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First-Year Simulation of Drilling and Completion Operations on the Atlantis Project

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Abstract

This paper describes drilling operability simulations that have been used by BP to better quantify the expected time, cost and risk associated with planned drilling and completion operations in the Atlantis field with the Development Driller II. The simulations were also used to help guide the development of new drilling technologies, which will deliver improved productivity and increased field economic value. They have been used to assess the impact of metocean conditions on the offshore drilling and completion operations. Such simulations allow different operating strategies and technologies to be compared, and to assess how they may reduce the economic risk of the project.

Introduction

As operations move out into deeper waters in the Gulf of Mexico (GoM), the cost of drilling and completing the wells is increasingly impacted by loop currents and hurricane abandonments. With its increasing GoM operating presence, BP has experienced substantial downtime associated with these events. The frequency and duration of loop currents has increased significantly as we have moved to water depths beyond 5,000’. Further, these deeper water depths dictate longer hurricane preparation times in order to secure the well, pull the long length of riser, and move the rig out of harms way. These problems are further magnified by the increasing well depths in the GoM (i.e. time on location increases), and as drilling and completion costs becomes a larger part of the total cost of developing a field. For many of the new HPHT developments well depths are 25,000’ to 30,000’+ resulting in drilling and completion costs being 60% to 70% of the total project development budget.

Drilling and completion operations are composed of a large number of tasks. Each of these tasks is sensitive to the prevailing metocean conditions; a large waveheight or an ocean current may prevent the task from proceeding. During the operation, the drilling team will also have to take account of the forecast conditions, and consider having to disconnect and pull the riser in advance of an approaching hurricane or extreme loop current eddy. In deep water, pulling the riser is a lengthy operation, and it is possible that, after starting to pull the riser, the approaching hurricane or loop current changes track and does not actually cross the rig location. While pulling the riser in advance of a loop current is rare, the number of occasions when a riser is pulled in anticipation of a hurricane can be three times the frequency of hurricanes at the location.

The cumulative effect of all the environmental downtime can be to significantly extend the duration, and therefore increase the cost, of a drilling program. One of the major incentives in developing new riser technologies is to try to reduce the amount of downtime due to the environmental conditions. Simulations provide a method of assessing the benefit of these new technologies.

In order to evaluate the benefit of several drilling technologies to use for the development of the Atlantis field, BP commissioned a series of simulations of the first year of the drilling and completion program. Three different riser technologies were considered:

- Conventional drilling riser.
- Freestanding riser.
  - This riser can be detached near the top, and left free standing in the water column supported by its own buoyancy in severe conditions.
- Freestanding riser with drag reduction technology,
  - Either fairings or some form of boundary layer control.

Modeling the Future

The metocean conditions

In order to select the best riser technology, it is necessary to compare how the different options can be expected to perform in the planned drilling and completion program. Simulations of the program can be invaluable in this respect. While it is never possible to predict exactly how a future drilling operation will turn out, by repeating the simulation many times it is possible to estimate both the average duration, and (equally important) the spread about this average duration.

Since the future metocean conditions are not known, the simulation makes use of information about past conditions for the same season of the year. If a long record of past conditions is available, then this can be used by the simulation. By predicting the time required to complete the operation in many