Offshore Development Concepts: Capabilities and Limitations

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April, 2013
TYPICAL OIL FACILITY BLOCK DIAGRAM
Outline

• Platforms
• Floating Structures
  – Semi-Submersible/ Floating Production System (FPS)
  – Tension Leg Platform (TLP)
  – Spar
  – Ship Shape/Floating Production Storage and Offloading (FPSO)
• Subsea
• Flow Assurance
  – Pressure Drop and Liquid Holdup
  – Hydrates
  – Paraffin
• Conclusions
Tamar Jacket
Tamar Topsides Sailaway
Figure 5  Launching and upending sequences of a platform jacket
Tamar Installation
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EXAMPLE SEMISUBMERSIBLE VESSEL (SSV) BASED FIELD DEVELOPMENT

• Location: GOM
• Water depth: 2,200 ft.
• Displacement: 35,000 tons
• Hull weight: 10,000 tons
  Number of wells: 24
• Export: Flowlines to hub
  Pipeline hub to shore
• Payload / Hub Capacity: Low
• CAPEX: Moderate
• OPEX: High
• Industry Experience: High
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EXAMPLE TENSION LEG PLATFORM (TLP)

- Location: GOM
- Water Depth: 4,000 ft
- Deck Weight: 23,000 tons
- Total steel weight: 40,000 tons
- Number of tendons: 16
- Displacement: 98,000 tons
- Number of wells: 24
- Installation method:
  - Hull & MSF floated out to site
  - Deck modules installed offshore
- Export: Pipeline to shore
- Payload / Hub Capacity: Moderate
- CAPEX: Moderate
- OPEX: Moderate
- Industry Experience: High
The Snorre TLP shows all features of a tension leg platform, except the most important one: the tethered mooring system, which remains completely under water. The water depth at this site is 309 m. Snorre was installed in 1992.

The voyage of the Ram-Powell TLP floater from the Belleli yard in Taranto, Italy, across the Atlantic Ocean to the Aker Gulf Marine yard in Corpus Christi, Texas, took 22 days. The hull weighs 14500 tons and is measuring 87 x 87 x 52 m. The overhang to both sides of the Mighty Servant 2 was 36.5 m.
Shell Mars
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EXAMPLE FLOATING PRODUCTION, STORAGE AND OFFTAKE SYSTEM (FPSO)

- Location: GOM
- Water depth: 4,000 ft.
- Displacement: 125,000
- Deck Payload: 30,000 tons
- Number of wells: 20
- Export:
  - Oil: Shuttle tanker
  - Gas: Pipeline to shore
- Payload / Hub Capacity: High
- CAPEX: Low
- OPEX: High
- Industry Experience: High
Foinaven FPSO
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<th>PLATFORM TYPE</th>
<th>PAYLOAD CAPACITY</th>
<th>COST</th>
<th>CAPEX</th>
<th>OPEX</th>
<th>EARLY PRODUCTION</th>
<th>EASE OF DRILLING</th>
<th>VERTICAL WELL ACCESS</th>
<th>EASE OF RE-USE</th>
<th>HUB CAPACITY</th>
<th>DEEPWATER APPLICATION</th>
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*H = High Score  M = Moderate Score  L = Low Score  N = Not Applicable*
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Subsea Trees, Jumpers, Manifold, Pipeline End Terminals (PLETs)
Ormen Lange - Statoil/Norsk Shell

- Subsea multiphase pipeline to shore
- Water Depth: 800 – 1000 meters
- Pipeline: 2- 30 in, 120km
- Flowrate: 70 MMMm3/d (2.5 BSCFD)
  - 24 wells
- Reserves: 400Bm3
Subsea Manifold Installation
Statoil Tordis – Produced Water Injection, Multiphase Measurement and Pumps
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  – Wax/Paraffin
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Inlet Pressure

Max Capacity Due to Pressure is between 500-600 MMscf/d. However, the maximum flow limit is further constrained by the Stabilizer Capacity.

Figure 5.4-2: Flow Line Inlet Pressure

Pressure fluctuations due to Slugging
HYDRATES

• A crystal of hydrocarbon and water

• Necessary Conditions:
  – Temperature (15 to 20°C)
  – Pressure
  – Free water

Mitigation

- Insulate flowlines and mitigate during cool down
  - Blow down to atmosphere
  - Circulate inhibitor or dead oil
- Heated fluid circulation
- Direct electric heating
- Chemical inhibition
  - Methanol
  - MEG
  - Low Dose Hydrate Inhibition (LDHI)
Wax Mitigation

- Insulation
- Pigging
- Hot oiling
- Pour Point Depressants
- Solvents

Wax in Flowline

Various Pigs

Scraper Pig
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Development Concepts