OCEANIC CONSULTING CORPORATION

Making Waves

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Berthing Studies for LNG Carriers in the Calcasieu River Waterway

Oceanic recently teamed up with Infinity Engineering of New Orleans and the Centre for Marine Simulation at Memorial University to perform a comprehensive study of the new Cameron LNG Terminal on the Calcasieu River, Louisiana. The project will see the creation of a large turning basin adjacent to the main river channel, with two berths for LNG carriers of up to 200,000 cubic meters capacity. The study, funded by the Calcasieu River Waterway Harbor Safety Committee, had two main components. The first component was a passing study to determine if the mooring system was adequate when large deep-draft vessels traverse the channel, with wind and current forces also present, and the second was a ship allision study. The first module involved Oceanic constructing a 1:45 scale hydraulic model of a section of the channel, the turning basin and the berths. The Institute for Ocean Technology's Offshore Engineering Basin was used to model the river with current. The passing ship was towed in the channel at fixed speeds ranging from 3 to 7.5 knots past the moored vessels. The passing vessel traversed upstream in a loaded condition, and downstream in a ballast condition. Two different LNG carriers, of 138,000 and 200,000 cubic meters capacity, were instrumented to measure surge, sway, and yaw. Part of the physical model study was to spatially survey the current profile in both the channel and the turning basin. A numerical model of the channel was also created using the Computational Fluid Dynamics (CFD) code FLOW3D, and was correlated with the experimental test results.

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FLOW3D was then used to predict the flow for a 1 knot current in both ebb and flood directions. The passing loads were found to be a function of the speed through water as well as the relative orientation and displacements of the moored and passing vessels. The study also found that the moorings could be treated independently: a second vessel on the other berth does not affect the results. The normalized passing function curves were used by Infinity Engineering to numerically model the prototype mooring using Tension Technology's OPTIMOOR program. OPTIMOOR solved 3 degree of freedom motions in the time domain, using externally applied wind and current forces as well as the hydrodynamic loads from the passing vessels. This program uses the non-linear characteristics of the mooring hawsers and fenders. The wind force was applied at seven different headings relative to the berth, and the line tensions were monitored as the vessel passed in the channel; the maximum line tension was determined for each scenario. Infinity considered various layouts to optimize the surge and sway restraint. The OPTIMOOR program was then used to provide guidance to the Calcasieu River Waterway Harbor Safety Committee as to the maximum safe transit speed for various vessel sizes, in differing current and wind conditions.

The second part of the study, a ship allision study, was conducted by the Centre for Marine Simulation and two members of the Committee. Twenty-nine simulations were conducted on the Centre's NMS90 full mission bridge ship simulator. The channel current information was obtained from the physical model tests and the CFD modeling. Two simulated target vessels were moored at the north and south terminal as ships in the main channel made their way past the terminals. At an inopportune moment, the passing ship suffered a loss of steerage, or propulsion, or both. The captain, an experienced river pilot and a member of the Calcasieu River Waterway Harbor Safety Committee, then took several corrective actions to try to avoid the allision with moored LNG carriers. The simulations were conducted with differing directions, wind, and current.

Proposed Cameron LNG Terminal.

Four different passing ships were used: a Panamax tanker, a MOSS type LNG carrier, a product tanker, and conventional and azimuth-stern-drive (ASD) tugs. The study concluded with specific recommendations about the number and type of tugs required to safely navigate vessels past the terminal.

Sub-critical Vortex Induced Vibration Testing

The demand for Oceanic Consulting Corporation's (OCC) small-scale vortex induced vibration (VIV) test apparatus has continued since its development. Recently, OCC completed another VIV suppression test program to evaluate fairing designs for potential use on British Petroleum (BP) drill rigs and floating production platforms such as *Thunder Horse*. A comprehensive test program was undertaken to evaluate various contractor-supplied fairings. Several fairing parameters, including chord-to-diameter ratios, were tested, along with several leading and trailing edge variants, to evaluate the sensitivity of each change. Bare pipe tests were also conducted to provide a reference baseline. Based on the test results, a number of fairing configurations were selected for future development.

OCC's small-scale VIV rig offers clients an opportunity to evaluate multiple small-scale VIV suppression devices in an efficient, cost-effective manner. Devices can be tested up to Reynolds numbers of 300,000 and with reduced velocities of 0 to 25, offering a chance for clients to evaluate preliminary designs before expending significant resources on larger scale testing. The apparatus provides basic free vibration drag and cross flow motion data using a test cylinder measuring 3.4 meters in length by 0.1 meters in diameter.

Continued evaluations of these and other fairings for BP are scheduled using OCC's high Reynolds Number test rig at the Institute for Ocean Technology. As the number of deepwater offshore fields with potentially high currents increases, the need to provide adequate VIV suppression to drilling and production risers is highlighted.

Artistic rendering of the Thunder Horse platform.