EC-Drill® Case Study
BP, Caspian Sea

EC-Drill® helps BP to successfully drill on the notorious Shah Deniz field

CHALLENGING CONDITIONS

Drilling top-hole sections on the Caspian's Shah Deniz field comes with significant challenges: there are a number of pressure-regime-related risks and difficulties associated with the region's high pressure, unconsolidated sands.

The soils in the Caspian are highly reactive and deformable, meaning inhibited mud has to be used.

THE SCENARIO

BP needed to drill a 26in top-hole section from a fixed platform to 1,191 mTVDbrt (3,907 ft) from the shoe of a 28" liner that had been set at 594 mTVDbrt (1,949 ft). The 22" surface casing was planned to be set at 1,181 mTVDbrt (3,875 ft) to obtain adequate formation integrity for the next hole section.

When drilling top-hole section through hazardous formations in terms of shallow water/gas flow from a fixed platform, a 36" environmental riser with a diverter on the top is essential to have direct control over the wellbore.

Minimum 1.44 S.G. (12.0 ppg) drilling mud was required to push against the high pressure fluid-bearing zones. Fracture gradient at the 28" liner shoe was 1.48 S.G. (12.34 ppg).

Water depth and air gap was 100 m (328 ft) and 42 m (138 ft) respectively.

CUTTINGS CREATE PROBLEMS

Rate of Penetration (ROP) was excessively limited due to build-up of cuttings in the hole as the result of low annular velocity.

The increase in equivalent mud weight due to the cuttings load caused losses to the formation.

The resulting hydrostatic pressure loss on the high pressure sand caused the fluid (water with dissolved gas) to flow as the margin of overbalance was very small.

ENTER EC-DRILL®

BP used a Managed Pressure Drilling (MPD) system called EC-Drill® to achieve its top-hole objectives.

With EC-Drill®, the driller was able to offset the effect of cuttings loading and frictional pressure loss to keep the wellbore pressure within the pressure window during whole phases of the drilling operation.

The level of mud in the riser was manipulated in order to achieve the planned Equivalent Circulating Density (ECD) at the bottom of the well. The wellbore remained overbalanced statically without applying any back-pressure or using any type of Rotating Control Device (RCD).

PROVEN TECHNOLOGY

To drill a top-hole section with EC-Drill®, the annulus of the wellbore is accessed by an Enhanced Drilling subsea disc pump (proven on more than 600 Riserless Mud Recovery and Cuttings Transport System jobs to date) through a valve connected to the 36" Low Pressure Wellhead (LPWH).

Wellbore pressure is controlled dynamically by a programmed control system based on the pressure at which the Enhanced Drilling subsea pump is set to operate. The control system changes the speed of the subsea pump automatically to either evacuate the riser or to fill it, so that the pressure set point at the wellhead is achieved.

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PROJECT

Enhanced Drilling provided EC-Drill® MPD services to BP in the Caspian Sea.

KEYWORDS
EC-Drill®

- Managed Pressure Drilling
- Shallow hazards
- Shallow gas
- Shallow water
- Narrow Pressure Window
- Top-hole Drilling
- Rate of penetration

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ENHANCED DRILLING

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Furthermore, this technology facilitates rapid detection of small fluid exchanges between the wellbore and a formation.

Should any amount of formation fluid flow into the wellbore or if drilling mud should be lost to the formation, the speed of the pump would automatically change if it is set at constant inlet pressure.

These easily noticeable speed increases or decreases are reliable, rapid indicators of both influxes and losses. Subsea pump power consumption and flow meter on the return line are also used as kick/loss indicators.

On this particular project, the subsea pump was placed on the sea floor. It pumped the returns back to the surface via a flexible jointed line which was hung off the platform.

The subsea pump speed can be adjusted both manually and automatically. It can be also run at either constant inlet pressure or constant rate, depending on requirements.

ADVANTAGES GAINED BY BP USING EC-DRILL®

- **Target Depth was achieved;**
- **Wellbore was in a good condition and ready for perfect cement job;**
- **Significant time and cost savings as pressure regime-related non-productive time was reduced substantially;**
- **No influx occurred despite there being a high-pressure formation and narrow pressure window.**
- **Formation Integrity Test was successfully performed at 800 mTVDbrt (2,625 ft) by introducing pre-designed a high-density pill to the riser from the top according to a well-devised volume plan. Wellhead pressure sensor was used for observation during the test.**
- **A new kill procedure was in place should the formation flow; kill mud could be pumped into the wellbore via the return line through the subsea disk pump if the drill string was not in the wellbore.**

EC-Drill®

BENEFITS

- Cost, safety and efficiency enhancing
- Rapid kick/loss detection
- Enables safer, reliable drilling in narrow fracture/pore pressure windows
- Effectively drill in narrow pressure window scenarios

Detail of EC-Drill® pump in the Enhanced Drilling workshop, Straume, Norway

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