Quad 204, Schiehallion Field: Exploitation of a deeper reservoir fairway.

Mary Ward, BP
DEVEX, 9th May 2017
• Schiehallion Field Introduction.

• T28/T25 reservoir interval description.


• Well results and future opportunities.
Schiehallion Field Introduction

- The Schiehallion and Loyal fields
  - Located 175km to the West of the Shetland Isles in ~400m water depth.

- Discovered 1993, production start-up 1998
  - >2 bbn bbls in place.
  - ~400 mmboe produced to date.

- BP operate both fields
  - Schiehallion: BP 33.35%, Shell 54.896% Siccar Point Energy 11.754%. Loyal: BP 50%, Shell 50%.

- Sub-sea tie-back to Schiehallion FPSO
  - Developed under water flood
  - Over 90 E&A and development wells:
    - 30 producer and 31 injector wells
    - Declining OE and large remaining resources led to Quad204 redevelopment.

- Replace FPSO
  - Glen Lyon start-up May 2017
  - ~20 infill well programme.
Reservoir stratigraphy and T30s system outline

Type well

T31-T35 reservoir intervals

T30s

T25-T28 reservoir intervals

T25-T28 reservoir

T28

T30s

T30s field outline

Schiehallion T30s field outline
Reservoir stratigraphy and T28 system outline

Type well

T25-T28 reservoir

T25-T35 reservoir intervals
Reservoir stratigraphy and T25 system outline

Type well

T25 reservoir system outline

T31-T35 reservoir intervals

T25-T28 reservoir
Schiehallion and Loyal fields
T28/T25 well control

Sum of Negative Amplitudes Map 30ms below
Top T28/T25 performed on Lithology Volume

- sst
- sltst
- mdst

Sum of Negative Amplitudes Map 30ms below
Top T28/T25 performed on Fluid Impedance Volume

- gas and oil
- oil
- water

Segment 1
Segment 2
Segment 3
Segment 4

Target X208
Target X406
Target W147
Target W184/W256
South-North structural cross-section: T28/T25 fluid contact variations
Reservoir quality: comparison of T28/T25 with the T30s

Segment 2 offset well

**T28**
- PHI av. 0.24
- Perm av. 653 mD
- NTG av. 0.86

**T25**
- PHI av. 0.23
- Perm av. 495 mD
- NTG av. 0.78

**T28/T25 core example:**
high NTG, good reservoir quality, amalgamated to non-amalgamated sands with thin mudstone intervals.

109m oil column in T30s.

39m oil column in T28.
Four of the 1st eight wells to target T28/T25

Challenges for T28/T25 development:

• Depth uncertainty,

• Fluid contact uncertainty,

• Reservoir system and producer-injector connectivity.
**Well planning considerations**

1. Producer -> proximity to Segment bounding fault.
2. Anti-collision and zonal isolation.
3. Attic appraisal well = equidistant from heel and toe of PX208 by 600m.
4. Top reservoir depth uncertainty +/- 15m.
5. Injector -> designed well during planning to be robust to a range of depth uncertainty scenarios.

**Alternative IX208 trajectories:**
- Shallow or reference top sand outcomes – drill well A.
- Deep case top structure outcome – drill wells B or C.

**Pilot well required for PX208?** No – already have a pilot in F01Y, drilled at crest of structure, tested GOC and OWC, and rock properties.
Depth and fluid contact uncertainties
Segment 1: PX406 and IX406

Well planning considerations

- Producer -> proximity to Segment bounding fault.
- Two fairways of different ages -> T28 / T25. Appraisal well only in the western T28 fairway.
- No well control in eastern fairway, therefore uncertainty on depth (+/-25m), fluid contacts, reservoir age (T28 or T25), net sand presence and distribution.
- Pilot well was justified for the producer target.
- Injector depth uncertainty +/-25m -> optimised search angle for reservoir entry.

→ risk of sub-economic outcomes justified pilot.
Reservoir sands connectivity uncertainties

Well planning considerations

- Inter- and intra-sand system connectivity
- Affects producer and injector reservoir section lengths and well position.

\[\rightarrow\] Designed long horizontal wells to cross-cut multiple sands,

\[\rightarrow\] Acquired LWD pressures.
Producer-Injector connectivity uncertainties

Well planning considerations

- Amplitude shut-off
- Related to faulting?
- Fluid affect?
- Reservoir absence in low amplitude areas?

→ Positioned injectors within high-amplitude areas,
→ Affects injector-producer spacing,
→ Acquired LWD pressures,
→ Assess well performance.
Segment 2: PX208 and IX208 well results

**Depth uncertainty**
- On depth or slightly shallow.

**Fluid contact uncertainty**
- PX208 remained within oil leg.
- IX208 OWC deeper than appraisal well. Sharper oil-water transition zone.

**Connectivity**
- Improved net sandstone distribution in injector location than prognosed.
- Pressure connectivity between the producer and injector wells and across T28 and T25 systems.

**PX208 producer result**

**IX208 injector result**

**Producer: 1068m long reservoir section.**

**Injector: 1118m long reservoir section.**
Segment 1: PX406 pilot, producer and IX406 injector well results

Depth uncertainty

• On depth or slightly shallow.

Fluid contact uncertainty

• Common contacts between T28 and T25.
• Sharper oil-water transition zone found in pilot well.

Connectivity

• Higher reservoir quality than prognosed.
• Pressure connectivity between the producer and injector wells and across T28 and T25 systems.
Conclusions and future opportunities

- Overall, positive well results.

- Play came in better than predicted.

- NTG higher than predicted.

- Transition zone thinner -> updated saturation height function being applied to full field model.

- Currently assessing further potential to develop T28/T25 accumulations elsewhere in the field.

- T28/T25 development expected to contribute 8% of the future field production.
Acknowledgments

• BP
  - Miriam Gordon, Jason Scott, Tim Primmer
  - Matt Le Good, Lisa Draper, Sophie Smithells
  - Rebecca Holyer/Andy Ronald
  - Tom Lyon, Catherine Owen, Alan Carruthers
  - Ross Walder/Thomas Harpley

• JV Partners
  - Shell
  - Siccar Point Energy