Deep Water Challenges

NSRI – the focal point for Research and Development for the UK subsea industry, aligned with Subsea UK

Dr. Gordon Drummond
Overview

- **Who we are**
- What is deep?
- What does deep look like?
- What are the opportunities / challenges?

- **Summary**
Who we are

A ‘not for profit’, industry led, expertly guided organisation

To enhance the UK’s position as the leading technology provider for the subsea industry

The technology arm of Subsea UK
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What is deep?

• 1970 – 1980s
  Diver depths  250m

• 1980 – 1995
  Birth of ROV  1000m

• 1995 – 2015
  New fleets √  2000m

• 2015 – 2035
  New fleets ×  3-4000m
Size of the prize
Size of the prize

Mature sedimentary basins in 3,000 to 4,000 m water depth

Ref: Deep offshore seminar
CLAROM Nov 2014

www.nsri.co.uk
State of the Art

Ref: Total Nov 2014

www.nsri.co.uk
The elephant in the room - Cost

London Olympics

- Bid $2.5 Billion
- Estimated $9 Billion in 2007
- Actual cost $14.6 Billion (+62%) – no schedule delay

Mega Project

- 2007 $8 Billion
- 2014 massive cost escalation, 18 months late

Norwegian projects

- Skarv +32%
- Yme +188%
- Valhall +86%

Ref: Managing the Efficiency of Foreign Engineering Contracts: A Study of a Norwegian and South Korean Project Interface; Byungmu Ahn
The elephant in the room - Cost

We are not ready to tackle ultra deep water until we have significantly better control of Cost & Schedule
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So what does deep water look like?

Google earth!
So what does deep water look like?

**Geography**

- 3000m-4000m water depth will be potentially 200kms from shore
- Probably with a step change (continental shelf) in depth on route back to shore.

**Reservoir characteristics**

- Reservoir would be composed mainly by liquid oil with dissolved gas due to high pressure, high CO2, H2S
- Reservoir will be long and flat in shape, large
- Reservoir will be deep subsurface, HP
- Pressure - high ~ 400bar
- Temperature - low ~ 50°C- 70°C
So what does deep water look like?

**Soils**
- Soil anticipated to have low mechanical properties
- Bathymetry generally flat and featureless (0.5°)

**Metocean**
- Almost no metocean data
- Subsea current not understood

**Political**
- Potential development areas are in and out countries boundaries, legal issues to be tackled
So what does deep water look like?

**Summary**

- These fields are highly remote; > 4 - 5 x tie backs
- The fluid properties are complex and onerous
- The seabed is not load bearing
- The location is deep, therefore offshore operations will be longer in duration.
- We know little about weather and metocean
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So what are the challenges/opportunities?

**Pre - FEED & FEED**

- Geo-phys - fewer exploratory wells

- Sensors to reduce uncertainty
  - Down hole, current, metocean, soils
  - Power and Communications for sensors

- Improved modelling from empirical input
  - Empirical co-efficients - scaling

- Solution! Long and remote
  - Tie back to the beech?
  - Standalone?
So what are the challenges/opportunities?

**Engineering**

- Flow assurance - thermal management due to distance
  - Pumping, separation, injection
  - Multiphase measurement; control & remediation

- Pipelines - thick walled for P, reduced diameter, corrosion allowance
  - Alternate materials

- Moorings, very, very long and congested
  - Alternate materials

- Controls
  - Versatility as unmanned
  - Rotating and reciprocating machinery - wear

L = Length
D = Diameter
So what are the challenges/opportunities?

**Installation**

- Subsea Positioning
- Simops infield
- The crane hook has a 8 Km journey
  - Wires and rigging, alternative materials
- Buoyance aids for deep water
So what are the challenges/opportunities?

**Transportation & Logistics**

- Weather windows
  - Flexible, dynamic schedule
  - Mistakes have a compounding effect

- Construction vessels remain in field
  - Materials brought to construction vessels, right kit @ right time in right place

- Support Port
  - Local content considerations
  - Alternate materials
So what are the challenges/opportunities?

Stand alone facilities

No export pipeline, no umbilical

- No pipeline;
  - Subsea storage facilities, Security!

- No Umbilical, No power
  - Renewable energy requirements
  - Low power demands
  - Energy harvesting & storage

- No Umbilical, No Comms
  - Through water, through air comms to remote desktop

- No Umbilical, No Hydraulics
  - Seawater hydraulics
  - Subsea accumulators
So what are the challenges/opportunities?

*Life of Field - OPEX*

- Inspection
  - GVI vs Measurement
- NDT Vs Condition monitoring
  - Non integrity threatening threats
- Life extension, defect evaluation
  - Minimise intervention
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