Hybrid Riser Tower – Tailored for Local Shallow Water Needs

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Overview

- Historical Bundle Hybrid Riser Towers
- Shallow Water Case Study
  - Background information
  - Riser solutions considered
  - Hybrid riser tower design implementation
    - Engineering
    - Fabrication
    - Installation
Shallow Water Riser Systems

- **Dry trees with well access at the surface**
  - Riser types
    - Conductors
  - Host facilities
    - Compliant towers
    - Fixed platforms

- **Wet trees**
  - Riser types
    - Flexible risers
  - Typical host facilities
    - Semi-submersibles
    - FPSOs

![Diagram of Flexible Risers and Conductors]
Deepwater Riser Systems

- **Dry trees**
  - Riser types
    - Top Tensioned Risers (TTRs)
  - Host facilities
    - TLPs/Spars

- **Wet trees**
  - Riser types
    - Flexible risers
    - Steel Catenary Risers (SCRs)
    - Bundle Hybrid Riser Towers
    - Single Line Offset Risers (SLORs)
  - Typical host facilities
    - Semi-submersibles
    - FPSOs/FPUs
Cameron Hybrid Riser Tower

- Bundled riser pipes
- Mechanically jointed and installed from drill rig on production platform
- Weight in water neutralised by buoyancy modules
- Tensioned wires from platform make riser follow platform
Cameron Hybrid Riser Tower

- Placid - Green Canyon (1988)
- Ensearch - Garden Bank (re-deployed 1994)

450-650m water depth

Both fields ended up producing sand. The riser was decommissioned and has not been used again.
2H Hybrid Riser Tower

- Adapted the Cameron design from under to offset from the platform
- Changed from mechanically jointed to all welded
- Beached fabricated, towed to site and upended
- First application on Total Girassol in Angola, 1350m depth
Shallow Water
Hybrid Riser Tower
Background Information

- 55 Nautical miles North of Matak island, Natuna Sea, Indonesia
- 90m water depth
- Estimated production rate 2000 – 3000 bopd and associated gas
- Field life of 5-7 years
Field Development Plan

- Fixed platform with dry trees not considered due to:
  - Remote location and lack of export infrastructure
  - Relatively high CAPEX for the desired production volume
  - Short field life to justify the CAPEX

- Three step-out pre-drilled subsea wells installed using a Jack up rig
- Tanker converted to an FPSO with mooring winches installed
Conventional Riser Solution Considered

- Flexible risers considered as base case
- Challenges for new build risers are
  - High cost: New flexible risers
  - Long lead time: Supply schedule could not be accommodated at time of project sanction
  - Interfaces: High hang off loads requiring deck structure strengthening resulting in increased FPSO modification costs

- Alternatively, an existing flexible riser from a stockist was evaluated and the issues encountered were:
  - Availability of the desired diameter and length
  - Adaptability in terms of pressure and temperature requirements
  - End fitting re-termination requirements and the associated cost and schedule
Alternative Riser Solutions Considered

- Bottom weighted riser: Technical feasibility proven, lack of track record
- Free-hanging coiled tubing based riser: Requires fatigue testing to establish fatigue performance curves
Selected Solution - Bundled Hybrid Riser Tower

- Riser bundle with a buoyancy tank to support and anchored to the seabed with a gravity base
- Dynamic bonded hose jumpers from riser top to FPSO
- Static bonded hose jumpers from riser base to wells
Selected Solution (contd.) - Bundled Hybrid Riser Tower

- Maximise use of stocked steel pipes and locally available materials
- Onshore steel fabrication
  - Lowest cost
  - Shortest lead time
- Parallel engineering, procurement and fabrication activities
  - Prioritise engineering and procurement of key components that require longer fabrication duration such as riser end terminations, spools, etc.
- Bonded flexible hoses connecting riser top to FPSO are available for a fraction of the price of equivalent unbonded flexible pipe jumpers and at much shorter delivery schedule
- Provides flexibility with installation vessel options instead of having to identify the installation vessel at the onset of the project
- Allows future riser relocation
- Has proven track record of being installed in deeper water depths
Riser Tower Schematic

- 3 x 6-5/8” production
- 3 x 3-1/2” gas injection
- 20” buoyant core
Riser Top Assembly

- **Function:** riser pipe spools to jumper departure to FPSO
- **Size:** 4m x 3.5m x 2m
- **Weight:** 8.6 Te
- **Chain Connection to BT**
Riser Bottom Assembly

- Function: riser pipe spools to jumper departure seabed wellheads
- Size: 3m x 3m x 2.2m
- Weight: 4 Te
- Chain Connection to Foundation
Buoyancy Tank

- Function: provide upthrust for the riser bundle
- Size: 4m dia x 6m length; 20m below MSL
- 50 Te net upthrust
Tether Chain

- Function: Provide articulation at the riser top and bottom
Riser Foundation and Dead Mass Anchor

- Function: Anchor the riser to seabed
- DMA attached to the riser bundle during installation
- Riser foundation structure installed prior to the riser bundle
Dynamic Jumpers

- Function: Conduit for production and gas injection lines from bundle riser to FPSO
- Size: 4in ID bonded hoses
- 12 x dynamic jumpers for riser
- 12 x static jumpers to wellhead
Installation - Riser Bundle

- Riser installed via cradle and upending from the rear end of crane barge
Riser Bundle Upending with Trunnion on the Barge
Riser Bundle Buoyancy Tank Connection Upon Upending
Overall Project Schedule

- Detail Design and Engineering; 5 months (Jan – May 2012)
- Procurement; 5 Months (Mar – Aug 2012)
  - Dynamic flexible jumpers
  - Static flexible jumpers
  - Dynamic Umbilical and buoyancy modules
- Fabrication; 5 Months (Mar – Aug 2012)
  - Riser bundle
  - Riser end assemblies
  - Riser foundation
  - Riser installation aid (cradle for upending)
- Installation; 10 days (Apr 2013) post monsoon and installation vessel availability
Challenges

- Preliminary and detail design combined into fast track schedule
- Engineering of riser bundle to suit the existing pipe stock
- Structural and pipe material verification to ensure they are fit-for-purpose
- Fast track flexible hose and umbilical engineering design to enable procurement and delivery on time
- Fabrication management to ensure adherence to fabrication specifications
- FAT/SIT and additional testing requirements for riser components such as tether assembly, flexible hoses and umbilical
- Depending on installation vessel availability, installation strategy and associated installation aids were developed
Questions?