OTC 19962

Benefits of Physical Modeling for Deepwater Pipeline and Riser Installations

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Abstract
Considering the magnitude and complexity of the new oil and gas deep-water developments new tools are required to fully understand the inter relationship between the drilling, production and transportation systems. Physical modeling in deep water has been shown to be an extremely useful tool. This aids defining the relationships between the components physically and then coupling the scheduling function during all phases of the installation. When considering a deepwater moored structure the entire footprint covers a vast area and usually consists of twelve to fourteen mooring lines. Through this maze there can be as many as twenty to thirty lines servicing the production area. On top of this, pipelines are required to traverse this area. The technique to maneuver amongst this mess is called "keelhauling". Keelhauling is the ability of the contractors with two or three large vessels tied together with a heavy cable to safely and efficiently work amongst the many elements. In addition you need a remote operated vehicle (ROV) the size of a large sport utility vehicle (SUV) in a garage be lowered to the bottom, then swim out some fifteen hundred feet and do hard work. It has to connect and disconnect cables holding up to 800 tons. During the modeling phase vessel operators, riggers and field engineers obtain a valuable understanding of the three dimensional aspects of working among pipelines, manifolds, risers and mooring lines safely. In fact the riggers use this as a tool for establishing their cable requirements, pendant lengths, and spooling capacities for a safe operation. The latest modeling has incorporated the surface support equipment "watch circles" for avoiding clashing amongst the various components. The information acquired shows the potential problem areas for which contingency plans can be developed and safe installations achieved.

Introduction
Complex deepwater developments require planning and insight that was not required for the shallow water installations in past. The deeper the water, the more the engineer is required to think three dimensionally. Model simulation has evolved to the stage that it is now being used with a high degree of accuracy three dimensionally. It provides a complete picture of projects for the engineer and clients and aids them to understand the clashing between the various offshore production systems. The deepwater systems require moorings that are complex and cover an area of some ten square miles. This is even more complicated when several different floating vessels vie for the same area. These can include forms of drilling and production risers along with flowlines, water injection and export systems. One would question how the use of modeling with strings versus chains would have identical curves. This is true when each are on the same starting and ending positions. The only difference is that the vertical force to hold up a chain is much greater than that of a string. This is the definition of the properties of a "catenary".

First Model
RJ Brown and Associates (RJBA) received a contract from Pan Arctic in Calgary in 1976 to design and provide engineering and construction management services for a bundled pipeline in the Canadian Arctic. This was to produce and test the first well in the Drake Gas Field offshore Melville Island. Since this was in a very remote area with no water access year around, the only choice was to develop a simulator to provide realistic environment in which a design could be prepared. This