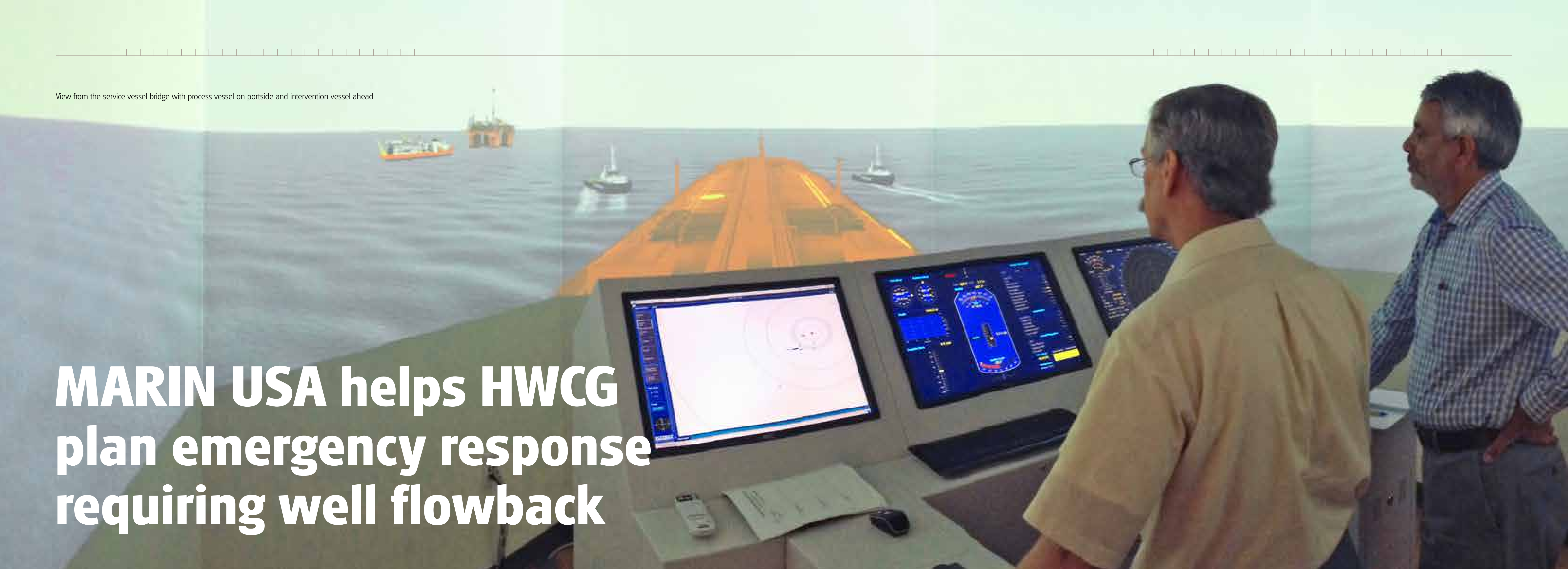

View from the service vessel bridge with process vessel on portside and intervention vessel ahead

MARIN USA helps HWCG plan emergency response requiring well flowback

Numerical analysis and bridge simulation are being used to develop a deepwater containment response system to ensure that there will never be a repeat of the Deepwater Horizon incident.

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The Helix Well Containment Group LLC (HWCG) is a consortium of 16 deepwater operators. HWCG was founded in the aftermath of the Deepwater Horizon event with the mission to develop a comprehensive and rapid deepwater containment response system for the Gulf of Mexico. HWCG worked with MARIN USA to study storage and offloading aspects of the containment system in a cap and flow scenario. Numerical analysis and bridge simulation work carried out by MARIN's office in Houston helped determine the feasibility and operating limits for loading and offloading operations, as part of an emergency response to a well blowout requiring flowback.

Subsea blowout response Two dual ram capping stacks are the core components of HWCG's subsea incident response system. These capping stacks can be deployed to effectively shut-in and contain a subsea blowout. In a situation where extreme well pressure may prevent a complete shut-in, a flow and capture containment system will be deployed. Using the flowback method, hydrocarbons are collected and safely transported via risers and flow lines from an intervention vessel to a process vessel, and via marine hoses to a storage vessel on the surface.

Both the process vessel and intervention vessel are station keeping with dynamic positioning (DP) systems, and all support tugs are DP2 class. The storage vessel is not DP but instead, is held at position by two DP2 tugs at the bow and a holdback tug at the stern. When the transport (service) vessel arrives, the holdback tug will disconnect from the stern, and assist with the heading of the storage vessel. The service vessel will approach with two escort tugs, one push-pull tug at the bow and a holdback tug connected to the stern.

A full time domain model with all the DP systems and hawser connections was set up in MARIN's software tool aNySIM. The model helped to determine the optimum layout and weather limits for this operation. To prohibit DP system interference, each support tug is station keeping to an earth fixed position set by the mooring master. The tug lines are sufficiently long to restrain the dynamics of the tanker, while giving it sufficient freedom to prevent peak line loads.

Vessel handling When a change of weather requires a significant heading change of a hose connected field vessel, all other connected vessels will need to respond with the appropriate heading and position change. This rotation around the well requires the production vessel and tug assisted storage vessel to move along a predefined track within the bounds of the floating hose as shown in the schematic below.

Desktop numerical analysis simulated hawser loads and holding tug tow line loads for two sizes of storage and offloading tankers within a range of wind, current, wave conditions and directions. The desktop study raised concerns about the ability to coordinate the movements of five vessels – two large tugs, a stern holdback tug, the storage vessel, and the transport (service) vessel. MARIN suggested that HWCG make use of MARIN's Houston bridge simulator. An AET Lightering mooring master then directed the operations of the tugs, storage and service vessels.

The hydrodynamic models of the storage and offloading tanker and holding tugs were then input into a bridge simulator to allow real-time simulation under various conditions. An experienced tanker offloading mooring master, DP process vessel OIM (Offshore Installation Manager) and positioning tug captains were brought in to participate. They used the bridge simulators to confirm feasibility and develop procedures for positioning and relocating the storage tanker using tugs.

Predefined tracks for weather required rotations around the well

Weather operating windows, hawser design and tug characteristics predicted by the numerical analyses were modified as a result of the bridge simulation work. The bridge simulator is now available for the training of emergency response vessel personnel. The study shows how integrating numerical analysis, bridge simulations and operator input helps solve complex operational design challenges.