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Precise Bottomhole Pressure Maintained with Automated Mud Rollover

i-balance control system provided precise constant bottomhole pressure while displacing between drilling fluid systems before and after tripping, North Sea

CHALLENGE

Maintain constant bottomhole pressure while displacing between statically underbalanced and overbalanced drilling fluid systems used for drilling and tripping on narrow margin well.

SOLUTION

Use i-balance[†] control system to perform dynamic pore pressure fingerprinting to verify overbalanced mud weight and use automated mud rollover to follow displacement pressure schedule developed by @balance[†] managed pressure and underbalanced drilling services with VIRTUAL HYDRAULICS[†] ECD and ESD management software and monitored with PRESSPRO RT[†] real-time downhole performance measurement software.

RESULTS

Successfully completed 6 displacements between drilling fluids maintaining bottomhole pressure within a window of ±0.11 ppg [±87 psi].

Narrow mud weight margin and large uncertainties

A customer in the North Sea was drilling an exploration HPHT well with a predicted narrow mud-weight window (0.92 ppg/0.11 sg) with large uncertainties on the pore pressure prediction. The customer decided to drill the hole section with a statically underbalanced drilling fluid and use managed pressure drilling to keep the well overbalanced at all times. This approach required displacing the well between lighter underbalanced drilling fluids used for drilling and a heavier overbalanced drilling fluid to maintain well control while tripping.

Dynamic pore pressure fingerprinting

To verify that the mud weight planned to maintain static overbalance was correct, a series of dynamic pore pressure fingerprints were performed prior to each displacement. Fingerprinting was conducted in three stages: reduce bottomhole pressure for 10 minutes and circulate bottom up; reduce bottomhole pressure for 30 minutes and circulate bottom up; and reduce the bottomhole pressure and circulate bottom up.

During each bottom-up circulation, the response was evaluated to determine if the bottomhole pressure was at or below pore pressure. This process was repeated until either the pore pressure or a predetermined pressure limit was reached. The i-balance control system provided accurate control of the pressure steps at each stage of the dynamic pore pressure fingerprinting.
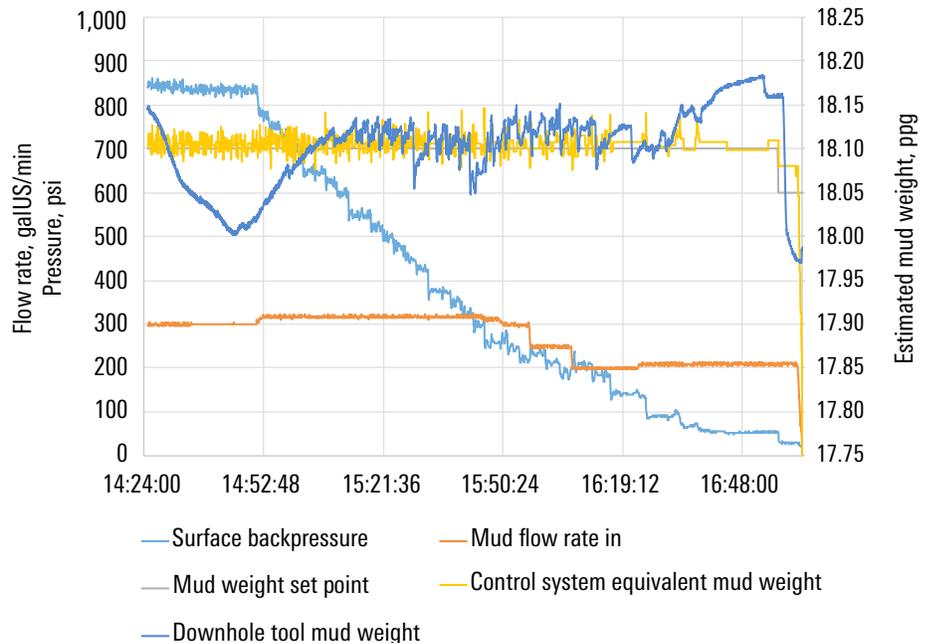
Comparison of downhole tool memory with automated mud rollover.

Automated mud rollover

Once the mud weight that would maintain the well statically overbalanced was confirmed by the results of the dynamic pore pressure fingerprinting, @balance services created a mud rollover schedule using VIRTUAL HYDRAULICS software. The i-balance system used this schedule along with the integrated real-time hydraulics model to automatically adjust surface backpressure and maintain constant bottomhole pressure as the drilling fluid was displaced down the drillstring and up the annulus.

Bottomhole pressure was monitored during the mud rollover operation using downhole tool data and PRESSPRO RT software. Using both measured and modelled downhole pressure provides a backup in case of loss of communication with the downhole tool.

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