Auk North Field Development: Outline

• Background

• Appraisal

• Development Concept

• Field Determination

• Project Execution

• Current Status

• Summary
Background: Location

• Auk North is the northern part of the Auk field

• The Auk field is located approximately 250 km east-south-east of Aberdeen in Block 30/16

• The Auk field was discovered in 1971

• First production from the Auk field occurred in 1975

• Talisman acquired the Auk field in December 2006
Background: Overview of Auk Field

- The reservoir consists of Zechstein carbonates and Rotliegend sandstones containing a low gas-oil ratio (GOR) oil

- Areal extent: 60 km²

- Reservoir depth: 7300-7750’ ft TVD(SS)

- Auk North undeveloped at time of acquisition (beyond reach of platform drilling rig)
Background: Auk Field Production History

- First oil in December 1975
- Initial development focus was on Zechstein
- Production peaked in May 1977
- Production mechanism is depletion drive with aquifer support
- Normally pressured reservoir with jet pumps and ESP’s used for artificial lift
- Development focus switched to Rotliegend in the 1990’s with application of horizontal well technology
**Background: Geology**

### Reservoir Summary

**ZECHSTEIN**
- Original justification for Auk development
- Leached dolomitised platform carbonates
- Vugs, solution channels and fractures dominate fluid flow
- Erosionally truncated towards the east
- Communication with Rotliegend reservoir below

**ROT1**
- Dominated by waterlain mass-flow sandstones, probably reworked dune sands
- Variable reservoir development with some better quality homogeneous intervals

**ROT2**
- Dominant oil-bearing interval in the Auk Field
- Aeolian sandstones, with both wind ripple and slipface sands
- Complex heterogeneous system of good quality slipface sands (linear dune slipface) enclosed within poor quality wind ripple sands (linear dune plinth and sandsheets)

**ROT3**
- Dominated by a thick succession of slipface sands
- Best reservoir quality rock in the Rotliegend but predominantly in the water-leg, with only a small oil leg in the crest of the field

### Generalised Stratigraphy
Background: Rotliegend Depositional Model

Laterally impersistent slipfaces developed at all levels on flanks of large linear dunes

Secondary wind

Higher wind velocities in upper portions of linear dunes result in winnowed, better sorted sands (reworked wind rippled sands)

Preservation threshold controlled by angle of climb of dune

Small barchanoid dune field in interdune corridor associated with sand flat and lower plinth areas

Patchy preservation of upper reworked wind ripple sand facies

Small barchanoid dunes on flanks of linear dunes or draa result in preserved slipfaces even on lower plinths of linear dunes

Slipfaces of linear dunes

Winnowed mid-upper flanks of linear dunes

Linear dune (wind ripple sand)

Isolated barchan dunes and barchanoid dune field

Sand flat

Modified from initial model presented in May 2007
Background: Auk Rotliegend Unit 2 Geological Variability

Rotliegend Core Showing Red Stained (Non-Oil Bearing) Wind Rippled Sands and Bleached (Oil-Bearing) Re-worked Wind Ripple and Slipface sands (Coarser Grained and More Permeable Sands)

Rotliegend facies proportions:
• Slipface Sand: 10-15%
• Re-worked Wind Ripple Sand: 20-30%
• Wind Ripple Sand: approx. 60%
Appraisal: Programme Objectives

- Existing appraisal well data in Auk North insufficient to reduce uncertainty in factors influencing STOIIP:
  - Depth of top structure on flank
  - Net-to-gross tends

- Existing seismic data unable to be used to map net-to-gross trends

- Recognised that several well penetrations would be required to reduce the uncertainty in the STOIIP

- Appraisal programme consisted of:
  - Vertical well with deviated side-track (30/16-15/15Z)
  - Vertical well with deviated side-track and horizontal side-track (30/16-16Z/16Y)

- Appraisal wells drilled between September 2007 and February 2008
Appraisal: Well Results

- Results incorporated into geological model

- Revised range of STOIIP indicated that there was sufficient volume in place to warrant development of Auk North
Development Concept

• Three options were considered for the development of Auk North:
  – Extended reach drilling from the Auk platform
  – Subsea wells drilled from a mobile rig tied back to the Auk platform
  – Subsea wells drilled from a mobile rig tied back to the Fulmar platform

• On the basis of feasibility and cost the option selected was a subsea tie-back to the Fulmar platform with ESPs being used as the means of artificial lift
Field Determination

- Auk field subject to Petroleum Revenue Tax (PRT)

- The Auk North project under a PRT paying environment would not be sanctioned as it would not meet Talisman's economic criteria to achieve project sanction

- However, the project would meet Talisman's economic criteria to achieve project sanction if the Auk North development area was determined to be a new field and therefore not subject to PRT

- Talisman liaised closely with DECC and HM Treasury to demonstrate that this was the case:
  - Open discussion on Talisman’s economic criteria required to sanction projects

- Auk North project sanctioned by Talisman Board in October 2008, conditional on Auk North being determined as a new field and therefore not subject to PRT

- Auk North determined as a new, separate field in January 2009:
  - Re-determination of oil field boundaries on economic grounds (document issued November 2008)

- Development consent for the Auk North field received in January 2009
Project Execution: Drilling

• Three development wells drilled and completed between January 2009 and August 2009 and between September 2010 and November 2010

• Issues during drilling:
  – Losses incurred while drilling the reservoir section of well N1 after encountering an area of intersecting faults
  – Well paths of subsequent wells revised to avoid areas where faults intersect (identified using seismic attribute data)
Project Execution: Completion

• Lower completion:
  – Sand screens and swell packers in reservoir section

• Upper completion:
  – Dual ESPs:
    ▪ 684 hp motor
    ▪ 140 stage centrifugal pump
    ▪ Non-return valve to prevent back-flow through pump
    ▪ Separate cables to surface for each pump
  – Use of subsea horizontal tree necessitated new penetrator design for cables through the tubing hanger that still provided a dual barrier

• Expected completion run life of four years

• Key challenge was sizing pump to cater for a wide range of well productivities
Project Execution: Well Results

Auk North Development Well PBU Log/Log Plot

Auk North Development Well Transient P.I.

Auk North Field Development 12th May 2011

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Project Execution: Topsides and Subsea Facilities

• Subsea manifold:
  – Designed for three wells with tie-in for future expansion

• Subsea pipeline:
  – Eight inch diameter and 10.5 km long
  – Insulated to a U value of 4 W/M²k

• Electro-hydraulic/chemical injection subsea controls umbilical and an ESP power cable

• Conductor riser:
  – Containing two risers and two J-tubes
  – Installed in redundant well slot

• Process facilities:
  – Utilised existing ‘B’ train 1st stage separator
  – Methanol and wax inhibitor injection system
  – Modules containing variable speed drives (VSDs) for ESPs

• Work on installing the topsides and subsea facilities took place between January 2009 and November 2010
Current Status

• First oil occurred on 17th November 2010

• Peak oil production rate in excess of 20,000 stb/d

• The results of the initial phase of the project has resulted in a fourth development well being sanctioned

• Well N4/N4Z spudded on 21st March 2011

• Currently running lower completion
Summary

• Auk North began production in November 2010, some eighteen years after initial appraisal

• The appraisal programme carried out in 2007-2008 showed that there was sufficient volume in place to warrant development of Auk North

• However, the development costs meant that the project had marginal economics in a PRT paying environment

• Talisman liaised closely with DECC and HM Treasury to facilitate the development of Auk North – this was achieved by having Auk North being determined as a new field and therefore not subject to PRT

• The success of the initial phase of the project has resulted in a fourth development well being sanctioned