Ormen Lange Well Delivery

Ormen Lange Workover Riser – A Critical Review

Presenter – James Edgar
Location – Grieghallen, Bergen, UTC 2008
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Development Concept

2 x 30” Production Pipelines

42” Northern Pipeline

Production Rate = 70Mm3/day

44” Southern Pipeline

20% of UK’s Domestic Gas Supply from 8 Wells
Ormen Lange Field

- **Location:** 125 km offshore Norway
- **Water depth:** 700-1100 m
- **Area:** 350 km² (44 x 8)
- **Thickness:** 50 m
- **Reservoir depth:** 2600-2950 m
- **Reservoir temperature:** 93 °C
- **Seabed temperature:** -2 °C
- **Reservoir pressure:** 289 bar
- **Fluid type:** lean gas condensate 
  (80 m³/Mm³)
- **Recoverable Volume:** 397 billion m³ 
  (14 tcf)
Main technical challenges

- Deep water
- Seastate
- Current
- Cold seawater, -2°C at seabed
- Hydrate prevention
- Very high gas well flow rates (10 MScm/day) (350MMscf/day)
7" versus 9 5/8" wells

- Phase 1, pre-drilling
  - 14 x 5 = 70MSm³/day
  - 14 x 7" wells = 700 MUSD
  - 8 x 10 = 80MSm³/day
  - 8 x 9 5/8" wells = 400 MUSD

Cost savings of 300 MUSD

Ormen Lange wells are the largest deep water wells in the world. (wrt diameter and production rate)
Well design risks

- Bigger wells
  - Well control incidents, blow-out, barriers
  - Well interventions, large gas inventory

- Higher flow rates
  - Maximum gas velocities versus erosion
  - Vibrations and water hammer effects
  - Lower completion constraint

- Fewer wells
  - More dependent on each well, reliability
Workover/Intervention Riser

• Subsea Test Tree versus Open Water Riser
  – Major risks included compensator lock-up and unplanned release of THRT

“the assessment showed the major risk contributor came from the time taken for gas releases to be successfully shut in. Large bore high flow rate wells release sufficient volumes of gas to cover the installation in less than 30 seconds. This type of massive gas release, in combination with a burning test flare with likelihood of ignition, was identified as an unacceptable risk. The analysis revealed that it was the detection and shut in time that was the driving safety parameter, and not the reliability of the barriers.“

• So, we have a workover riser system....
10k, -20°C to 85°C
Principal Design Challenges

- Severe/variable Weather
- Interface with moonpool
- Management of temperature/pressure during intervention
- Weak link design
  - Physical design
  - Implications for rig
- Storm Hang Off (fatigue and interference)
- Protection of annulus line
What are we up against?

- Storm hits Ormen Lange field 10.01.2006
- Norne reports:
  - 17 meter significant
  - 27.1 max
- 100 year storm is 16 meter significant!
- Similar storm reported in 2005
- West navigator not in storm, sheltered in fjord
Interface with moonpool

- West Navigator moonpool
- 4.5m from well centre to edge of moonpool
- Pitch plus current may cause interference
- Reduction of operating envelope
Solution

- Centraliser Unit & Moonpool Skid
  - Functionality
  - Implications
  - Final iterations
  - Performance
Management of Temperature/Pressure

- Uncontrolled depressurisation could result temperatures <100°C
- Thermal analysis performed by Shell Global Solutions
- Recommended bleed down rates
- Experience
Weak Link

- NORSOK requirement to ensure barrier integrity
- Functionality
- Implications for the rig
- Performance
Storm Hang-Off

- Unable to hang-off conventionally due to fatigue and interference
- Resultant complication of disconnect criteria
- Experience
Protection of Annulus Pipe

- Contact forces with centraliser unit
- Detailed analysis
- Reduction of operating envelope
- Performance
Conclusions

• Implications of drillship underestimated
• Planning challenges resolved (?)
• Design specification not satisfied (Temp & Current)
  – Running criteria too optimistic?
• Manageable in summer months but unsuitable for winter (refer to work in progress)
Recent Work - RTOL

- Real Time Operating Limitations

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<table>
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<th>RTOL Limitations Table</th>
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<tr>
<td>Limit</td>
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```python
# Real Time Operating Limitations

def determine_operating_limits(input_data):
    # Determine the operating limits based on the input data
    # Example:
    # Limit 1: 1.0
    # Limit 2: 2.0
    # Limit 3: 3.0
```

![Real Time Operating Limits Diagram]

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`Real Time Operating Limits` for running the Orman Large URP based on Real Time Current Measurement. For more details, see the [RTOL Manual](#).