Marginal Field Development Concept

SEAL Engineering: Ange LUPPI, Gilles COUSIN (Speaker)
AMPLUS: Ian HERD, Steward RISK (co-authors)
TechnipFMC: Bente THORNTON, Chris FELT (co-authors)
Agenda

► Foraging System Overview

► DP FPSO

► Multi-Lines Flexible Riser System
  ▪ Riser Description
  ▪ Preliminary Analysis
  ▪ Outline Installation & Re-location Procedure

► Subsea Production system
Foraging System Overview

▶ Concept Premise:

- ‘Foraging’ system, incl.: DP FPSO + SURF & SPS
- Targeting small pools
- DP FPSO
  - No Anchor / mooring deployment
- Multi-Lines Flexible Risers
  - Design for recovery / re-location
- Flexible Flowlines
  - Flowline Integrated Manifold (FLIM)
- Subsea Production System
**Amplus Versatile Production Unit**

- **Amplus VPU 360**
  - DP 3 Classification
  - 360,000 bbl oil storage capacity
  - 40,000bpd process capacity
  - Double hull
  - FES Disconnectable Turret System
  - Full 360° weathervanning

Produced gas to be used in engines
Produced water treated and discharged to sea
System designed to handle 40,000bpd (option to increase)
Gas compression can be accommodated
Full range of options
Modular concept allows for building blocks – catering for a

Standardised components across the Process T

Proven technology has been incorporated throughout

24+
Megawatts
35%
usage
365
Days
Multi-Lines Flexible Riser System

Riser Description

- 1600m WD, WoA Case Study
- Flat Buoy
  - Steel Weight: 350t
  - Displacement: 910t
  - Dimensions:
    - Diameter: 14.5m
    - Height: 6m
  - Compartments: 24 off (12 x 2 levels), 32 to 41m³ per cpt

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Multi-Lines Flexible Riser System

► Riser Description
- 1600m WD, WoA Case Study
- Flat Buoy
  - Extensive Basin & Wind-tunnel Test Campaigns
  - Numerous CFD simulations & validations
  - Very stable buoy concept (OMAE2011-49329, ISOPE 2011)
Multi-Lines Flexible Riser System

► Riser Description
- 1600m WD Case Study
- Flat Buoy
- Lower Riser Assembly & Foundation
Multi-Lines Flexible Riser System

Preliminary Analysis (in progress)

- Nominal Configuration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
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<tbody>
<tr>
<td>Jumper Lengths</td>
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<tr>
<td>8&quot; ID Production</td>
<td>m</td>
<td>600</td>
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<tr>
<td>8&quot; ID Water Injection</td>
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<td>570</td>
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<tr>
<td>Umbilical</td>
<td></td>
<td>750</td>
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<tr>
<td>Flat Buoy</td>
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<tr>
<td>N° of Flooded Cpts</td>
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<tr>
<td>Net Uplift</td>
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<tr>
<td>Effective Tension @ Foundation</td>
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</table>

- Distance Turret / Foundation = 250m
- 8" ID Satellite Riser
- Umbilical, incl. equivalent 4" ID Gas Lift

- WD = 1600m
- 8" ID Central Riser (Length = 1430m)
- Turret Bottom View
- Satellite Riser
- Central Riser
- Umbilical

- WD = 1600m

- Flat Buoy
Multi-Lines Flexible Riser System

Preliminary Analysis (in progress)

- Main “Extreme” Results (100 years conditions)
  - No Contact between Flexible Lines
  - Min Tension @ Foundation = 70t
  - Max Tension @ Foundation = 172t

<table>
<thead>
<tr>
<th>Load Cases</th>
<th>Flat Buoy Rotations (deg)</th>
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<tr>
<td></td>
<td>Around X-axis</td>
<td>Around Y-axis</td>
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<tr>
<td>Min</td>
<td>Max</td>
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<td>Max Operating / Extreme</td>
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<td>-5.1</td>
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<tr>
<td>Buoy Flooded 2</td>
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<td>Buoy Flooded 3</td>
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<td>-3.7</td>
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<tr>
<td>Free Hanging</td>
<td>-8.1</td>
<td>-6.9</td>
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</table>
Multi-Lines Flexible Riser System

Outline Installation Procedure

- Flexible Pipe-Lay Vessel & Flat Buoy on site
- Crane operator to engage WI Riser into Flat Buoy slot
Multi-Lines Flexible Riser System

Outline Installation Procedure (cont.)

- Riser pull-down & connection to Foundation
- Flexible WI flowline connection to Riser Base and lay-away toward SPS
- Satellite flexible riser 1st end connection to Flat Buoy and flowline lay-away to SPS
- Jumpers connection at Flat Buoy, deployment and transfer to FPSO
Multi-Lines Flexible Riser System

► System Re-Set to Next Field

OUTLINE METHOD

Step 1 - Recover satellite jumpers
Step 2 - Recover production riser and umbilical
Step 3 - Disconnect water injection jumper from FPSO for free hanging at flat buoy
Step 4 - Disconnect stem riser system from seabed foundation
Step 5 - Tow riser system to next location (this drawing)
Step 6 - Repeat riser system installation procedure (refer to drawing R239 - DR100)
Subsea Production System

- SPS Generic Building Blocks
  - Flowline Integrated Manifold (FLIM)
Subsea Production System

 ► SPS Generic Building Blocks
   ▪ Flowline Integrated Manifold (FLIM)
   ▪ Subsea Tree
   ▪ Umbilical Termination Assembly
MARGINAL FIELD DEVELOPMENT CONCEPT

Thank You / Questions

Gilles COUSIN
SEAL Engineering
GCO@sealengineering.net