Offshore Underbalanced Drilling with a Closed Loop Circulating System

Geoff Gough - DONG Energy

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The implementation of underbalanced technology, to enable drilling in field, was successful.

The wells were drilled and controlled effectively within the prescribed operational envelope.

No appreciable losses were encountered during the drilling of this well.

Pre-job onshore commissioning of surface separation and circulating equipment was invaluable.

Zero lost time injuries recorded.
Why UBD?

- To reach reserves targets
- To verify UBD as a viable technology for unlocking unrecoverable reserves in the north of the field
- Variations in pore pressure and fracture gradient along the wellbore
- Stimulation a requirement.

The Wells

- Both flank wells
- ~2000m 6" horizontal sections
- Well 1 targeted a high pressure zone
- Well 2 targeted a low pressure zone.
Drilling Campaign Summary

It was proposed to plan the 2008 Drilling Campaign with 5 major changes from 2007 campaign:

- Drill wells with Crude Oil instead of water
- Especially manufacture process equipment for rig
- Manufacture new drill string
- Drill as far as possible with conventional tools
- Limit loads on formation (drawdown).

**Additionally:**

- Proved closed loop separation system (with high speed centrifuge).
High Speed Centrifuge

X20
Self Regulating Interface

Centrifuge water in/outlet

Water export

Water import
Well Performance

Well 1

- Underbalanced throughout – with both crude oil and SRP water
- Very productive – oil and gas production
- Represents the high influx case.

Well 2

- Underbalanced in the toe
- No production – without a high drawdown
- Gas injection – increased complexity and risk of hole enlargement.
Incremental Reserves

INCR. RESERVES (MMBOE)

Oil volumes

Gas volumes

TOR COVERAGE

Comp 14 (95m MD)
Comp 14 to 12 (195m MD)
Comp 14 to 11 (290m MD)
Comp 14 to 10 (390m MD)
Comp 14 to 9 (490m MD)
Comp 14 to 8 (590m MD)
Comp 14 to 7 (690m MD)
Comp 14 to 6 (860m MD)
Comp 14 to 5 (940m MD)
Comp 14 to 4 (1040m MD)
Comp 14 to 3 (1130m MD)
Comp 14 to 2 (1260m MD)
Comp 14 to 1 (1370m MD)
System Strengths

- Recovered oil and gas to process, minimising flaring to atmosphere. *66,108 bbls of incremental oil production was sent to the processing platform and over 45 MMscfd gas*

- Continuous solids removal from circulating and fluid export systems

- Maintained well parameters within planned matrix

- Effective hole cleaning was maintained throughout

- The addition of lubricant reduced bottom hole torque and drag

- The bespoke demulsifier proved effective even in the presence of lubricant when continuous dosing was necessitated

- QHSE.
System Strengths Cont'd

- Samples to the palaeontologists
- Ease of use
- Removing screens
Opportunities for Improvement

- High speed centrifuge shutdowns due to plugged nozzles and high vibrations. This was rectified by increased filtration and running the upstream decanter centrifuge in series rather than parallel.

- Liquid carry over from high pressure separator at low gas rates. This was found to be a result of the cyclonic vessel internals that were employed.

- Liquid metering: coriolis meter performance was intermittent.

- Data acquisition system QA/QC requires optimisation especially at interfaces i.e. other service companies and the production platform.

- Snubbing stack configuration.

- Downhole Isolation Valve.

- Footprint.
New Project Sanctioned

WELLHEAD PLATFORM NORTH
Unmanned, 12/16 well slots

SUBSEA
Production, water injection and gas lift pipelines plus umbilical

WELLHEAD PLATFORM EAST
6/10 well slots, bridge-linked

BROWNFIELDS
Compression upgrade plus tie-ins

WELLS
11 Wells drilled in 2 campaigns