High-Pressure Flowmeter Application

Monitors Real-Time Flow, Detects Anomalies in Drilling, Improves Operational Efficiency, Reliability

Flow reading comparison in a real dynamic formation integrity test (DFIT) between HPFM and SC calculation.

Objectives

- Acquire reliable data by incorporating new fluid rheology parameters such as density, temperature, and viscosity, in addition to the inlet flow rate.
- Improve the quality and accuracy of data describing the behavior of the fluid entering the well for greater precision in fluid characteristics.
- Identify pump failures via early detection of anomalies in pump operations to prevent false loss events.
- Deliver more accurate tracking of flow balance by using the virtual trip tank (VTT) to compare between flow-in and flow-out.

Our Approach

- The high-precision flowmeter (HPFM) was successfully deployed during managed pressure drilling (MPD) operations on three wells drilled from a deepwater drillship offshore in Brazil. The project was planned in two distinct stages:
  - Stage 1: Assess the HPFM's performance in terms of flow and density measurements, operating as an auxiliary sensor without integration with the hydraulic model from the Victus™ Intelligent MPD system.
  - Stage 2: Integrate HPFM data with the Victus hydraulic model, enabling the system to dynamically react based on real-time flow conditions.

LOCATION
Brazil

FORMATION
Carbonate

LINER SIZE AND TYPE
Well 1: 10 3/4-in. liner
(12 1/4-in. section)

Well 2: 10 3/4-in. liner
(14-in. section)

Well 3: 10 3/4-in. liner
(12 1/4-in. section)

DEPTH
Well 1: 21,223 ft (6,469 m) MD/TVD
Well 2: 20,351 ft (6,203 m) MD/TVD
Well 3: 20,941 ft (6,383 m) MD/TVD

PRODUCTS/SERVICES
- SeaShield® Model 7875 below-tension-ring (BTR) rotating control device (RCD)
- Surface pressure management system
- Victus Intelligent MPD system software and manifold
- Surface valves controls

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HPFM skid in Standpipe #1 (SP#1).

HPFM skid in the booster line.

Our Approach

- During operations, Stage 1 was successfully completed, with the HPFM functioning as an independent diagnostic tool that operated separately from the hydraulic modeling system. This allowed for real-time monitoring of surface and downhole conditions, providing valuable insights into drilling performance.
- Traditional flow-in calculations based on stroke counters were found to be limited by their reliance on manually input pump efficiency, which is typically determined during MPD calibration or fingerprinting. However, real-world drilling conditions revealed that pump efficiency fluctuates due to factors such as fluid compressibility, well depth, mud weight, rheology, surface backpressure (SBP), and the specific MPD technique employed (e.g., pressure mud cap drilling and floating mud cap drilling).
- The HPFM successfully overcame these limitations by delivering direct, real-time flow measurements, independent of pump efficiency assumptions. Operational results confirmed its effectiveness as a standalone diagnostic tool, significantly improving situational awareness and enabling faster, more informed decision-making throughout drilling.
- By providing greater accuracy in flow measurement and early detection of operational anomalies, the HPFM demonstrated its value as a key innovation in real-time drilling diagnostics. Its Stage 1 deployment yielded positive results, and Stage 2 integration will be implemented in upcoming projects, further enhancing automation and efficiency in MPD applications.

Value to Customer

- Accurate flow-in rate measurement: Ensures precise readings of both drillstring and booster flow rates, improving operational efficiency and reliability.
- Rapid detection of pump cavitation: Quickly identifies cavitation issues, whether caused by air in the system or suction problems, minimizing downtime and equipment wear.
- Enhanced event differentiation: Helps distinguish between a loss of pump efficiency and a loss circulation event, enabling more informed decision-making.
- Improved safety for the MPD team: Provides greater confidence and security in managing critical operations, supporting safer and more effective execution.
- Dynamic formation integrity test (DFIT) procedure support: Assists during the DFIT when increasing SBP pressure, ensuring clarity on whether fluid loss is due to the DFIT exercise or pump efficiency variations.

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