Subsea technology & potential significance to the UK
Top 18 Operators

Top 18 Operators responsible for 74% of subsea trees

Source: Quest Subsea Forecast Awards August 2008
Total subsea assets – Mid 2008

37% of operated production

400 subsea wells operating from 2015
TOTAL Subsea Projects Track Records

Note: Bubble size represents the number of subsea wells.
Numerous technological challenges

- Deep Water
- Long tie backs
- Complex fluids (Viscous, heavy, low energy)
- Smaller reservoirs
- Environment (metocean conditions, protection)
- Industry cost current trend

- New architectural concepts
- Extended tie-back for paraffinic and none paraffinic fluids
- Subsea boosting up to 200 bars
- Subsea processing: decanter well, subsea water treatment and injection
- All electric technology: K5F AET pilot start-up, Electrical DHSV development
- Innovative materials: insulation, composite
- Subsea « autonomous » vehicles
- Subsea gas compression
The challenge of deep water - Girassol – Angola

A challenging Flower…

- Block 17, Angola
- Deepest and largest subsea development at Project Sanction in July 1998
- Production capacity 240,000 bopd
- FPSO: 2 Mbls storage, 23,900t topsides
- 39 wells and 11 manifolds
- First use of Riser Towers (3 off)
- Extensive qualification program
- Startup December 2001

Girassol has opened new perspectives to the Subsea Technology
The challenge of deep water
DALIA – ANGOLA
Integrated Production Bundles
The challenge of subsea processing and boosting
Paz Flor – Angola

- Project Sanctioned in Jan. 2008
- Production capacity 230,000 bopd
- FPSO: 2 Mbls storage, 34,000t topsides
- 49 wells and 3 manifolds
- 3 Subsea Separation Units with multiphase booster pumps
- Startup in 2011

Why Subsea Separation

- Effective solution to manage flow assurance issues with the Miocene Heavy Oil
The challenge of long tie backs - Canyon Express (Gulf of Mexico)

- Water depth world record in year 2002 with 2,225 meters
- 100km tie-back from 3 fields
- Capacity: 500 MMCFD (14 MMSm$^3$/d)
- 2 x 12” looped flowlines, 9 wells
- Multiphase flow
- Intelligent well completions
- Start-up September 2002
Step Change – All electric trees
K5F  Netherland

- First Subsea development with DC electric Xmas Trees
- Production Capacity 2MMsmd
- 2 wells 10 km subsea tie back to K6N Platform
- Water depth 40m
- Extensive qualification program
- First Gas in September 2008

Stimulus for all Electric Subsea Technology

- Step change improvement in reliability & availability
- Address limitations of electro-hydraulic systems
  - Ultra deepwater applications
  - Long tieback distances
  - Electro-hydraulic components failures
  - Environmental Issues
- Enhanced Functionality
  - Response times
  - Condition monitoring
  - Performance trending
The challenge of HP/HT subsea developments
Kessog field

15 000 psi
185 deg.C
73 tons
Significance for the North Sea

Subsea developments allow:

1) To develop small or marginal reservoirs with tie-back to existing infrastructure
2) Extend production plateau of our mature fields
3) To develop deepwater discoveries

1983: First Gas of North East Frigg
Subsea Template, Field control from articulated column

2002: Otter First Oil, 3 production wells equipped with ESPs for artificial lift
North Sea - Subsea to extend production plateau
The Alwyn Area Story …

- Initial Production in 1987 for 12 years
- 21st anniversary celebrated last june and... another 20 years still to go
The Alwyn Area example… First Gas in 1987

Production forecast

1st subsea well PN1 1988
The Alwyn Area example... Ellon & Grant 1994-98
The Alwyn Area example… Tie back of Nuggets 2001

68 Kms tie-back -10”
Subsea control from Dunbar
Trunkline always operates
in hydrates region
Horizontal trees
Forvie 2005
1 subsea well
1 subsea manifold
for future tie-backs
Historical fields have their life extended.
Jura Project - UK

- Fast Track Project: First Gas May ’08, only 17 month after discovery
- One of the largest discovery for TEPUK. Increase Alwyn Area remaining reserves by 50% (170 Mboe)
- Capacity 8Mscmd (50,000 boepd)
- The field is located in 113 m water depth, 32km from Alwyn and 20km from Dunbar

- 2 well subsea tieback to existing Forvie Subsea Manifold
- 3km bundle integrating all process functions
- HP/HT development (600b / 120°C)
- Innovation
  - IL3 Subsea HIPPS
  - Communication through Optic Fiber
  - Largest Bundle towhead ever installed
  - Chemical Injection Metering Valve
Deep water challenge – West of Shetland -Laggan & Tormore A New Subsea Challenge

- Laggan field discovered in 1986 (Block 206/1a)
- Tormore field discovered in 2007 (Block 205/5a)
- Production Capacity 500 MMscfd
- 125km north west of the Shetland Island
- 600 m water depth
- 2 six slot template manifolds
- Provision for subsea compression in the late field life
Going to the West of Shetlands...
Harshest environment in UK
Extreme waves : 100yr Hs-18m; Hmax 33m
Persistent weather – little / no calm
High winds, low water temperatures, strong currents

Laggan Site - Wave Height (1 Year Return Period)

Source: Metocean Criteria for the Laggan Field (UK Block 206/1). PhysE 28th October 2005

Weather Window

Laggan - Current Profile

FloaTEC

Weather Window

≈ 11.5 m
Laggan /Tormore – Long tie back Alternative

Subsea Production System
(600m water depth)
Laggan & Tormore (5 + 3 wells)

140km Multiphase Pipelines
(500 MMscf/d)
2 x 18” gas lines
rock dump material
chemical injection line
control umbilical

New 500 MMscf/d Gas Processing Plant at Sullom Voe

374km 24” Gas Export Pipeline
SVT to St Fergus
500 MMscf/d Laggan-Tormore
Total E&P UK Operated Production

In 2007, 20% of TepUK production was Subsea

From 2013 onwards, it will be 50%
Subsea Developments - Key to Success - Lessons learnt

- Dedicated project team
  - For engineering phase, tenders, project phase

- Comprehensive Testing programme treated as key commissioning activities
  - Qualification testing for all new components
  - System testing (FAT for each item + integration)
  - External Interface Testing
  - Operational Testing

- Dedicated team of inspectors provided by the operator

- Early Involvement of end users
Subsea Systems – The Downside – Systems

- **Obsolescence**
  - Parts no longer available
  - Often for relatively new systems

- **Vendors**
  - Focus on big new projects
  - Lack of interest in older systems
  - Lack of personnel to support the systems
  - Solution to obsolescence is to sell a new system whilst withdrawing support to the older systems

- **New Systems**
  - Quality control – reduced.
    - Systems appear to be in place, but are the people there?
  - Corporate Knowledge (Vendor and Operator) – are we repeating past mistakes?
    - Leaks due to materials
      - Correct ones specified
      - Wrong ones installed

- **Global efficiency of subsea production below platform production**

  Problems often appear very early after installation and require long recovery procedures.
Subsea Systems – The Downside – Support

- **DSVs / ROVSVs**
  - Shortage – unable to readily obtain vessels for rapid intervention
  - New vessels coming onto the market
    - Where are the experienced crews / engineers / divers to man them?
  - Cost

- **Competence**
  - Lack of training
    - Vendor personnel
    - Operator personnel
  - Two contradictory assumptions prevalent:
    - Instrument subsea is the same as an instrument topsides.
    - It’s a black box, we need the vendor.
Subsea production – Potential improvements

- Tie-back to a platform – Primary importance to get first oil in time followed by a sustainable production

- Reliability of systems to be improved
  - Quality control
  - Requirements for Routine maintenance to be minimized: difficult and expensive
  - Unplanned incidents cost huge loss of production

- Long term operability of subsea systems must become a major trend for improvement,

- Operability of long subsea tie-backs is field proven but not yet a routine operation,

- Impact of subsea developments on topsides often under estimated,

- Standardization: Typical project approach going systematically for tenders is not compatible with standardization of subsea equipment, what can we do?

- General lack of competency, lack of inspection resources, are we doing enough?
Conclusion – Subsea, significance to the UK

- UKCS is a mature production area (38 Billion barrels already produced)
- 10 to 15 remain to be produced, 5 to 10 yet to be discovered
- 90% of new developments mobilize less than 50 MBoe, most below 20.
- Existing Infrastructure + Existing Subsea technology available in the UK are well adapted to this problematic.
- However success will be very dependant of the price of oil and capacity of the industry to keep costs at an acceptable level.
- Today, and specially today, such costs are not at a reasonable level in the UK.
Thank you for your attention