GAS LIFT OPERATIONS IN APACHE’S NORTH SEA REGION

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Introduction

- Apache North Sea
- Gas Lift vs. ESP
- Typical gas lift completion and equipment
- Gas lift surveillance, optimisation and troubleshooting
- Common misconceptions
Apache in the North Sea Region

- Forties Field - 97.14%
- Beryl Field – ~57%
- Bacchus – 50%
- Maule – 100%

- Net production: ~ 80Mboed
- Gross production: ~150Mboed
The Forties Field

- ESP & GL wells
  - 16 ESPs
  - 1 GL

- ESP wells
  - 15 ESPs

- ESP & GL wells
  - 4 ESPs
  - 15 GL

- ESP wells
  - 10 ESPs

- ESP & GL wells
  - 4 ESPs
  - 17 GL

- ESP wells
  - 2 subsea

- ESP wells
  - 17 GL

Bacchus Bundle

Drawing not to scale
Gas Lift vs. ESP – Ever Changing Challenge!

**Gas Lift Issues**
1. Numerous plant trips due to old equipment & slow recovery times following shutdowns.
2. As more wells were drilled the lift gas available per well was reduced.

**Run More ESP’s**
1. Poor ESP run lives (sand, shutdowns, etc.)
2. Rig crews spending time working over failed ESP’s & unable to drill new targets.
3. Improved topsides efficiency reduced gas lift “shoulder losses”.

**More ESP’s or More Gas Lift?**
1. Topsides projects have resulted in higher available gas lift rates & more system redundancy.
2. Improved topsides efficiency – benefits both systems.
3. Improved ESP run life (sand control, ESP spec., etc.)
4. Expected well PI.
5. Availability of drilling facilities (i.e. FASP).
Typical gas lift completion and equipment

- Two packers
  - Shallow dual packer
  - Deep set production packer

- G-DHSV & P-DHSV

- Typical number of unloading valves: 2-4 valves
- Typical size of the orifice valve: 3/16”, ¼”, 5/16”
- Typical gas injection rate: 1.4 – 2.6MMscfd
- Typical gas injection depth: ~ 1800m TVD
- Typical size of the production tubing: 3 ½”, 4 ½”
- Gas injection string 2-3/8”
- Cased and perforated or sand control
  - Cased & perf
  - Frac Pac
  - SSS
  - GP
- Downhole gauge
Sidetrack in Oct 2008

10-3/4” shallow dual packer

3-1/2” tubing

2 unloading valves, orifice valve (¼”)

Distribution Temperature Sensing (DTS)


Frac Pac

Scale squeeze due to BaSO₄ formation risk

First scale squeeze (since sidetrack and recompletion)

Well came back on line with difficulty
  - difficult to kick off
  - different values for injection parameters (once well flowing) observed
DTS clearly showed
- No tubing leaks
- Unloading valves were not passing

Packer calculations – during squeeze
- Tubing contraction due to change (reduction) in temperature
- Show forces greater exerted on the packer during the squeeze were greater than the shear pin specification

Suspected unseated packer

Intervention
- Changed out orifice valve
- ¼” to 3/16” new orifice

General conclusions:
- Improve completion (packer) specification
- Improve pre-squeeze analysis
- Packer calculations post the incident
- Hot water squeeze for other wells with this specification packer
- Gas lift system upgrade
- Change-out of old 1st stage compressors
- New compressors operating in parallel
- GAP analysis for gas lift distribution
- Prosper model analysis
- Gas lift valves replacement program
- Kickover tool – wireline operations
Wells monitoring

Stability issues analysis and plan a way forward

Contact platform

Wells start-up / optimisation

Well test and data recording

PI Processbook as a useful tool for wells monitoring

Well shutdown for 5hrs

Production choke position

Gas injection pressure

Bottom hole pressure

Well Head Flowing Temperature

Gas injection rate

Gas injection flow control valve

Well head flowing pressure

Well unstable

unloading valve open

Well stable – gas injected only through the orifice

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Gas Lift Misconceptions

“We are going to let the well build up a head of steam”

“There must be a sticky valve”

“The annulus pressure is high. We must have a hydrate across the orifice”

To address we now do the following:

- PE’s must attend a gas lift course. Where possible follow up with a nodal analysis course
- Good surveillance
- Coaching and mentoring of younger PE’s in surveillance, optimisation techniques and troubleshooting – develop a good foundation and don’t let the misconceptions take hold!
- Coaching sessions with offshore staff
- Providing good start-up procedures
- Short presentations offshore to familiarise the crew with gas lift operations. Include DHSV animation
- Keep accurate and up-to-date records of gas lift designs
Thank you