

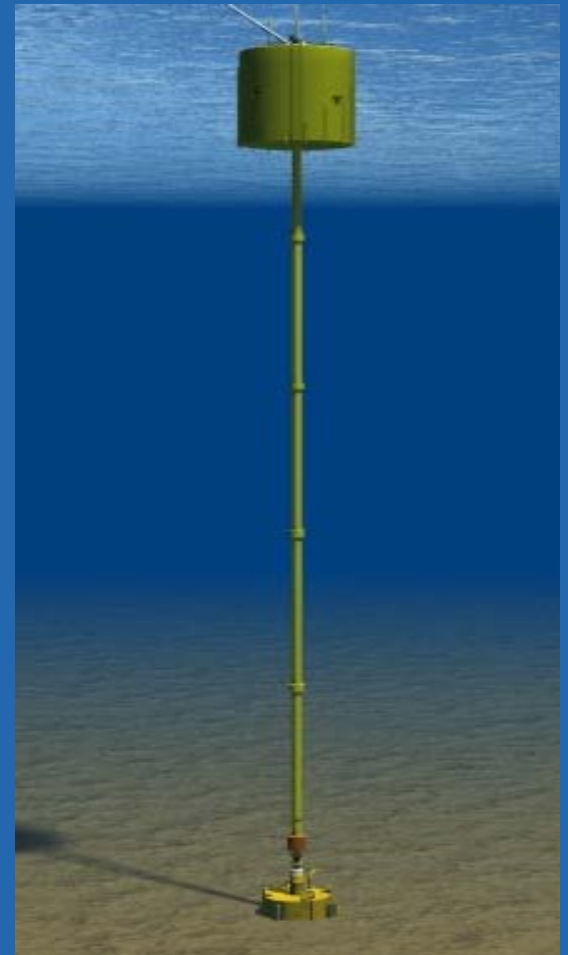
# **Coil Tubing Drilling and Intervention System Using Cost Effective Vessel**

**SPE Paper Number 130688**

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## *Background for this paper*

This paper is centered on a self standing riser (SSR) technology that will change the economics of deep water well intervention; it will provide service companies with a critical enabling technology to help operators increase oil and gas production in deep water; and it will save them hundreds of millions of dollars.



- **Nautilus International LLC is a technical service and engineering company who's focus is to develop and demonstrate cost effective drilling and completion technologies for deep water through a patented free self standing riser. (SSR)**

**We do not compete with any company in this room and we hope to show you how this project and our technology will enable you to increase your market share in deep water.**

# Nautilus International LLC

*A company dedicated to providing solutions to reduce the cost of drilling, completing and producing deep water offshore wells.*

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**Nautilus is conducting 2 projects which are co-funded by RPSEA:**

**Coil Tubing Drilling and Intervention System Using a Cost Effective Vessel** 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** – 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.



# RFP2008DW1502 - Coil Tubing Drilling and Intervention System Using Cost Effective Vessel

## Project Team:

RPSEA Operator Advisory Committee: Anadarko, Chevron, Shell, ConocoPhillips

### Subcontractor

NOV CTES

IntecSea

General Marine Contractors

GE Vetco

Tidewater

Huisman

Baker Hughes Inteq

### Work to be Performed

CT equip specs & ops.

Riser design & analysis

Vessel & equip. & ops.

Subsea equipment

Vessel configuration & cost est.

Riser extension & stabilization

Downhole Tools application

## Why develop the SSR?

- There are billions of barrels of oil to find and produce in deep water fields with recoverable reserves less than 100 million bbls. Maybe as much that has been found in the big fields greater than 100 million bbls.
- The deep water industry has literally made itself too expensive, too technically complex, with painfully long times from discovery to first oil!!
- Major companies and most big independents have made the assumption that even with \$100 per bbl oil the smaller deep water fields are uneconomical and do not warrant the prioritization of the already limited technical and operational work force!!
- NOCs and Governments holding deep water marginal oil and gas fields are frustrated being told that these assets are uneconomical and cannot be developed for a long, long time!!

# SSR SOLUTION OPENS UP NEW MARKETS IN THE GOM AND WORLDWIDE DEEP WATER

- SSR could open up many Deepwater (1000 to 5000 ft) shallow gas plays (3000 to 12,000 ft) not commercial using conventional deep water technologies.
- Hundreds of deepwater wells in the GoM, West Africa, and Brazil need to be re-completed - most of these wells will be abandoned because the cost of using a MODU approach is too expensive.
- Using SSR technology and coiled tubing could add millions of BOE from existing wells.

## SSR SOLUTION IS THE ENABLING TECHNOLOGY TO ECONOMICALLY DEVELOP DEEP WATER MARGINAL FIELDS HAVING LESS THAN 100 MILLION BARRELS OF RECOVERABLE RESERVES

- By 2005 a study has shown over 3,300 discovered offshore fields with recoverable reserves less than 100 million BOE.
  - Most of these fields in more than 500 ft of water are not developed and will not be developed unless near a producing infrastructure
- As many as 1000 deep water fields of less than 100 million BOE could be discovered in the next ten years,
  - But companies have no desire and can't afford to pursue exploitation of these smaller deep water fields using conventional deep water technology.
- SSR solution enables the exploration, testing, completion, production, and intervention of these marginal fields.
  - Companies could add billions of BOE developing these fields.

# Subsea Market is Exploding

- According to the MMS, a greater number of deep water wells in the GoM are being completed as subsea completions and tied back to production facilities.
  - Flow assurance advances coupled with the high cost of production facilities will increase the number of subsea (ss) completions
  - Already 3,000 ss wells worldwide (400 GoM)
- Future Deepwater E&P must focus on smaller <100 million b.e. fields)
- Artificial lift is essential for most DW wells to maximize recovery
- Intervention is a reality

**The high cost associated with re-working these wells if and when they encounter problems is significant**

**Growing need  
for Cost  
Effective Deep  
water  
intervention**

- *Re-entry is one of the most costly challenges for deep water wells*
- *Many wells are not re-entered because of cost*

**Address an  
expanding  
market of deep  
& ultra deep  
subsea wells**

- *For: Initial completion, Cleaning out wells, Repair down hole tools, Replacing/Installing ESPs, Re-completing new zones, zonal isolation, stimulations-mini frac's.*

## The limiting factor for CT is size and weight

1. The deck space requirements for a CT footprint is too large for MODU's and thus too expensive (without costly modifications)
2. For the majority of applications a riser is required. (Safety, circulation, buckling, etc.)

# IF THE SSR IS PROVEN VIABLE - THE MARKET OPPORTUNITY FOR NON-MODU TYPE VESSELS AND AUXILIARY EQUIPMENT IS IMMENSE

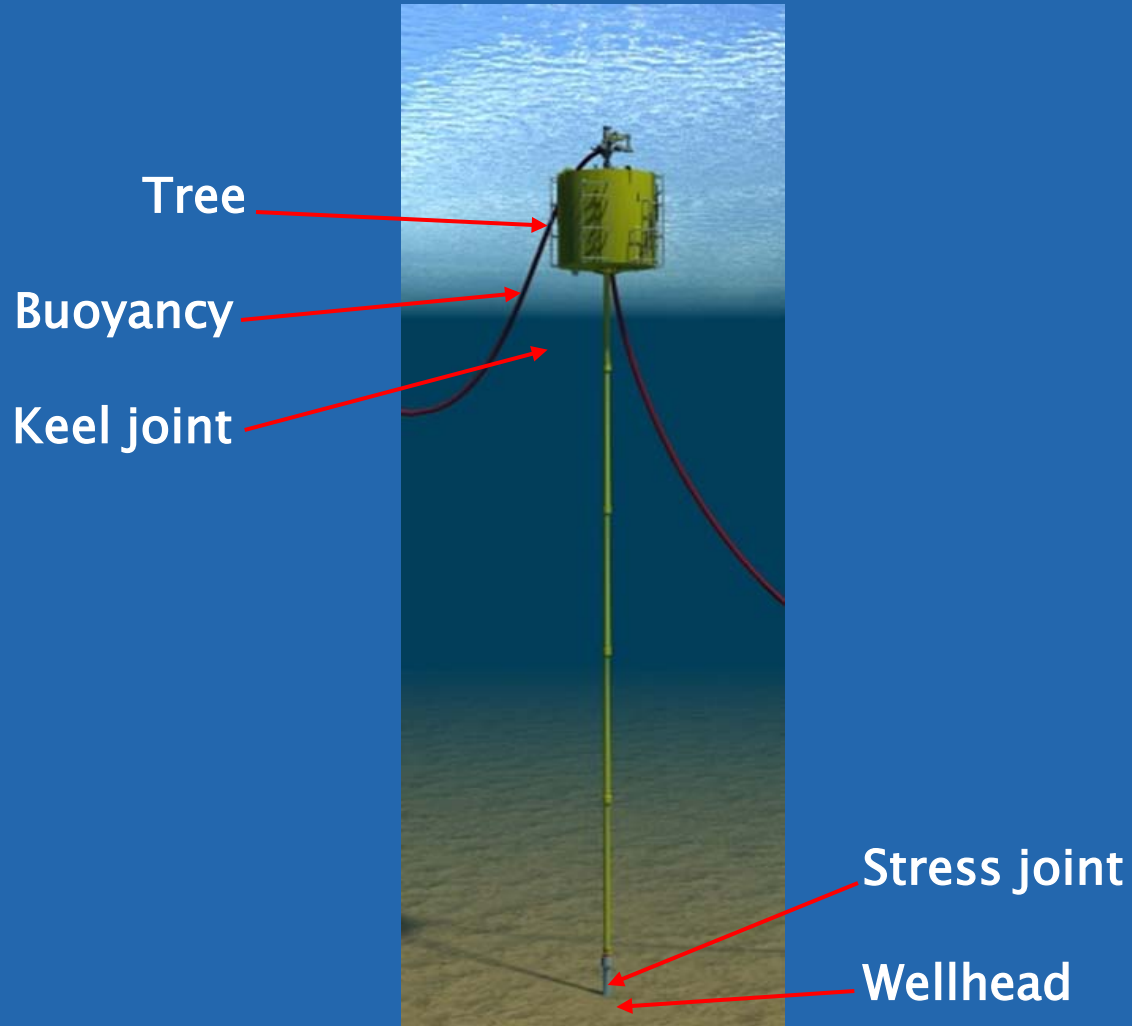
The cost effectiveness of this approach will generate:

- New affordable drilling systems
- Open up a market for CT units
- Increase market/share for intervention of marginal wells
- Affordable install and service artificial lift
- New market for SSR related auxiliary equipment - production tees, safety systems, riser monitoring equipment

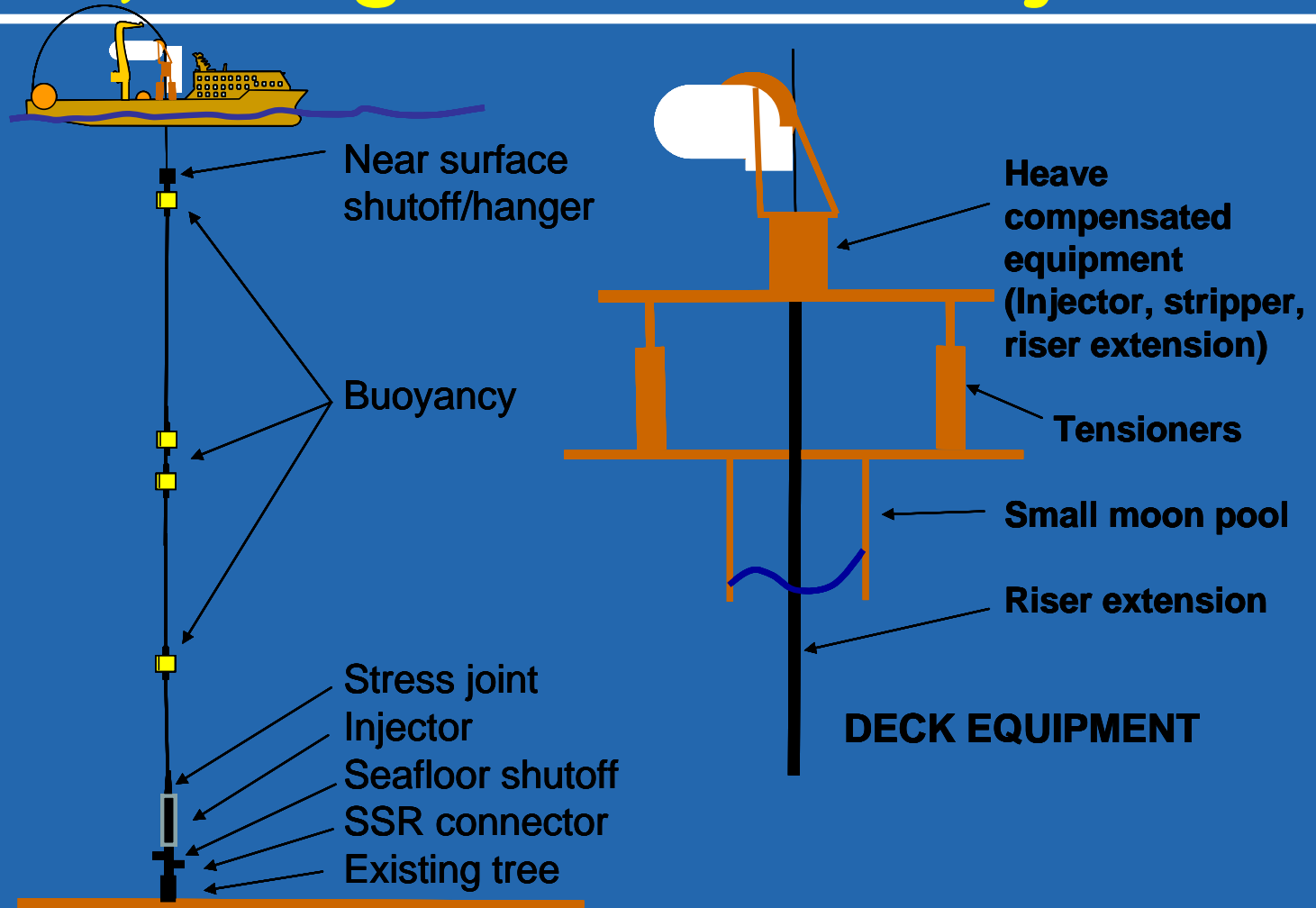
**Understanding the Challenge to do subsea intervention without a MODU – this system would have:**

1. Connection to existing subsea production or injection tree
2. Design of SSR that can be pre-installed and made ready for intervention
3. Safety devices to control the well and prevent failures
4. The CT design to operate from a non-MODU vessel
5. Vessel requirements to facilitate running and operating the CT to do the intervention

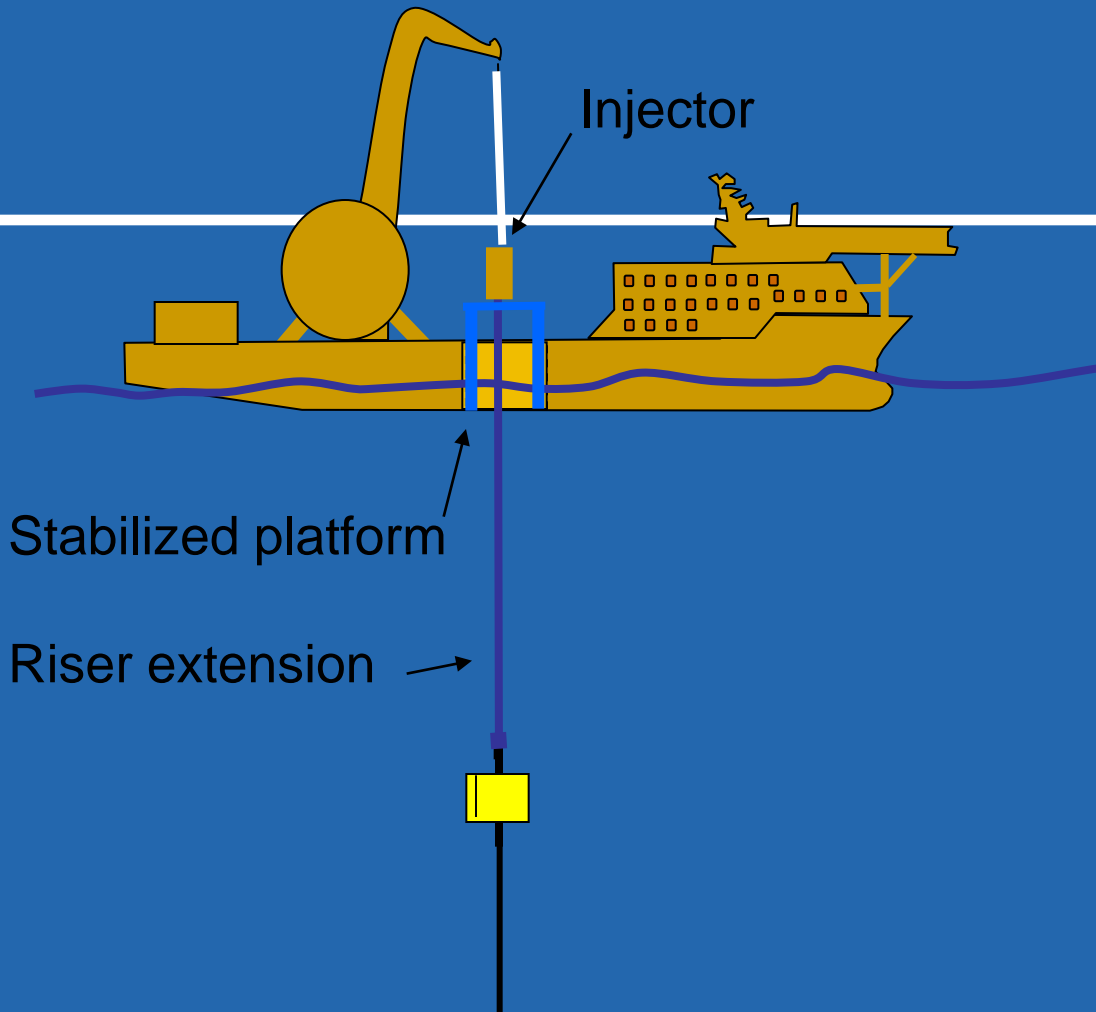
# The Self Standing Riser (SSR)



# Overall CT System Deployed via a SSR, Using a non-MODU system

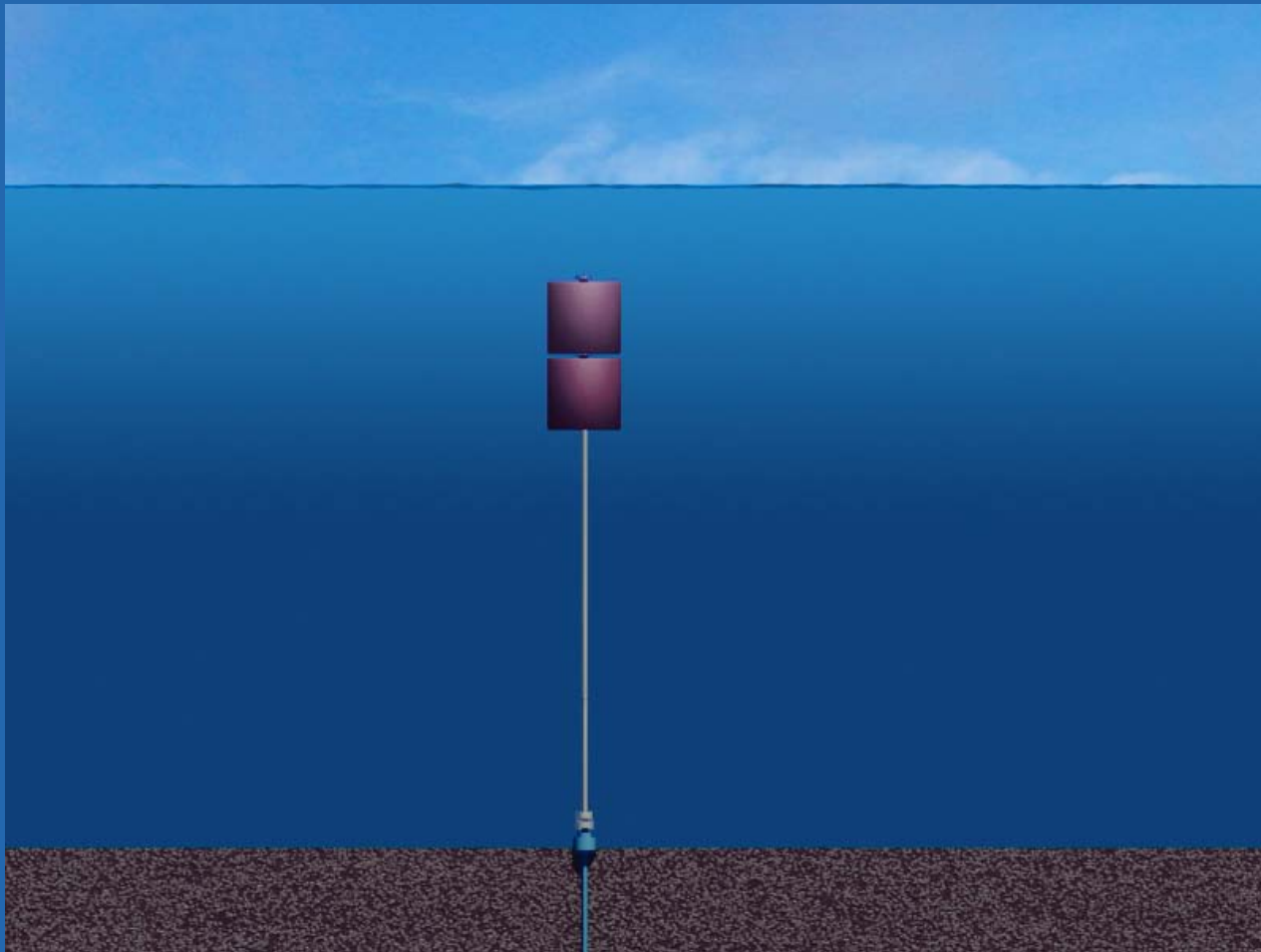


**Fig. 1 Proposed Self Standing Riser Coiled Tubing System**



**RISER EXTENSION & INJECTOR  
SUPPORTED BY STABLE PLATFORM  
DURING DOWNHOLE WORK**

# Connection to the Subsea tree with the SSR



# **INTERFACES TO INTERVENTION VESSEL**

## **RISER / VESSEL INTERFACE SYSTEM**

- **Riser extension engages top of riser**
- **Stabilized platform installs over moonpool**
- **Stabilized platform supports injector & riser extension**

Connection to the well



Water depth  
to 10,000 feet

Selected  
isolation  
functions

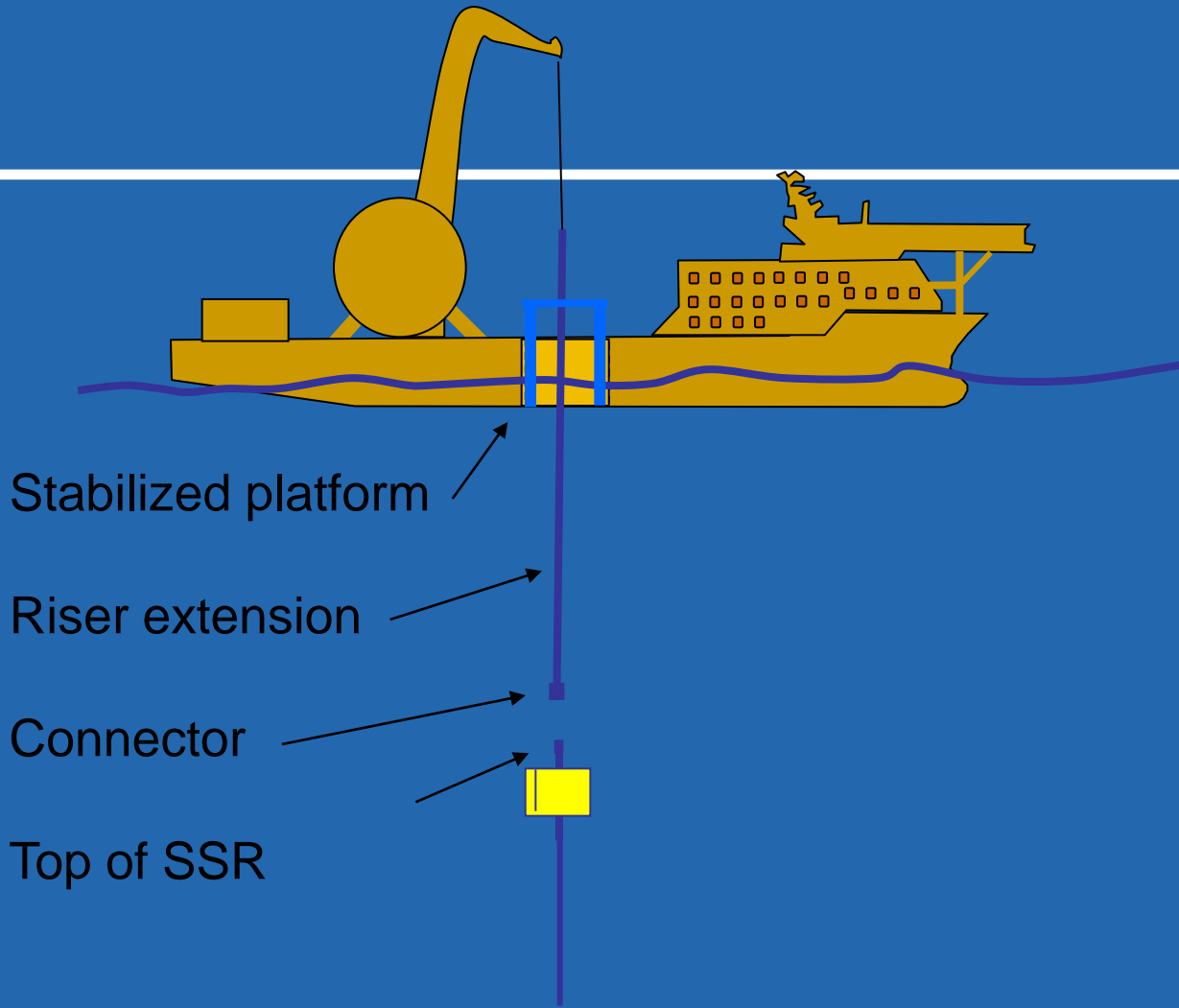


Seafloor shutoff

Tree



**SELF SUPPORTING RISER AS FOUND  
BY INTERVENTION VESSEL**



Stabilized platform

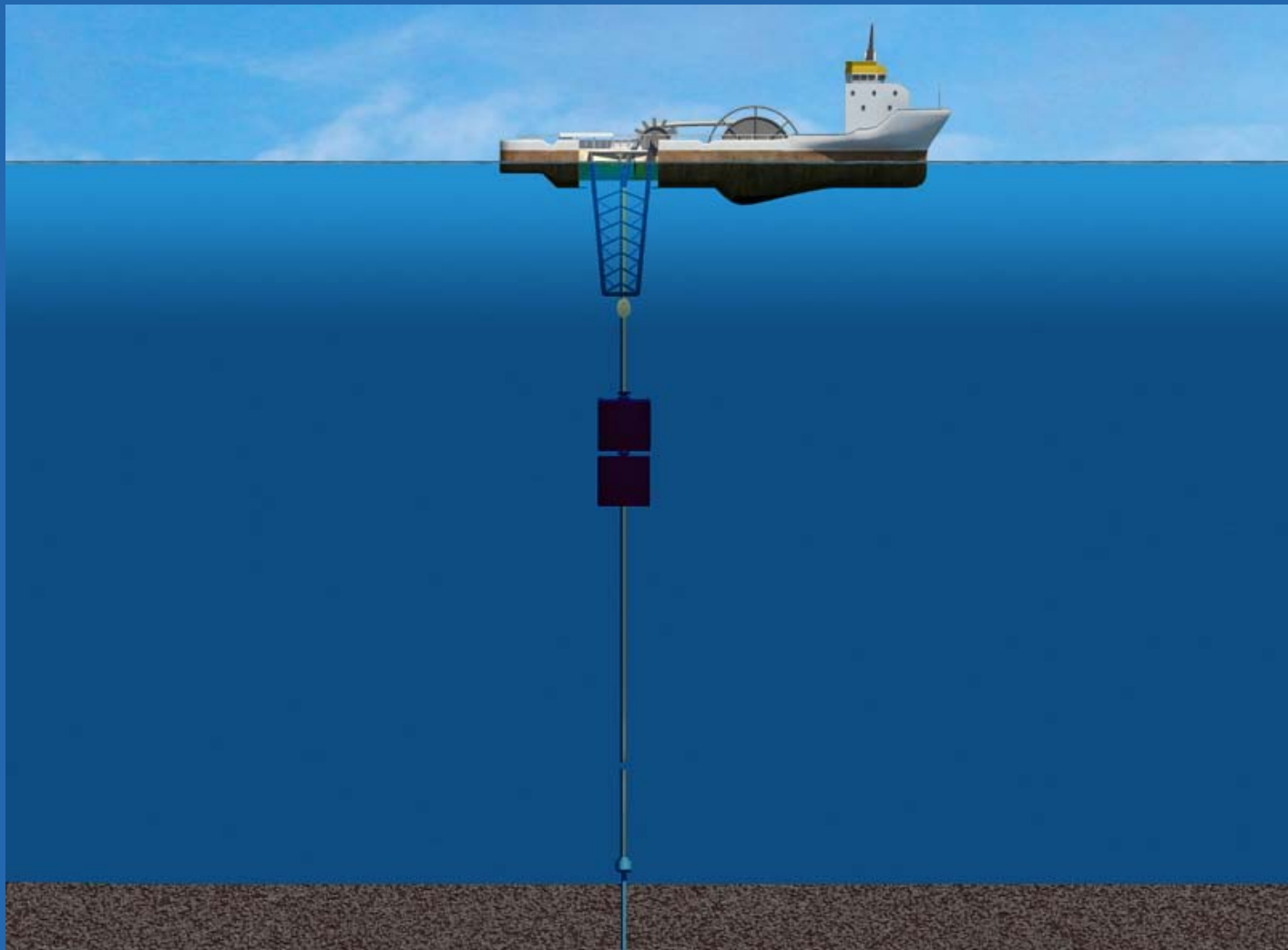
Riser extension

Connector

Top of SSR

**INTERVENTION VESSEL RUNS RISER EXTENSION**

# SSR Design, installation, removal and operation



# SSR test in the GoM

- Three years ago Anadarko Petroleum installed a SSR in the GoM.
- Invested substantially in engineering, design, testing, field trial.
- Attempt to address number of arguments for not using SSRs

# GoM Test 2006

## Location

Port Isabel  
Block 921  
Gulf of  
Mexico

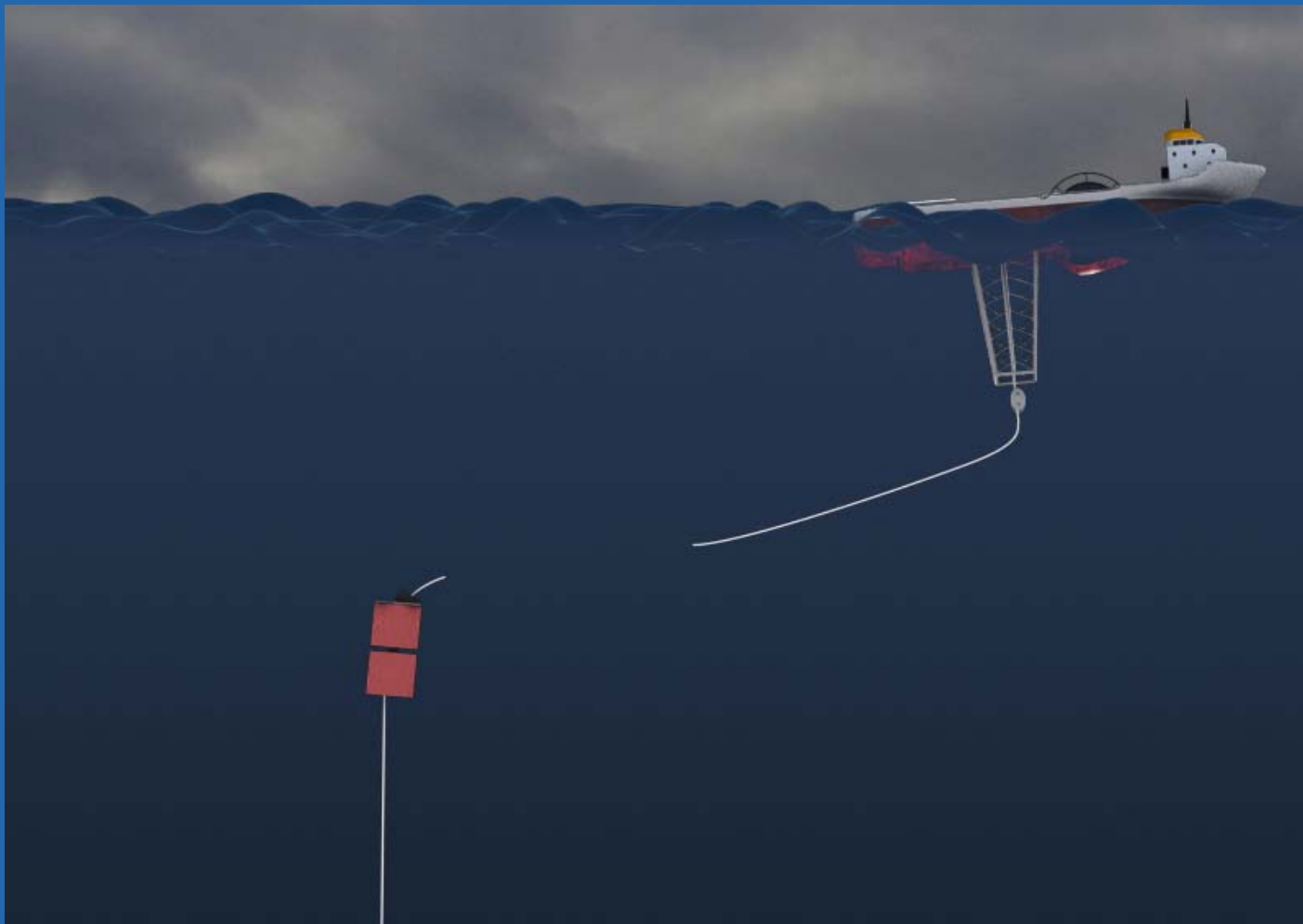
Water depth  
~3395 feet



# Safety Devices to Control the Well and Prevent Failures

- Strength of the production tree to support SSR
- Control functions of the tree from intervention vessel
- Once operating - Killing well

# Safety Devices to Control the Well and Prevent Failures



# The CT Design to operate a Vessel (non-MOU)

- Engineering designs of vessel to consider: Weather and storms, sea states, deck space, auxiliary equipment, vessel motion - handle pitch and roll, accommodate personnel, safety.
- Modifications: moon pool, weight factors

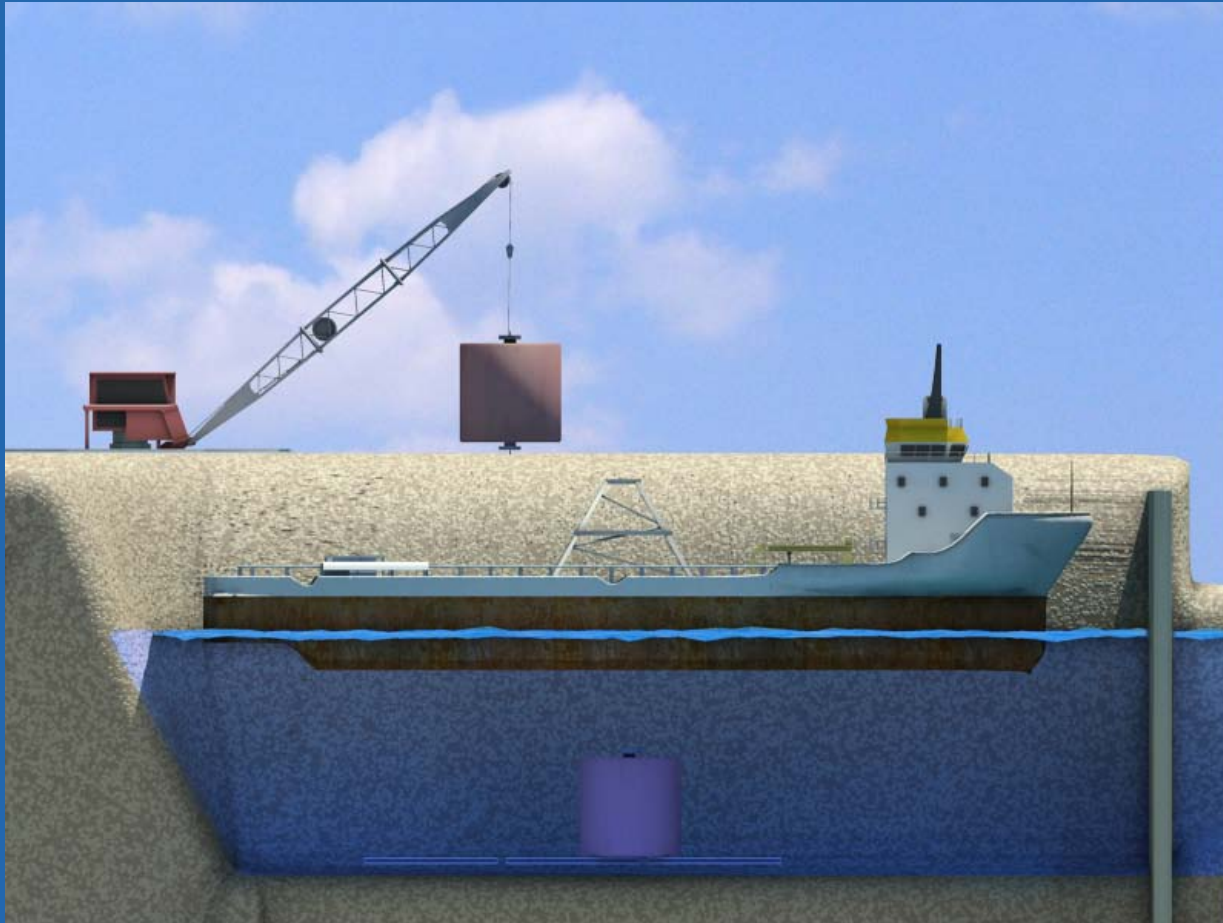
# Vessel Requirements

- SSR Installation Vessel
- Workover Vessel

# Vessel Requirements



# SSR Installation vessel



***RPSEA Project: Coil Tubing Drilling and Intervention System (CTIS) Using Cost Effective Vessels 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**
- **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**
- **RPSEA Phase I will be completed in 2010**

# 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](http://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 covering the riser, CT systems, marine requirements, compensation systems, safety systems and overall systems integration; the RPSEA industry steering committee of Anadarko, Shell, Chevron and ConocoPhillips; and RPSEA project manager Art Schroder.