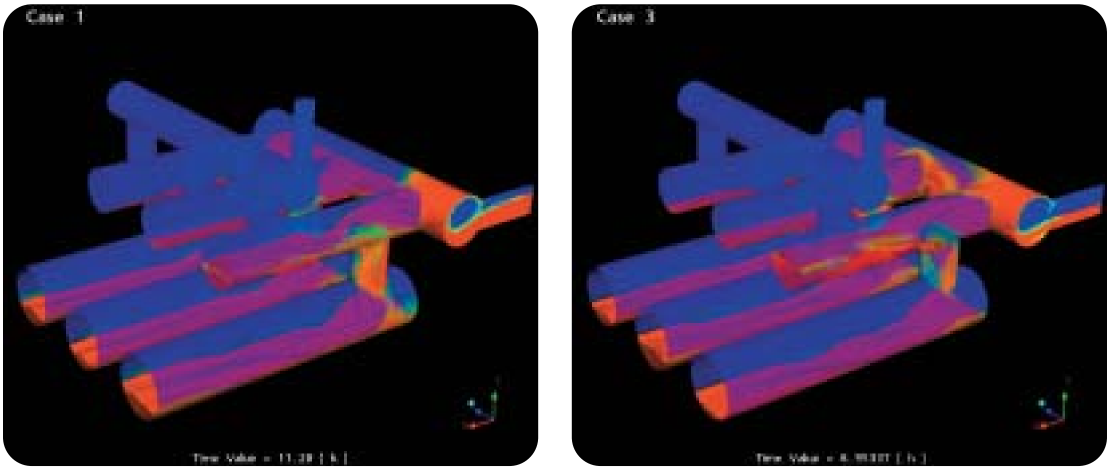
The slug catcher receives a mixture of production gas and liquid condensate from the pipeline into six separation pipes or "fingers," where gravity acts to separate the two phases: the gas passing upward to the gas outlet with the heavier liquid falling through short downcomers into long liquid fingers, where it is stored. If the surge of gas and liquid in the 20-minute period after daily cleaning ("sphering") of the pipeline is too great, then liquid could overflow into the gas outlet causing problems downstream. So Genesis needed to know if the existing slug catcher has the capacity to cope with higher flows of gas and liquid. If not, then a new slug catcher would have to be built at an estimated capital cost of $25 million.

To assess the capacity of the slug catcher, Genesis asked ANSYS to simulate the time-dependent two-phase fluid flow in the system using the Eulerian multiphase flow model in ANSYS CFX software. To forecast liquid overflow reliably, the CFD model needed to track the motion of the gas-liquid interface accurately throughout the pipe system. Normally, the size of mesh required to do this would make a long transient simulation intractable but, by using transient mesh adaption to concentrate cells into the region around the interface, we were able to reduce the total mesh size by an order of magnitude.

The peak liquid levels were predicted for the original pipeline gas/liquid flow rate and for a flow rate increased by 45 percent. It was found that the



Example of transient adaptive meshing to resolve the gas–liquid interface, where blue represents gas and red represents liquid.



Comparison of maximum liquid height for current and 45 percent higher flow rate. In both cases, no liquid overflow to the gas outlet is predicted.

maximum height of the liquid in the separation fingers increased significantly when the flow rate was increased but no catastrophic overflow of liquid into the gas outlet was found. As a result, it was concluded that the existing slug catcher will be able to cope with the increased pipeline capacity.

The innovative nature of this work was recognized when the BG Tunisia team, including the present authors, received an award under the BG Group Chief Executive Innovation Awards Scheme for 2004. The submission was the winner in the “Alliance with an External Party” category, one of only three winning projects from over 100 entries submitted. ■

This view of the slug catcher at the BG Hannibal terminal shows the inlet pipe and header as well as the short separation fingers above the much longer liquid fingers.