Frontier Deepwater Lower Tertiary Drilling and Production System
Making Discoveries Like the Lower Tertiary Profitable at Less Than $50/bbl

Frontier Production System (FrPS)

Movable Wellbay in FrPS Moonpool

ABS Approval in Principle 2017
BSEE Concept Review 2018
US Patent 9,976,364 2018

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The Next Step in Deepwater – Proven Solutions with Innovation
The Commercial Setting for GoM In a Critical State

- Daunting subsalt reservoir uncertainty
  - Faulting and connectivity
  - Reservoir drive mechanisms
  - Sand control & completion
  - Intervention frequency

- Very high drilling and completion costs
  - 35,000’ wells requiring >250 days
  - 20K MODU (BOP, completion and intervention system) with 20K back up?

- 1st time 20k subsea equipment and HIPPS demands massive CAPEX, OPEX and RISKEX over the long term

Lack of reservoir and completion performance information means huge, riskier bets, so projects are being deferred or cancelled.
Low Cost - Low Risk Phased Approach

• Convert 6th Gen Semi using 5-well dry tree movable wellbay
  – Newbuild option enables 10+ wells slots

• **Use of simpler proven technology reduces risk**
  – TLP well systems reduce technology complexity,
  – Equipment can be ordered today

• **Sanctioning a phased system avoids the need for a large appraisal program for full field development**
  – Each phase can be economic at less than $50/bbl
  – Dry trees increase recovery adds 15% - 25% more oil

• **Provides critical reservoir, drilling, completion and intervention information to de-risk full resource development**
Like Onshore Shale
“FrPS on the Pad” – “Drill the Cube!”

- Directional drilling area is HUGE
  - Project sanction is based on reserves that can be accessed from 1 drillsite
  - Fewer appraisal wells and faster project schedule results in ½ the cost and time to develop

- Much cheaper sidetracks result in the best bottom hole locations and maximize recovery

- Inexpensive dry tree interventions will significantly increase total resource recovery
  - Downhole pumping with (ESP’s)

Subsea wells can be drilled and tied back to the FrPS as 20K technology and equipment becomes cost effective.
FrPS 6th Gen MODU Conversion Concept

Shipyard Conversion Scope
• Remove subsea BOP, drilling riser and DP equip
• Install a permanent polyester mooring system
• Install 65+kbpd production module
• Install 5 well movable wellbay

Resulting Drilling and Production Unit
• A safer permanently moored platform
• Fully rated dual barrier well systems
  • Simple, reliable direct hydraulic surface BOP
  • Strong enough to bullhead with full pressure from the surface BOP
  • Simpler accessible downhole completion equipment
• Full capability drilling and completion system
• 65 kbd production facility

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**Patented Movable Wellbay**

- Risers have syntactic foam buoyancy to reduce tensioner size to 4 x 250 kips per slot.
- Risers stroke freely on tensioners in all winter storm conditions (100 yr).
- Risers allowed to hit the “stops” and stretch for survival conditions during 1,000 year hurricane (rig abandoned).
  - OrcaFlex FEA shows risers never exceed 80% of yield during 100 year hurricane.
  - Tree and BOP remain inside deck when riser is on downstop.

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Shipyard Modifications Required

3,500-ton 65,000 bpd production module

Production Module with Decks Located in Riser Storage Area

Movable Wellbay

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Dramatic Cost Savings Delivered

FrPS rig has a loaded dayrate less than 1/3 rd of a 20K drillship.

1 - FrPS 5 wells
2 x FrPS with 10 wells are cheaper than a 20K subsea 10 well system and host

Frontier FrPS - 5 Wells Phase 1
Frontier FrPS - 5 Wells Phase 1 + 2
20K Subsea - 10 Wells
Hull and Topsides Installed
Dry Tree Risers and/or 20K SURF
Drilling and Completion

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FrPS Start of Operations
5-well Drilling Plan

Pre-DRILLING Using Fleet 15K MODU
- Drill & case #1 & #2 to full depth
- Drill & case wells 3, 4, & 5 through 14”

Install FrPS into Pre-Installed Mooring System
- Run/connect/hang-off five (5) outer risers (16” OD)
  - Establishing full hurricane survival status in 1 week
- Run full pressure-rated inner riser (11-3/4”) and complete #1
  ➔ Start flow of FIRST OIL
    [Can use 13-5/8” surface BOP]
- Run full pressure-rated inner riser and complete #2
- Directionally Drill & Complete wells 3, 4, and 5
  - Use Combo riser strategy – drill to top of reservoir thru outer riser.
  - Run dual barrier inner riser to drill reservoir section.
Dramatic Time Savings Delivered

First Oil 3 Years Faster than Full Field Hub!!
Don’t Skid the Rig – Skid the Wellbay!

Rather than **skidding** this **MOUNTAIN**

- Rig can be statically integrated like a MODU
  - Lower CG means less acceleration and smaller storm loads
    - Huge “building size” movable sub-base eliminated
  - Utilities are simpler with fewer interfaces rather than on the moving sub-base
  - Reduces platform size and costs for TLP, Spar and Semi

**Other Applications**

- Direct vertical access to subsea wells
- Subsea trees directly beneath the platform with ESP’s
- Subsea caisson’s with ESP’s and remote subsea wells

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Movable Wellbay Commercial Advantages

Provides technology to convert under utilized MODU’s to profitable units

- Less than $\frac{1}{2}$ the cost and schedule of a full field system
- Phased approach generates cash flow and reservoir data years sooner
  - Sanction project with fewer appraisal wells
  - Project generating profit for Operator at well below $50/bbl
  - Reservoir performance information to determine best development strategies for full field
  - No need for huge, risky investment in 20K subsea, 20K drillship or HIPPS

Can be used on purpose built TLP’s, Spar’s or Semi’s

- 10 or 15 well slots for direct vertical access to subsea wells
- Rig can be located statically, more simply and much more cost effectively
  - Lower CG will reduce platform and mooring system size and cost
Movable Wellbay Safety Advantages

Fully rated dual barrier well systems with surface BOP much safer

- Proven technology with much lower costs
- Direct hydraulic controls provide reliable surface system (BOP and 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
THANK YOU!

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