The Design Evolution of Freestanding Risers

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THE DESIGN EVOLUTION OF FREESTANDING RISERS

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Agenda

• Riser Technologies & Challenges

• Freestanding (Hybrid) Risers
  – Configurations
  – Main Features
  – Main Components
  – Track Record
  – Recent Development

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Catenary Risers

Flexible

Steel

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Top Tensioned Risers (TTR)

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Flexible Riser Design Challenges

- Potentially large vessel payloads
- Water depth (collapse) limitations
- Pipe diameter limitations for deep water and higher internal pressure
- Prone to external sheath damage during installation
- Potential end fitting integrity issue

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*SCR Design Challenges*

- Potentially large vessel payloads
- Fatigue critical requiring good quality offshore welds and fatigue testing requirement
- Requires offshore welding
- High spec pipe-lay vessels required to install risers and flowlines
- Flow assurance may be a challenge due to potentially long tie-in

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TTR Design Challenges

- Tree and well control at the surface
- Large vessel payloads
- Complex interfaces and require speciality joints, e.g. keel joint, tapered stress joint
- Require high cost vessels such as Spar, TLP due to design sensitivity to vessel motions
- Heavy lift requirement for riser installation

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Freestanding (Hybrid) Riser

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What is a Hybrid Riser?

Hybrid Riser = Flexible Riser + Rigid Riser

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Freestanding Riser Types

- SINGLE LINE (SLOR / COR)
- BUNDLES (Internal) (External)

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Freestanding Riser Components

- Buoyancy Tank
- Upper Riser Assembly (URA)
- Upper Rigid Riser Pipe
- Lower Rigid Riser Pipe
- Lower Riser Assembly (LRA)
- Base Foundation
- Crossover Joint
- LRA Frame
- Piping
- Lower Flexible Joint
- Ballast Box
- Driven Pile
- Upper Flexible Joint
- Winch Support Frame
- URA Piping
- URA Frame
- Crossover Joint

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Freestanding Riser
Main Features

Key Advantages:
- Decoupled from vessel motions
- Not highly sensitive to environmental loading
- Low vessel payload
- Host vessel type flexibility
- Installation flexibility
- Local content
- Design standardization

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Freestanding Riser
Main Features

Key Disadvantages:

- Interference issues
- Limited quantity of SLORs in close area
- Increased design complexity
- High CAPEX compared to SCRs
- Installation challenges
  - Large components
  - Overall lift weight

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Design Considerations

- Storm Analysis
- VIV Fatigue Analysis
- First Order Fatigue Analysis
- Clearance Analysis
- Rigid Base Jumper Analysis
- Detailed Component FEA
- Installation Analysis / Vessel Capacity

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Freestanding Risers Track Record

- **1988**: Green Canyon 29
  - Placid Oil
  - Region: GoM
  - BHR

- **1994**: Garden Banks 388
  - Ensearch
  - Region: GoM
  - BHR

- **2001**: Girassol
  - Total Elf
  - Region: Angola
  - BHR

- **2004/5**: Kizomba A/B
  - Exxon
  - Region: Angola
  - SHR

- **2006**: Rosa
  - Total Elf
  - Region: Angola
  - BHR

- **2007**: Greater Plutonio - Block 18
  - Petrobras
  - Region: Angola
  - BHR

- **2010**: Macondo
  - BP
  - Region: GoM
  - SHR

- **2012**: Cascade/Chinook
  - Petrobras
  - Region: GoM
  - SHR

- **2012**: PSVM - Block 31
  - BP
  - Region: Angola
  - SHR

- **2012**: Guará & Lula-NE
  - Petrobras
  - Region: Bacia de Santos
  - BSR

(B2013)

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BHR – Bundle Hybrid Riser
SHR – Single Hybrid Riser
BSR – Buoyancy Sustained Risers
Shallow Water Freestanding Riser: Early Production System (EPS)

- Indonesia’s Natuna Sea, 95m water depth
- Early Production System (EPS)
- Bundled hybrid riser

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Riser Design - Assembly

- Buoyancy Tank
- Riser Guide
- Riser Bundle
- Jumpers
- Riser Support
- Dead Mass
- RTA
- RBA

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Riser Design - RBA

Gas Pipe

Production Pipe

Riser Bundle

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Flowline Assembly - 24” Pipe Flowline

- Flood Manifold Frame
- 24” Pipe
- Flexible Jumpers
- FTA

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Shallow Water EPS Benefits

- Onshore steel fabrication
- Significantly improved lead time compared to the conventional flexible riser systems
- Host vessel flexibility and reduced interface requirements
- Pre-assembled hoses to reduce installation time
- No high spec reel-lay or installation vessel required, can suit with DSV and crane barge for installation

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BSR – Guará & Lula NE

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Thank you for your time.

Questions?

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