Latest Advancements in Drilling Riser Analysis Technology

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Introduction

- State-of-the-art drift-off simulator for DP drilling rigs
- Integrated drilling riser disconnect and recoil analysis capability
- Detailed wellhead and conductor/casing modelling capability
Drift-off Simulator for DP Drilling Rigs

• DP Drilling Rigs use Watch Circles to ensure safe disconnect

• Various approaches exist for calculating watch circles:
  • Fixed Percentage of water depth
  • Perform simulations to predict vessel drift (uncoupled from riser)
  • Perform coupled simulations considering both vessel and riser

• Only “coupled’ approach considers the effect of riser on vessel drift
Drift-off Simulator for DP Drilling Rigs

• The latest drilling riser analysis software calculates watch circle using a fully-coupled model

• Dynamic analysis is performed, calculating environmental forces acting on the vessel (and riser)

• System limits are monitored at each step of the simulation to determine the POD and watch circles
Drift-off Simulator for DP Drilling Rigs

• Advantages of fully-coupled approach:
  o Avoids potential for excessive conservatism
  o Substantially improves the economics of harsh-environment drilling

• Advantages of performing fully-coupled approach offshore, using real-time data:
  o Has lead to reduction in non-productive time and drilling costs (drillers have reported 30% increase in operability)
  o Has lead to successful drilling of shallow water wells, previously considered inoperable
  o Reported savings in excess of $2.8M in rig day rate alone on a single well
Riser Disconnect and Recoil

• When is it necessary to perform an emergency disconnect?

• Why perform simulations of an emergency disconnect scenario?

• Simulation of this scenario requires:
  • Detailed hydro-pneumatic model of riser tensioner system
  • Anti-recoil control system modelling
  • Drilling mud flow modelling
Riser Disconnect and Recoil

• Simplified approaches to tensioner modelling is not sufficient

• The latest drilling riser analysis software incorporates a detailed hydro-pneumatic model

• Mud column has a significant effect on the recoil response, imparting drag loading on the riser, counteracting upward movement

• The software integrates a finite volume (FV) mud flow model with the FE structural model of the riser
Riser Disconnect and Recoil

• Simulated tensioner responses have been validated against measured data, showing precise agreement

• The recoil response predicted by the software has been validated against
  o Published Data
  o Tensioner Manufacturers Data
  o Disconnect test
Detailed Wellhead and Conductor/Casing Modelling

• A well contains multiple intervals of casing, successively placed within the previous casing run

• Traditional modelling approaches not sufficient

• Recent developments within the offshore drilling industry have led to an increased focus on fatigue

• The latest drilling riser analysis software has been developed further to incorporate the latest modelling practices and analysis methodologies
Detailed Wellhead and Conductor/Casing Modelling

- The latest software includes advanced modelling capabilities:
  - Pipe-in-Pipe
  - Drilled & Grouted vs. Jetted installation
  - Cement Shortfall
  - Fully bonded or sheared cement
  - Soil modelling
  - High Pressure and Low Pressure Wellhead Housing
  - Tapered sections
Detailed Wellhead and Conductor/Casing Modelling

• Detailed wellhead, conductor and casing modelling bridges the gap between the older ‘composite’ models and local models

• The latest detailed global models deliver improved fatigue-life predictions

• Improved predictions are essential to demonstrating the feasibility of drilling, workover and plug-and abandonment operations
Conclusions

• As the oil and gas industry adjusts to a new market reality, it remains clear that development of offshore reserves will continue to play an important role in meeting the world’s hydrocarbon energy demand.

• As exploration moves into deepwater and harsh-environment locations, new digital technologies are playing an important role in ensuring this can be done in an economically-sustainable way.

• Wood’s DeepRiser tool is an example of one such technology that is helping to maximize the viability of drilling operations in some of the world’s most challenging environments.
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Thank you!