How to **Profitably** Exploit GoM’s Lower Tertiary STONES Field CASE STUDY

Providing:
- Increased Safety
- Improved Decision Quality
- Improved Well Operations
- Improved Reserves Recovery

with
- Existing Technology Components, and
- **Greatly Reduced Costs and Risks**

“An innovative engineering step change solution for the Paleogene - because the 20K Supply Chain cannot get us there.”

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Frontier Deepwater’s Wellhead Platform Creates Value for ultra-DW Fields

- **Problem:** The STONES field is losing billions of dollars

- **STONES field was brought onstream in 2016...11 years after discovery in 2005**
  - Reserves are estimated at ~2bn boe estimated over 8 blocks
  - Phase 1 was sanctioned in 2013 when oil & gas prices were very high
  - SHELL has invested billions into STONES including 15 subsea wellbores plus sidetracks

Based on published BSEE production data and project costs
Stones Subsea Infrastructure Performing Poorly

STONES’ subsea well production and **uptime is disappointing**
- Well completions are performing poorly
- Large number of sidetracks and interventions costly @ $1.1MM per day
- Subsea system uptime appears poor
- DP Drillship Thalassa ongoing support cost prohibitive

**BSEE Production Data**
- Average ~45%?

**Stones Production History**
- Published BSEE production data
Solution: Install Frontier FrPS Wellhead Platform(s)

- Convert 6th generation semisub MODU with 5-slot movable wellbay
  - Direct drilling/completion and vertical access for simplified well construction & completions
  - Direct access to downhole ESP’s and/or seabed lift systems
- Sending produced fluids to FPSO limits topsides kit on the Wellhead Platform
- Use existing wellheads and wellbores to tieback dual barrier dry tree risers

Conversion Cost and Well Systems $600MM

Two curves show existing production rate (BSEE data) increased by:

- +50% due to artificial lift
- 90% well uptime

Assuming $55/bbl oil

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Bringing Real Value to STONES - RESULTS summary

- Installing 1st converted FrPS Wellhead Platform as STONES Phase 1+ with production flowing to Turritella will stop the “bleeding” in ~3yrs
- Phase 1+ proves concept viability for full field development at <$50/bbl
- The Phase 1+ investment turns the field profitable within 5yrs of operation
- The Phase 1+ investment provides a positive NPV within 8yrs of sanction – even if production is limited to 50,000bopd
  - Downhole lift of fluids may increase output and profitability... 
    - **IF** the FPSO can be de-bottlenecked
  - Artificial Lift & direct access increase ultimate recovery

As is, STONES will always have negative NPV

But, STONES could be a $bn NPV winner with Dry Trees & ESPs + Artificial Lift

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Let’s Change the Game and Win!

**Next Steps** *(with Shell and their preferred Contractors*)

- 6th Gen MODU Conversion Study
- Stones Movable Wellbay Preliminary Design
- Dual Barrier Top Tension Riser System Design
- FPSO Transfer Line Design and Flow Assurance

*Frontier has proposals from Dril-Quip, Schlumberger and Transocean*
KEY REFERENCE SLIDES

MOVABLE WELLBAY for STONES

Providing:
• Increased Safety
• Improved Decision Quality
• Improved Well Operations
• Improved Reserves Recovery

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Frontier Movable Wellbay

Outboard Well Positioned Under Rotary

Frontier Deepwater Movable Wellbay

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Surface Wellhead landed on Tension Joint. Riser is centralized inside tension joint.

Riser Tensioner (1 of 4 per slot)

Telescopic joint connected during 100 year winter storm, then removed when platform is abandoned for Hurricanes.
“Tension Ring” showing wireline riser tensioner connections

UHMW Wear Strips with very low coefficient of friction allowing the tension ring to slide up and down inside the frame.

Soft and Hard Rubber Pads to Allow the Tension Ring to land out on the up and down stop with minimum impact loads
Wellbay Centered and Locked for Hurricane Showing Maximum Upstroke

Frontier Deepwater Movable Wellbay
## Well Systems – proven technology

### Drilling Riser

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<thead>
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<th>Outer Riser</th>
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<tbody>
<tr>
<td>OD</td>
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<tr>
<td>Wall Thickness</td>
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### Production Riser

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<th>Inner Riser</th>
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<tbody>
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<td>Q-125</td>
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<tr>
<td>Buoyancy OD</td>
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<tr>
<td>Buoyancy Length per Joint</td>
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<td>Number of Buoyed Joints</td>
<td>80</td>
<td></td>
</tr>
</tbody>
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Shipyard Modifications Required

6th Gen MODU Wellhead Platform

Movable Wellbay

Production sent to FPSO for processing
Movable Wellbay Safety Advantages

Fully rated dual barrier well systems with surface BOP

• Improved safety
• Proven technology with much lower costs
• Direct hydraulic controls provide reliable surface system for BOP and dry trees
• Equipment easily inspected and maintained
• Well control more reliable
  • Can bullhead with full pressure at the surface
  • Eliminates the Macondo analog
• Better performance downhole ESP implementation
• Historically documented 15 – 25% more oil recovered with dry trees
• Fewer vessel and manhours offshore reducing HSE exposure
CONCEPT PREMISE – Use existing facilities as much as practical

• Convert/install 1st FrPS Wellhead Platform with movable wellbay providing direct surface drilling/completion capability, but minimal topsides production kit over an existing well clusters

• Send produced fluids to Turritella FPSO for processing/export of 50,000bopd + gas

• Use existing wellheads as much as possible
  • Add new wells when needed to replace non-performing wells

• Create and install additional FrPS Wellhead Platforms in stages as needed
  • NOTE - New wells for dry tree completion can be drilled while MODUs are being converted into FrPS
Wellhead Platform can service six (6) STONES wells

- The graph below shows that a 3% “watch circle” in 9500ft WD makes 6 wells directly accessible from the permanently moored FrPS.
- One slot of the 5-slot movable wellbay can be dedicated to servicing any well that is not converted to dry tree tieback.

STONES well positions per BSEE coordinates data