Deepwater Opportunities and Challenges

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Keynote Speaker
Global Deepwater Discoveries

- Oil: 30 billion bbl
- Gas: 14 billion boe
Deepwater 2000 Daily Operated Production
Fields in WD >500 m

- Petrobras
- Shell
- bp
- ChevronTexaco
- Amerada Hess
- Kerr-McGee
- ExxonMobil
- Others

kboe/day
Uncertain Future
Brent crude 1985-2020

$/bbl

energy efficiency
cost cutting
fuel competition
producer restraint
demand growth

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Key Deepwater Challenges

- Reservoir Identification/Characterization
- Technology Development & Application
- Value Creation/Cost Leadership
- Access to Experienced Staff
- Societal Expectations
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Seismic Imaging

- Prospect identification
- Positioning of development wells
- Time lapse seismic to discern changes in fluid properties as the field is produced
Real Time 3D in “Caves”

Viewing sub-surface in virtual reality centres

Accelerated planning and knowledge sharing
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Technology Impact on Cost Reduction

Source: Cambridge Energy Research Associates
In the meantime, as we can see from this chart developed by the Cambridge Energy Research Associates, technology has had a major impact on industry performance.

And I am convinced that technology will continue to be a significant differentiator in the future of the industry. The difference is and will continue to be technology.
Role of Technology in Deepwater

*Breakthroughs and ever-increasing water depth:*

**50’s**
- First single point mooring system (Malaysia)

**60’s**
- First subsea completion (GoM)

**70’s**
- First dynamically positioned drill ship
- First “J-lay” installed flow line/flexible pipes
- First FPSO (Spain)
- Deepest fixed steel platform (Bullwinkle)

**90’s**
- Successively deeper and cheaper
- 5 Tension Leg Platforms in GoM
- Deepest subsea field development
TSF Deepwater Nautilus
Expandable Tubulars

Current

Future

Diameter

Slender

Clad / Re-Entry

Standard

Courtesy: Enventure Global Technologies
Conventional Circulation

- Drilling Fluid Processing
- Marine Riser
- Subsea BOP

Subsea Pump Circulation

- Drilling Fluid Processing
- Subsea Pump & Return Conduit
- Marine Riser
- Seawater Filled

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**Smart Wells**

**VALUE:**
- Avoid high cost recompletions in multi-zone wells
- Commingle zones w/ different pressures & drive mechanisms
- Reduce total well count in a project

**ISSUES:**
- Mechanical complexity could reduce well reliability & increase high cost intervention
- Lack of a reliable multi-lateral HP junction
- Lack of a reliable multi-phase meter
- Complexity of GOM Gravel Packs

**SEPCo PLANS:**
- Brutus - 1 well
- Nakika - 5 wells
Breakthrough Surface Systems

- Composites for outer skin
- Alternative hull shapes
- Robotics for Internal Inspection
- Risers as mooring
- Dynamic Positioning Assist
- Slack Risers
- Composite Risers
Breakthrough Surface Systems

Breakthrough surface systems - focusing on enabling marginal fields by lower life cycle costs and by increasing the crude sales price by crude enhancing technology.

Key problems with marginal fields are that they are sensitive to CAPEX and frequently have poor quality crude properties. The poor quality can affect the sales price by up to $2/bbl.

This initiative will focus on lowering the initial cost of surface systems by working on breakthrough technologies and on improving the sales price of the crude production through the use of crude enhancing technologies.

Surface technologies such as using different hull shapes to lower the environmental forces and using slack vertical risers without tensioners may dramatically lower the cost of surface structures. The use of new composite materials may also add further cost reductions.
Novel Deepwater Systems

- DICAS Mooring System
- Synthetic Mooring Lines
- Crude Enhancement Technology

- PinP Electrically Heated Flowlines
- Steel Lazy Wave Risers
- Surface BOP Drilling and Completions

- Wellhead Spar
- DVA Semi
- Near-Surface Transfer Line
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SEPCo DW Drilling & Completion Performance

2000 - 2001 Highlights

• Best-in-class HSE performance
• Drilling the Limit™ savings $65MM in 2000
• 17% improvement in TLP drilling
• 30% time/15% cost improvement in TLP completions
• Leading DW technology implementation (e.g. expandable casing)
HSE performance GOM TRIR = 0.62

1.8MMBE SS accelerated production from TLP completion performance improvement

From increased penetration rate on chart, with average well depth of 18,300 BML and $350k/day rig spread rate, this difference equals $23MM!
Equipment Standardization

Mensa Tree System
Height = 35’
Weight = 240,000 lb.

Standard Tree System
Height = 19’
Weight = 144,000 lb.
Tree System Costs

- Mensa
- Trees 1-5
- Trees 6-10
- Tree 11

Frontier Technology
Developing Standard
Applying the Standard with Discipline

Learning Curve
Target Cost

$M
GOM Subsea Tree Installation Time

Days per 3,000 ft Water Depth

- Tahoe: Average 7.8 Days
- Popeye: Average 7.8 Days
- Mensa: Average 7.8 Days
- Macaroni: Average 3.6 Days
- Angus: Average 3.6 Days
- Europa: Average 3.6 Days
Development Projects Cost Index

- Auger
- Schiehallion
- Ram-Powell
- Mars
- Ursa
- Brutus
- Bonga
- Forecast

- Jan-89
- Jan-91
- Jan-93
- Jan-95
- Jan-97
- Jan-99
- Jan-01
- Jan-03
- Jan-05

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Subsea Cluster Developments

- Proven Economically Viable Option
  - Remote, Deep Areas
  - Smaller Accumulations
- Improved Reliability
  - Experience
  - Standardization
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The Resource Challenge

O&G Industry Technical Professional Workforce

Distribution %

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Global Deepwater Technology and Expertise Flow
Global Deepwater Discoveries

Notes for previous slide

Approx. 35 BBOE have been found to date with breakout mix at approximately 2/3 oil - 1/3 gas

Reserves found by Region:

<table>
<thead>
<tr>
<th>Region</th>
<th>BBOE</th>
<th>% of BBOE Discovered Globally</th>
</tr>
</thead>
<tbody>
<tr>
<td>South America</td>
<td>~10</td>
<td>28%</td>
</tr>
<tr>
<td>Africa</td>
<td>~9</td>
<td>25%</td>
</tr>
<tr>
<td>North America</td>
<td>~6</td>
<td>17%</td>
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<tr>
<td>Australia</td>
<td>~4</td>
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<tr>
<td>Europe</td>
<td>~4</td>
<td>11%</td>
</tr>
<tr>
<td>Asia</td>
<td>2.5</td>
<td>7%</td>
</tr>
</tbody>
</table>
Global Communication

Viewing sub-surface in virtual reality centres

Accelerated planning and knowledge sharing
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Expectations of Society
Expectations of Society

With all these achievements in technology and value creation, we must not forget that we are operating in potentially exposed environments, working with highly flammable products. Until our technology allows us to remove manned facilities from the offshore, this exposure will increase as we move to deeper and more remote waters. Our industry must maintain its management of Health, Safety and the Environment. Our own responsibilities and the expectations of society will not let us put our people at risk.

A series of major offshore incidents in the late 1960s and the 1970s highlighted these risks, but it was not until the Piper Alpha disaster in 1988 that the industry woke up to the fact that something could and should be done. Today, HSE is approached systemically - HSE management is the watchword, and Safety cases are mandatory in most operations. Looking after the safety of an offshore installation requires continuous monitoring and improvement.

Our industry needs to approach this together - there cannot be any element of secrecy or competitiveness about HSE management. We believe that in the long term all accidents can be prevented, but it will require the efforts of everyone to be a part of the solution.

Finally, business conditions will become more challenging as investors see other, new opportunities for their investments. We all need to satisfy our various shareholders and stakeholders. Cost reduction and technological improvements, along with ensuring that development is sustainable are essential to achieve this objective.
HSE Commitment

• No harm to employees and contractors
• Protection of the environment
• Efficient use of materials and energy resources
• Public reporting on HSE performance
• Sustainable development strategies
• HSE Management System
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DP Challenges/Opportunities

- Equipment and hardware
- Procedures and commissioning
DP Challenges/Opportunities

**Equipment/hardware**

- More reliable/robust DGPS systems
  - Integration between different manufacturers
  - System response to equipment failures
- More sophisticated/reliable acoustic systems
  - Handle variable pitch thrusters
  - Improve signal time transfer
  - Eliminate interference problems in close proximity operations
DP Challenges/Opportunities

Procedures/commissioning

- Standardized failure reporting and follow-up
- Standardized procedures and training
- More rigorous system integration testing and commissioning
- Recommended guidelines on drills, watch standards, roles & responsibilities
- Supply vessel standards and guidance for interactions with other vessels
Thank You!