PRESENTATION TO DRILLING ENGINEERING ASSOCIATION

NEW TECHNOLOGY FOR DEEPWATER INTERVENTION USING A SELF STANDING RISER

June 24, 2010- RPSEA Project 1502
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RPSEA 1502 Coiled Tubing from a Small Vessel
June 2010 Update Presentation Topics

• Background
• Project Objectives
• System Configuration
• CT Capabilities
• Features & Advantages
• Opportunities for Industry Participation
Nautilus is conducting 2 projects which are co-funded by RPSEA:

- **Coil Tubing Drilling and Intervention System Using a Cost Effective Vessel RPSEA 1502** - addresses the growing need for a low cost well intervention system in deep water subsea wells. The enabling technology is a patented self standing riser that will provide companies with a safe and affordable way to complete, re-enter and maintain subsea wells.

- **Early Reservoir Appraisal, Utilizing a Well Testing System – RPSEA 2501** - will develop an integrated “general source” to deal with varied disciplines needed to plan, cost and run deep water tests in the Gulf of Mexico. This project will provide a way a company can evaluate all the possibilities for deep water testing in the Gulf of Mexico to determine the optimum options to test including the planning, costing, and operational requirements.
RPSEA PROJECT TEAM

RPSEA Operator Advisory Committee
Anadarko • Chevron • Shell • ConocoPhillips

Subcontractors
IntecSea • NOV CTES • General Marine Contractors
• GE Vetco • Tidewater • Huisman • University of Tulsa

Industry Advisors
Halliburton • Baker Hughes Inteq
Project 1502 uses a self standing riser (SSR) which we believe is an enabling technology for deep water well intervention - to allow the cost effective use of coiled tubing.
RPSEA Project: Coil Tubing Drilling and Intervention System (CTIS) Using Cost Effective Vessels

This project is an approach that would go from conceptual feasibility, to the actual field test design and construction of necessary components, concluding a field test demonstration

- Establish intervention systems to reduce cost by 50% compared to MODU intervention for GoM
- Full coiled tubing capability same as from a Jack Up or on land
- Establish reliable hardware and operating scenarios
- Optimize for work in 1500 to 2000 meters of water, suitable for 3000 meter
- Strong emphasis on safety and environmental safeguards
The Search for a Cost Effective Deep Water Intervention System has been going on for Years

- Riserless intervention systems have evolved around a subsea lubricator for electric and wireline intervention.
- Seafloor intervention systems for coiled tubing have been investigated, but found too complex and expensive.
- Coiled tubing intervention from dry trees (for deep water) has been increasing.
- Other deep water intervention, requiring circulation, is done using MODUs.
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FOLLOW-ON OBJECTIVES

• Detail Design & Fabrication
• Demonstrate CT with Self Supporting Riser
  ▪ Simple Tasks on an Available Well
  ▪ Vessel of Opportunity
• Commercialize Safe Low Cost Deep Water CT
  ▪ Suitable for Central Gulf of Mexico
  ▪ Half the Cost of a MODU
  ▪ Work With Existing Service Contractors
  ▪ Dedicated Vessels if Justified
  ▪ Reusable Rental Risers
• Risers on Standby for Callout
New Technology for Deep Water Drilling, Production, Testing, Intervention

**RISER ELEMENTS**

- Buoyancy
- Keel joint
- Premium joints with strakes
- Standard joints
- Stress joint
- Tieback connector
- Wellhead or suction pile
ALL THE TECHNOLOGY EXISTS TODAY

- Small vessels to handle using drilling and coiled tubing drilling and to run SSR
- Casing drilling, mud motors, cementing, etc.
- Self-standing risers, shear rams, BOPs
- Coiled tubing intervention and drilling
- Mono bore completion with coil tubing
- Damp trees, subsea shallow separators
- SSR support platform for separator and storage of liquids
Reasons CT Not Being Used in Deep Water

1. Deck space
   - Requirements for CT footprint too large for MODU’s
   - Thus too expensive (without costly modifications)
2. Riser required for majority of applications
   - Safety
   - Circulation
   - Buckling
   - Etc.
3. MODU’s are in high demand and very expensive

Is there a way to eliminate the need for an expensive MODU?
STATUS

- Building on Anadarko SSR Program
  - Computer Simulations
  - Wave Tank Validation
  - Prototype Installed in 3400 Depth In 2006

- Complete RPSEA Phase 1 in 2010
SSR TECHNOLOGY – FIELD TRIAL
New Technology for Deep Water Drilling, Production, Testing, Intervention

MEPS Technology – Field Trial

Test Location 26.0669098 lat, -96.0032272 longitude
yellow ~980 m deep purple ~ 1050 m deep

Houston

Gulf of Mexico Test Location
PHASE 1 WORK

- Adapt Riser for Retrieval & Reuse
  - Easy Installation And Recovery
  - Small Low Cost Vessels
  - Smaller Buoyancy For Small Moon Pools
- Low Cost Stress Joints and Riser Pipe
- Simplify Design Of Variable Buoyancy
- Interface To Available CT Equipment
- Optimize For 1500 to 2000 Meter Depth
  - Suitable For 3000 Meter Water Depth
RISER INSTALLATION VESSEL

Typical SSR Installation Vessel

- 180 To 200 Feet Long
- DP 2
- 15 Ft Moon Pool
- 75 Ton Crane
- ROV
New Technology for Deep Water Drilling, Production, Testing, Intervention

**RISER READY FOR INTERVENTION VESSEL**

- Selected BOP functions including shear & isolation
- Maximum water depth 10,000 feet
- SELF SUPPORTING RISER AS FOUND BY INTERVENTION VESSEL
- Shear & Reservoir Isolation
- Tree

Maximum water depth 10,000 feet
New Technology for Deep Water Drilling, Production, Testing, Intervention

TYPICAL INTERVENTION VESSEL
• 180 TO 200 FEET LONG
• DP 2
• 10 FT MOON POOL
• 10 TON CRANE FOR TUBING & TOOLS
• ROV
• CT CONTRACTOR’S STANDARD CT EQUIPMENT

DOWN HOLE INTERVENTION CONFIGURATION

CT reel
Injector
Stabilized platform
Diverter/wiper
Selected BOP functions
Key CT Modeling Conclusions By NOV CTES

- CT Strings Can be Designed to Perform Interventions in Most Subsea Wells
  - Straight-Wall String Designs can Reach > 33,000’ TD
    - With available 120kpsi material
  - Tapered String Designs can Reach 40,000’+
    - Using reasonable buoyancy & pressures
- Optimum CT Size to Balance Pump Pressure and Fatigue Life is: 2-3/8” to 2-7/8”
New Technology for Deep Water Drilling, Production, Testing, Intervention

## Maximum Well Depth

- Max Allowable Stress = 80% of Yield Stress
- Max Allowable Force = Force in CT @ Max Allowable Stress
- Incl. Margin of Overpull (MOP) = 10% of Max Allowable Force
- Same Fluid Inside & Outside the CT

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Maximum CT Depth (ft)
SYSTEM WILL INCORPORATE THESE FEATURES

• SSR can be pre-installed on existing tree
• SSR is left ready for intervention vessel
• SSR has control umbilical for tree
• Redundant CT shear & reservoir isolation functions
  – At seafloor & near surface
• Provisions for vessel emergencies
  – Fast emergency disconnection, easy re-engagement
SYSTEM WILL INCORPORATE THESE FEATURES

• No compromise in safety
  – Personnel safety
  – Asset protection
• Redundant reservoir isolation
• Risers on standby for callout
• Less than half the cost of MODU intervention
**IF THE SSR IS PROVEN VIABLE - THE MARKET OPPORTUNITY FOR NON-MODU TYPE VESSELS AND AUXILIARY EQUIPMENT IS IMMENSE**

The cost effectiveness of this approach will:

- We do not compete with other service providers
- Open up a market for CT units
- Increase market/share for intervention of subsea wells
- Provide an affordable way to install and service artificial lift
- Provide a new market for SSR related auxiliary equipment - production tees, safety systems, riser monitoring equipment
- Could provide another way for early well testing
Acknowledgements

This project is co-funded by Research Partnership to Secure Energy for America (RPSEA), contract # 08121-1502-01. Information on our project and others is posted on their website www,rpsea.org

RPSEA and DeepStar identified the high cost of well intervention as one of their primary deep water challenges. They issued an RFP and Nautilus was awarded a contract in 4Q 2009.

Nautilus would like to thank its project team: CTES NOV, General Marine Contractors, Huisman USA, GE Vetco, IntecSea, BHI, Tidewater and others; and the RPSEA industry steering committee of Anadarko, Shell, Chevron and ConocoPhillips; and RPSEA project manager Art Schroder.
Questions?

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