

2H Offshore - deep water riser engineering

**ENERGY WISE WORKSHOP 2002**


**TECHNOLOGY OPTIONS FOR  
DEEPWATER BRAZIL**



**“FIELD DEVELOPMENT SOLUTION  
WITH A  
RISER & WELL SYSTEMS FOCUS”**

**By  
Stephen Hatton / David Walters  
2H Offshore**


2H Offshore - deep water riser engineering



**Deepwater Field Development Drivers**

- ❑ **Reduce CAPEX and OPEX**
- ❑ **Cost Effective FPS**
- ❑ **Less Expensive Riser Systems**
- ❑ **Minimise Offshore Construction**
- ❑ **Flexibility to facilitate upside**
- ❑ **Flexibility to accommodate EPS**
- ❑ **Simplified Interfaces to improve Schedule**
- ❑ **Direct well access for efficient drilling/WO**
- ❑ **Flow Assurance (Thermal & Productivity)**

2H Offshore - deep water riser engineering



## CURRENT SOLUTIONS

<b>SUBSEA TREES</b>	<b>DRY TREES</b>
<b>Advantages</b> <ul style="list-style-type: none"><li>❑ Low Capital Cost</li><li>❑ Development flexibility</li><li>❑ Seabed isolation</li><li>❑ Simplified interfaces</li><li>❑ Vessel Flexibility</li></ul> <b>Disadvantages</b> <ul style="list-style-type: none"><li>❑ High Drilling Cost</li><li>❑ High OPEX Cost</li><li>❑ Process flow challenges</li></ul>	<b>Advantages</b> <ul style="list-style-type: none"><li>❑ Low Drilling Cost</li><li>❑ Low OPEX Cost</li><li>❑ Process flow friendly</li></ul> <b>Disadvantages</b> <ul style="list-style-type: none"><li>❑ Complex interfaces</li><li>❑ Vessel Constraints</li><li>❑ Offshore Construction</li><li>❑ High Capital Cost</li><li>❑ Limited flexibility</li><li>❑ Surface isolation</li></ul>

2H Offshore - deep water riser engineering




## Better Solution?



**STORM<sup>TM</sup>**  
Subsea Tree Offset Riser Manifold

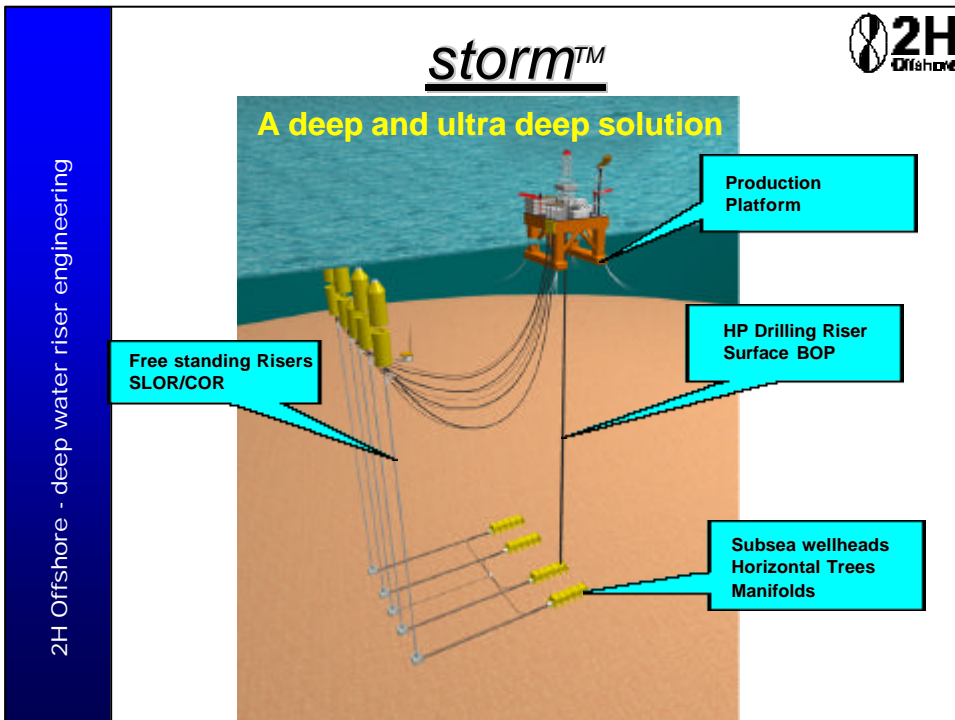
A Deepwater Solution  
to  
Deepwater Problems  
with a  
**Riser & Well Systems Focus**

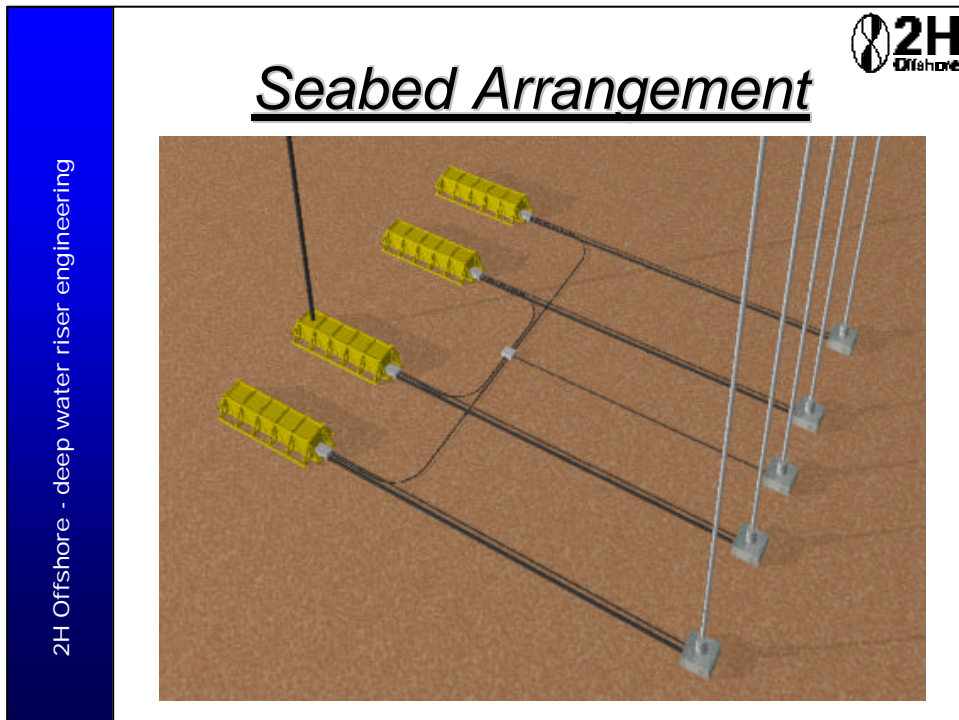
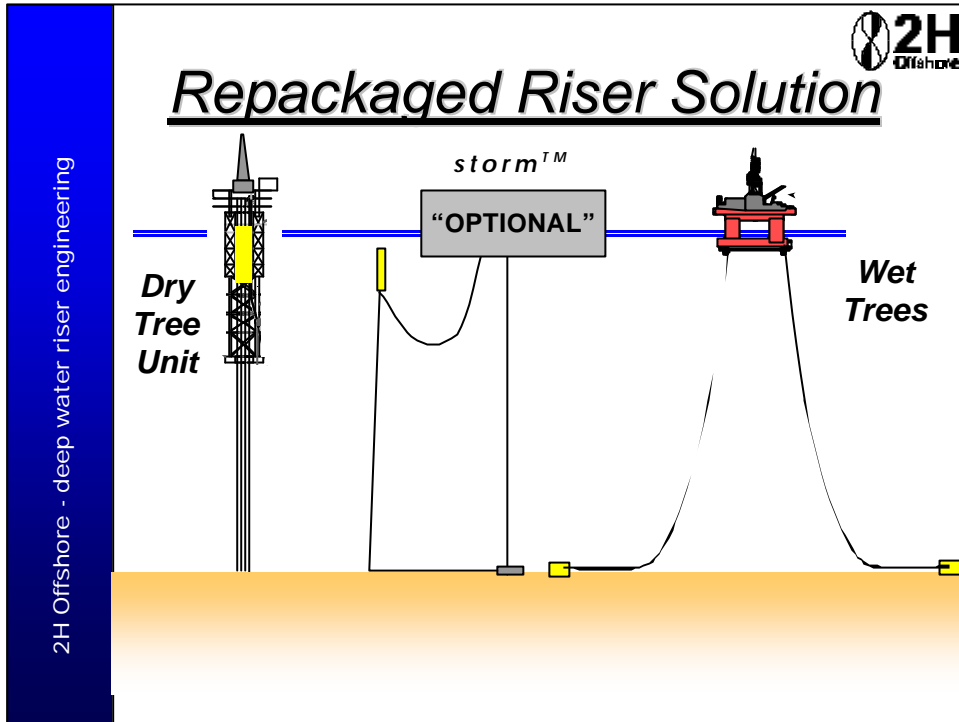
2H Offshore - deep water riser engineering



## storm<sup>TM</sup> - Design Drivers

- ❑ System focus on riser and well systems
- ❑ Combine the benefits of Dry Tree and Wet Tree Solutions
- ❑ Illogical to tie back heavy dry tree risers in deepwater
- ❑ Maintain direct well access for efficient drilling/WO (Single drill site)
- ❑ Simplify interfaces to simplify execution
- ❑ Isolation at the seabed is safe
- ❑ Subsea trees have never been cheaper or more reliable
- ❑ Facilitate upside flexibility (locally and remotely)
- ❑ Riser system accommodates EPS
- ❑ Provision for Artificial Lift

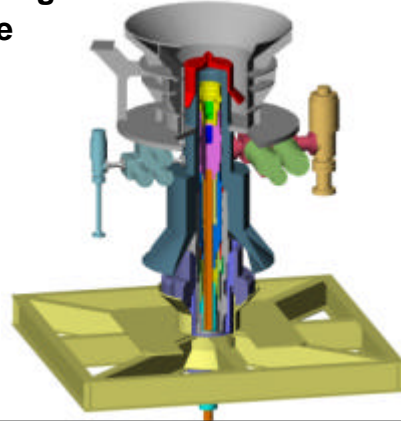






## Benefits of Horizontal Tree

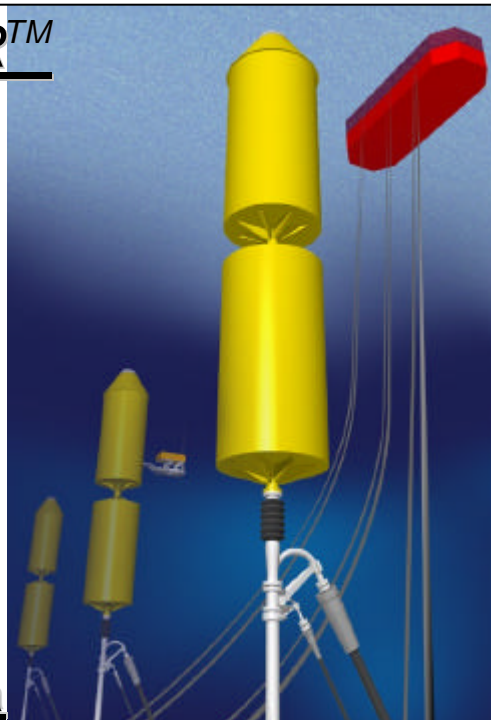
- Tubing Hanger located within the tree
- Tree remains in place while tubing string is pulled
- Good for frequent workover
- Use of High Pressure Drilling Riser w/Surface BOP
  - Jump riser - tree to tree
  - More efficient W/O



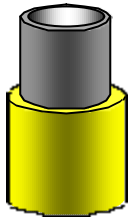

## COR™/SLOR™ 'TRF' JIP

- PHASE I
  - Mechanical Design
  - Structural Analysis
- PHASE II
  - Detailed Design
  - Inst. Procedures
  - Thermal Analysis
- PHASE III
  - Fatigue Testing

Selected by  
Exxon for Kizomba

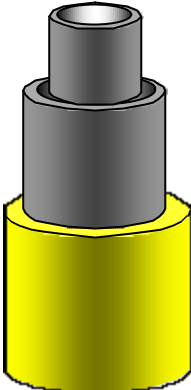


2H Offshore - deep water riser engineering



**SLOR™**  
*Single Line Offset Riser*

- Production
- Gas Injection
- Water Injection
- Export

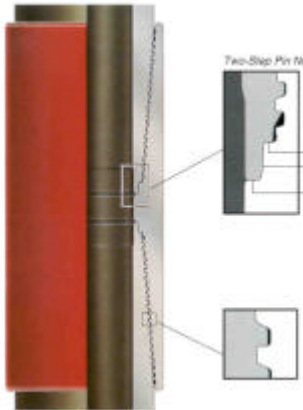



**COR™**  
*Concentric Offset Riser*

- Production
  - Riser Base Gas Lift
  - Active Heating
  - N<sub>2</sub> or Vacuum Insulation

2H Offshore - deep water riser engineering

*Threaded and Coupled Connection*



- Non Welded
- High strength steel
  - Thinner Wall Thickness
  - Less Steel Weight
  - Less Buoyancy
- Proven metal seal
- Fast make-up
- Good fatigue
- 'Better than weld'
- Low cost

2H Offshore - deep water riser engineering



## Coupling Fatigue Qualification

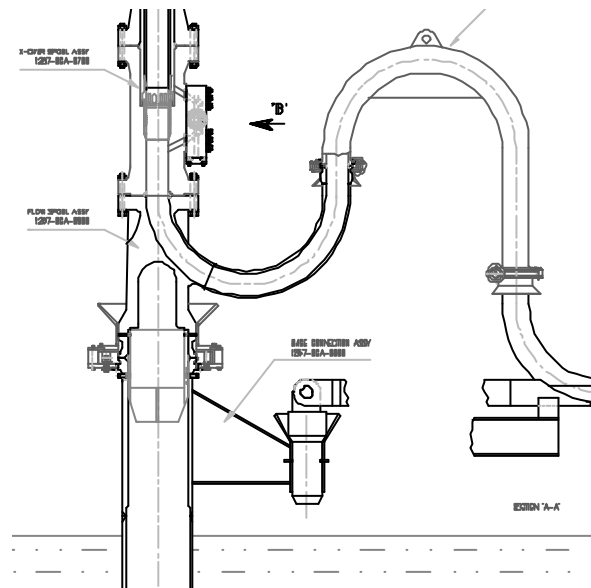
- ❑ 9-5/8" VAM TOP FE Coupling
- ❑ Qualified SCF 3.0
- ❑ 150Te Mean Tension (internal jacking)
- ❑ 11 samples
- ❑ 3 stress ranges
- ❑ Integrity gas test

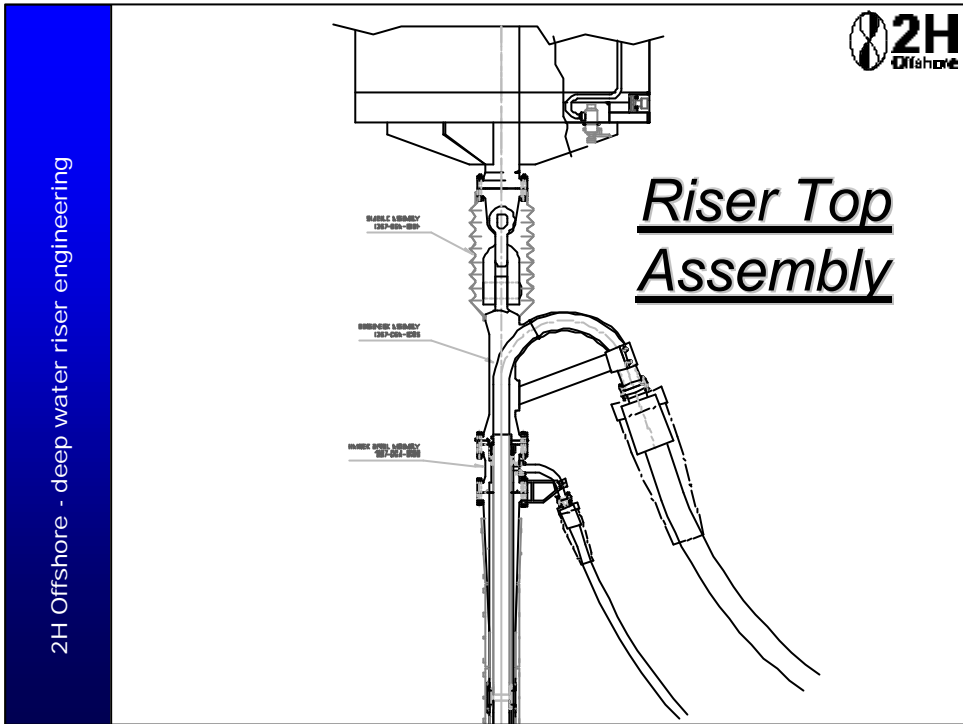


2H Offshore - deep water riser engineering



## Riser Base Assembly





2H Offshore - deep water riser engineering

**2H Offshore**

Riser System Benefits

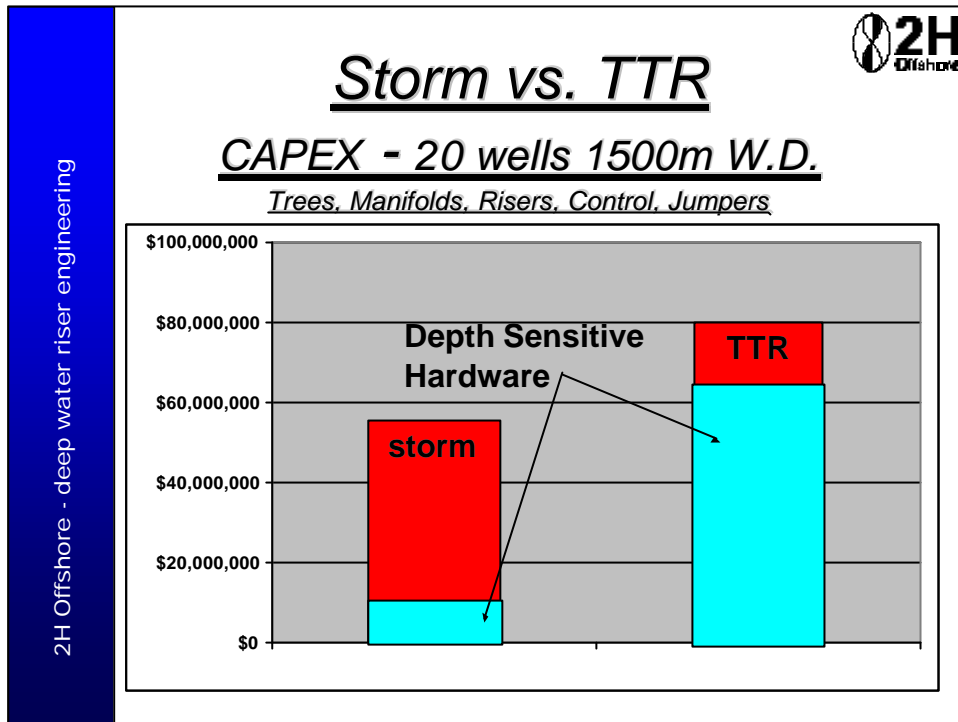
**DTU**  
3,300 lb/ft

**storm**  
570 lb/ft

**Saving 2,730 lb/ft**


Steel @ \$1500-\$10,000/Te  
Air can @ \$2500/Te

2H Offshore - deep water riser engineering



- 2H Offshore - deep water riser engineering
- ## Riser System Benefits
- ❑ Depth Insensitive – Low CAPEX
  - ❑ MODU or FPS Installation (No Mob Cost)
  - ❑ Pre-Installation Feasible
  - ❑ Suitable for disconnect for replacement of EPS
  - ❑ Flexible field layout (Single point of contact)
  - ❑ Low Payload
  - ❑ Fatigue Insensitive
  - ❑ Process Flow Efficient
  - ❑ Flexible Annulus usage
    - ❑ Riser Base Gas Lift
    - ❑ Vacuum
    - ❑ Active Water Heating


2H Offshore - deep water riser engineering



## storm<sup>TM</sup> vs. Subsea System

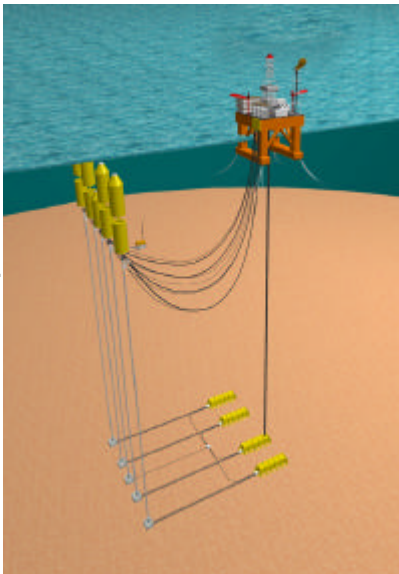
<b>BENEFITS</b>	<b>LIMITATIONS</b>
<ul style="list-style-type: none"> <li>❑ Well Access from FPS</li> <li>❑ Efficient Drilling &amp; W/O</li> <li>❑ Reduced OPEX</li> <li>❑ Eliminates long flowlines                             <ul style="list-style-type: none"> <li>❑ Reduced installation</li> <li>❑ Good Thermal performance</li> </ul> </li> <li>❑ Facilitates EPS                             <ul style="list-style-type: none"> <li>❑ Riser Disconnect/Connect</li> </ul> </li> <li>❑ Improved Schedule                             <ul style="list-style-type: none"> <li>❑ Risers Pre-installed (EPS?)</li> <li>❑ Fast Riser Hook Up</li> </ul> </li> <li>❑ Less vessel Payload</li> <li>❑ Less congested Seabed Layout</li> <li>❑ Emergency Disconnect</li> </ul>	<ul style="list-style-type: none"> <li>❑ Single Drill Site</li> <li>❑ Not suitable for fragmented reservoir (over large area)</li> </ul>

2H Offshore - deep water riser engineering



## storm<sup>TM</sup> vs. Dry Trees

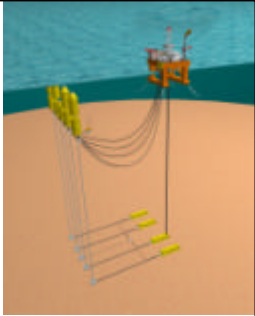
- ❑ Improved safety
  - ❑ Eliminates HP risers
  - ❑ Subsea isolation
  - ❑ Eliminates congested wellbay
  - ❑ Separates drilling & production
  - ❑ Eliminates riser clashing risk
  - ❑ Improved emergency disconnect
- ❑ Reduced cost
  - ❑ Lower cost hull + deck
  - ❑ Low cost risers and subsea equip.
  - ❑ Low Cost Abandonment
  - ❑ Residual asset value
- ❑ Min. offshore construction
  - ❑ No offshore hull/deck mating
  - ❑ No hull air cans installation
- ❑ Flexibility
  - ❑ Well count flexibility / expansion
  - ❑ Predrill or pull-over drilling
  - ❑ Pre-installation of risers
  - ❑ Accommodate remote wells



2H Offshore - deep water riser engineering


## *storm*<sup>TM</sup> Summary

- ❑ Riser & well system focus solution
- ❑ It is a true deepwater solution
- ❑ Suitable with any production vessel
- ❑ Safer, lower cost, more flexibility than a spar
- ❑ Equivalent drilling and WO capability to DTU
- ❑ Proven hardware
- ❑ Simplified interfaces
- ❑ Eliminates requirement for long flowlines
- ❑ Depth insensitive
- ❑ Suitable for EPS
- ❑ Optimum solution a combination of direct and satellite trees



2H Offshore - deep water riser engineering

## *storm*<sup>TM</sup>



**Neither Surface or Conventional Subsea Solution .....**

<p>High Capital Cost <b><u>Low Cost Drilling</u></b> <b><u>Low OPEX</u></b> Low Flexibility Surface Isolation <b><u>Process Flow Friendly</u></b> Complex Riser Interfaces</p>	<p><b><u>Low Capital Cost</u></b> High Drilling Cost High OPEX <b><u>High Flexibility</u></b> <b><u>Seabed isolation</u></b> Process Flow Challenge <b><u>Simplified Interfaces</u></b></p>
--	---

.... but has the benefit of both

