RPSEA Administered Cost Share Research Overview: Ultra-Deepwater Program

James Pappas, P.E.

Vice President, Ultra-Deepwater Programs

jpappas@rpsea.org

(281) 690-5511

20th Meeting: Ultra-Deepwater Advisory Committee
Hyatt North Houston, Houston, TX
Wednesday, September 26, 2012

Outline

- Current UDW Program Status
- Technical Accomplishments 2011 – 2012
  - Accomplishments
  - Significant Findings
  - Safety & Environment Impact
- Plan Forward
  - 2011 Annual Plan Solicitations
  - 2012 Annual Plan Progress
  - Current Schedule

RPSEA
Research Partnership to Secure Energy for America

Current UDW Program Status

Selected Project Totals

	2007	2008	2009	2010	Total
Universities	5	4	1	3	13 (21%)
For Profits	9*	10	9	15	43 (70%)
Non Profits	3	0	0	1	4 (7%)
National Labs	0	0	1	0	1 (2%)
TOTAL SELECTED	**17***	**14**	**11**	**19**	**61**

* 17 selected, 16 awarded

RPSEA
Research Partnership to Secure Energy for America

Completed Project Totals

	2007	2008	2009	2010	Total
Universities	5	2	0	0	7 (27%)
For Profits	7	6	4	0	17 (65%)
Non Profits	2	0	0	0	2 (8%)
National Labs	0	0	0	0	0 (0%)
TOTAL SELECTED	**14**	**8**	**4**	**0**	**26**

RPSEA
Research Partnership to Secure Energy for America

Committed Funds through 2010

($MM)	RPSEA Funds	Cost Share	Total Costs
2007	$15.35	$ 4.58	$19.93
2008	$13.14	$ 3.51	$16.65
2009	$12.18	$ 5.80	$17.98
2010	$26.19	$ 7.25	$33.44
Totals	**$66.86 (76%)**	**$21.14**	**$88.00**
Remaining Funds	**$52.14***		

* May be reduced to ~ $40.5 million if follow on phases and uncosted options estimates are approved by DOE.

RPSEA
Research Partnership to Secure Energy for America

Technical Accomplishments 2011 - 2012

Projects Completed in 2011

RPSEA Contract Number	Project Name	Company	Principal Investigator	Start Date	End Date	Total Project Cost	RPSEA Cost Budget	Cost Share Total
08121-2501-02 COMPLETE	Early Reservoir Appraisal Utilizing a Well Testing System	Nautilus International, LLC	Dr. Keith Millheim	10/20/09	03/31/11	$1,025,000	$820,000	$205,000
08121-1502-01 COMPLETE	Coil Tubing Drilling and Intervention System Using Cost Effective Vessel	Nautilus International, LLC	Chuck Yemington/ Thomas Williams	10/01/09	04/01/11	$1,025,000	$820,000	$205,000
07121-1801 COMPLETE	Effect of Global Warming on Hurricane Activity	National Center for Atmospheric Research	Dr. Greg J. Holland	02/23/09	04/01/12	$684,085	$544,085	$140,000
08121-2502-01 COMPLETE	Modeling and Simulation of Managed Pressure Drilling for Improved Design, Risk Assessment, Training and Operations	Stratamagnetic Software, LLC	Wilson C. Chin	10/19/09	04/18/11	$460,000	$360,000	$100,000
07121-1901 COMPLETE	Subsea Systems Engineering Integration	GE Global Research Center (GE-GRC)	Christopher Wolfe	12/03/08	07/31/11	$1,511,448	$1,200,000	$311,448
07121-1201 COMPLETE	Wax Control in the Presence of Hydrates	University of Utah	Dr. Milind Deo	09/02/08	08/31/11	$500,000	$400,000	$100,000
08121-2902-02 COMPLETE	Technologies of the Future for Pipeline Monitoring and Inspection	University of Tulsa	Dr Michael Volk, Jr.	12/02/09	12/30/11	$187,841	$120,000	$67,841
08121-2902-03 COMPLETE	Wireless Subsea Communications	GE Global Research	Dan Sexton	01/22/10	12/31/11	$150,506	$120,000	$30,506
TOTALS						$5,543,880	$4,384,085	$1,159,795

8 Completed projects

RPSEA
Research Partnership to Secure Energy for America

Projects Completed in 2011: Additional Information - Links

RPSEA Contract No.	Project Name	NETL Project Factsheets & Reports
08121-2501-02 COMPLETE	Early Reservoir Appraisal Utilizing a Well Testing System	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW2501-Nautilus.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/08121-2501-02_FinalReport-04-14-2011.pdf
08121-1502-01 COMPLETE	Coil Tubing Drilling and Intervention System Using Cost Effective Vessel	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW1502-Nautilus.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/08121-1502-01-final-report.pdf
07121-1801 COMPLETE	Effect of Global Warming on Hurricane Activity	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1801-NCAR.html http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1801-NCAR-Abstract.html http://www.netl.doe.gov/kmd/RPSEA_Project_Outreach/07121-DW1801_OTC-20690-MS.pdf http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/07121-1801-final-report.pdf
08121-2502-01 COMPLETE	Modeling and Simulation of Managed Pressure Drilling for Improved Design, Risk Assessment, Training and Operations	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW2502-Stratamag.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/08121-2502-final-report.pdf
07121-1901 COMPLETE	Subsea Systems Engineering Integration	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1901-GE.html http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1901-GE-Abstract.html http://www.netl.doe.gov/technologies/oil-gas/publications/newsletters/epfocus/EPNewsSummer09.pdf http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/07121-1901-final-report.pdf
07121-1201 COMPLETE	Wax Control in the Presence of Hydrates	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1201-UofUtah.html http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1201-UofUtah-Abstract.html http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/Publications/07121-1201_Phase1TechReport.pdf http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/07121-1201-final-report.pdf
08121-2902-02 COMPLETE	Technologies of the Future for Pipeline Monitoring and Inspection	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW29022-UofTulsa.html
08121-2902-03 COMPLETE	Wireless Subsea Communications	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW29023-GEGlobal.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/08121-2902-07-final-report.pdf

Safety & Environmental Sustainability: Drilling, Completions & Interventions

Early Reservoir Appraisal Utilizing a Well Testing System - Nautilus Intl

- Accomplishments
  - Reservoir analysis - Guidance regarding well test methods & results in terms of the type of well test to perform based on test duration & expected flow rates, & develops expected outcomes in order to better characterize a reservoir.
  - Well test system architectural designs & operational feasibility analysis – Provides all available options for deepwater well testing for various downhole, subsea, surface, & vessel options, with an extensive focus on safety requirements, for more accurate decisions when justifying the production capacity & commerciality of a field or reservoir.

RPSEA
Research Partnership to Secure Energy for America

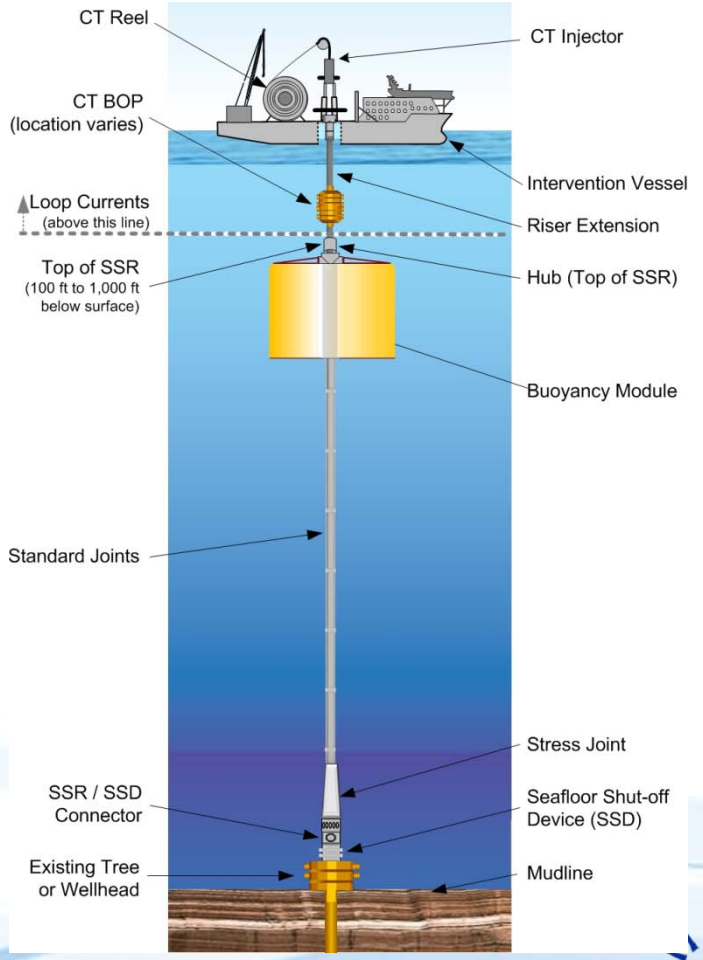
Early Reservoir Appraisal Utilizing a Well Testing System - Nautilus Intl

- Significant Findings
  - Numerous well test simulations showed that production rates between 1000 and 2000 BPD will give necessary pressure vs. time results to perform classical pressure transient analysis.
  - Deepwater testing can be done less expensively, & in less time, using this technique as is common with traditional deepwater well testing today.
  - A representative set of injection well test simulations (fluid injection and pressure fall-off) yielded the same end results as the more common production and build-up tests.
  - Industry experts attending the Technical Readiness Level workshop supported conclusion & recommended doing more work to prove the technical & operational viability of injection testing in deepwater.
- Safety & Environmental Emphasis
  - *Shorter test period = Fewer problems or chance for errors*
  - *No hydrocarbon flaring*
  - *No production flow back, injecting treated water only*

RPSEA
Research Partnership to Secure Energy for America

Coil Tubing Drilling and Intervention System Using Cost Effective Vessel - Nautilus Intl

- Accomplishments
  - Phase 1 - Conceptual design of the components needed for the subsea riser (SSR) system.
  - Challenges addressed include the use of CT from a cost-effective vessel in deep and ultra-deep water—the size and weight of the CT equipment in relation to vessel deck space and deck load, the effects of water depth and ocean currents on the equipment, & need to have a riser for circulation.
  - A detailed hazard identification review concluded that the hazards identified during this design phase have been effectively managed and mitigated.



RPSEA
Research Partnership to Secure Energy for America

Coil Tubing Drilling and Intervention System Using Cost Effective Vessel - Nautilus Intl

- Significant Findings
  - Work completed shows that the goals of the project can be met.
  - This includes improved safety and environmental protection, a design suitable for use in the strong current and deep water of the central Gulf of Mexico, and cost of less than half that of using a MODU for downhole intervention in deepwater satellite wells.
- Safety & Environmental Emphasis
  - *Use of vessels of opportunity = faster turnaround on well interventions in emergencies*
  - *CT & SSR system can be used to intervene underbalanced in high pressure wells if necessary*
  - *Dual, redundant BOPs*

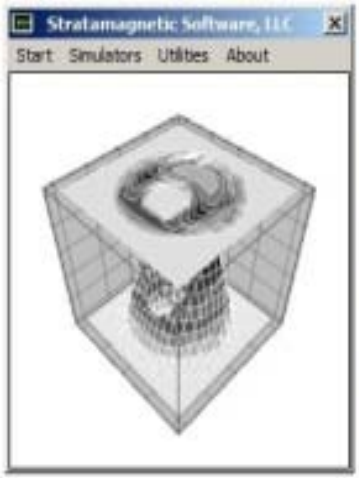
Note: Follow-on Project to design & build system in progress.

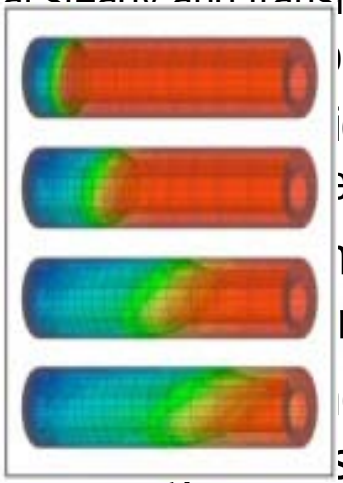
RPSEA
Research Partnership to Secure Energy for America

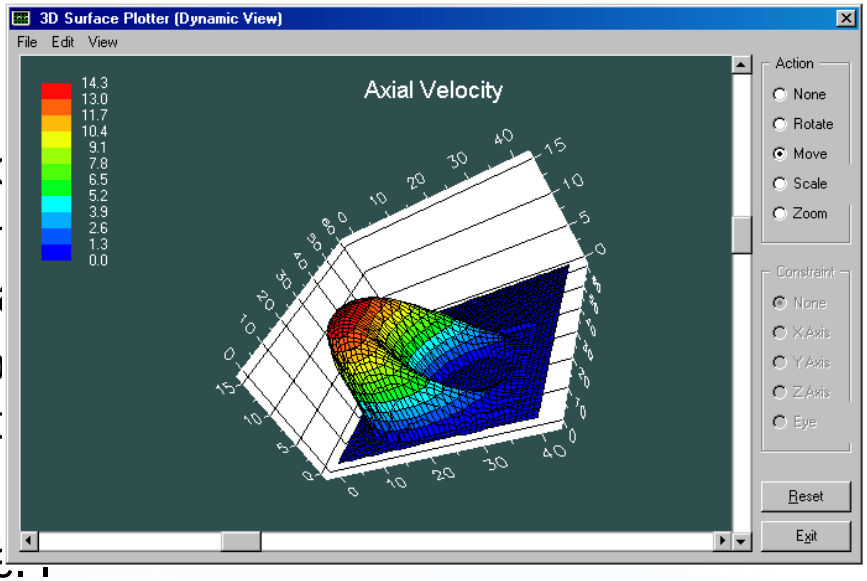
Advanced Steady-State and Transient, Three-Dimensional, Single and Multiphase, Non-Newtonian Simulation System for Managed Pressure Drilling – Stratamagnetic Software

o Accomplishments

- Numerical methods used, fast and extremely stable, hosted by user-friendly, "plain English," graphical interfaces (with integrated 3D color capabilities) to support job planning efforts and
  - Highly eccentric borehole annu
    fractures) are described using
  - General steady and transient, r







ordina
c rigo
expert
e 20
rence.
g published research, plus practical applications, as
ssure Drilling: Modeling, Strategy and Planning.

RPSEA
Research Partnership to Secure Energy for America

Advanced Steady-State and Transient, Three-Dimensional, Single and Multiphase, Non-Newtonian Simulation System for Managed Pressure Drilling – Stratamagnetic Software

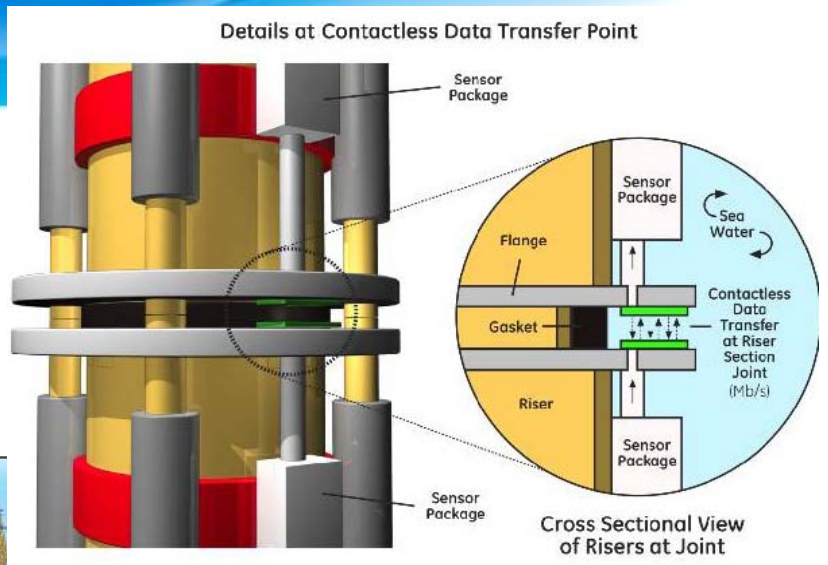
- Significant Findings
  - Developed many “firsts” which importantly find immediate practical application. For example:
    - Plug zone size, shape & location rigorously calculated for general yield stress fluids for arbitrary annular cross-sections;
    - Detailed hole geometry & rheology accounted for in swab-surge analysis;
    - Hole cleaning correlations now possible based on quantitative assessments on yield stress, pipe rotation & reciprocation, & geometry;
    - Drill string rotation as a simple and effective means for pressure control is demonstrated computationally with pressure-while-drilling log data;
    - Extremely fast and stable real-time methods for “cement displacing mud” applications are developed to be conveniently run at the rig site.
- Safety & Environmental Emphasis
  - *General safety from better modeling and real time (RT) comparison*
  - *Can be adapted to open drilling systems*

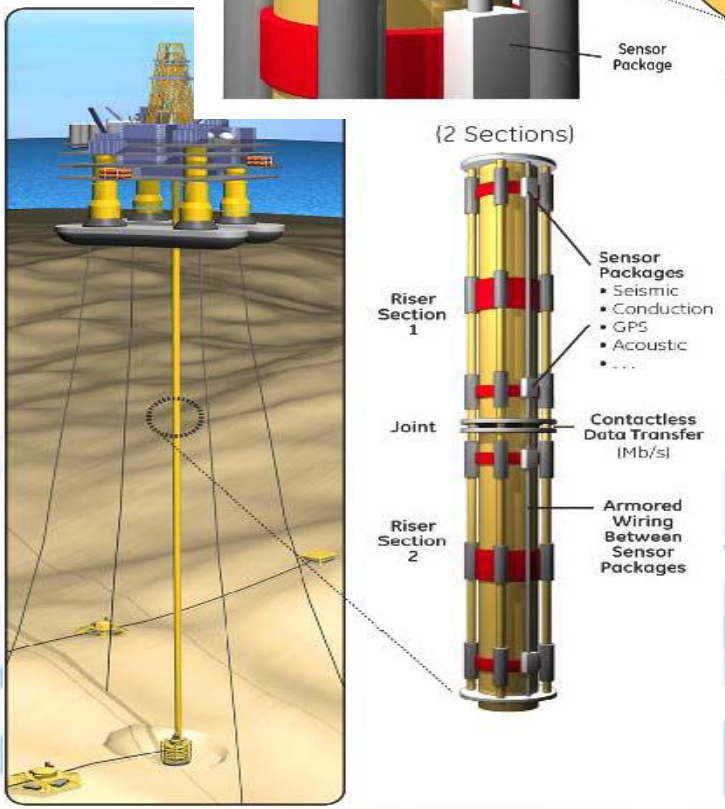
RPSEA
Research Partnership to Secure Energy for America

Safety & Environmental Sustainability: Subsea Systems – Processing/Pressure Boosting/Instrumentation

Wireless Subsea Communications – GE Global Research

- Accomplishments
  - Feasibility of high data rate communications using RF conduction through saltwater as a mechanism for communications was proven with a sea trial demonstrating a data rate of approximately 5 Mbps over a distance of 10 cm.
  - Physics based models developed & verified for the signal propagation and further simulation & analysis predicted channel capacities near 50 Mbps, depending on the power of transmission.





RPSEA
Research Partnership to Secure Energy for America

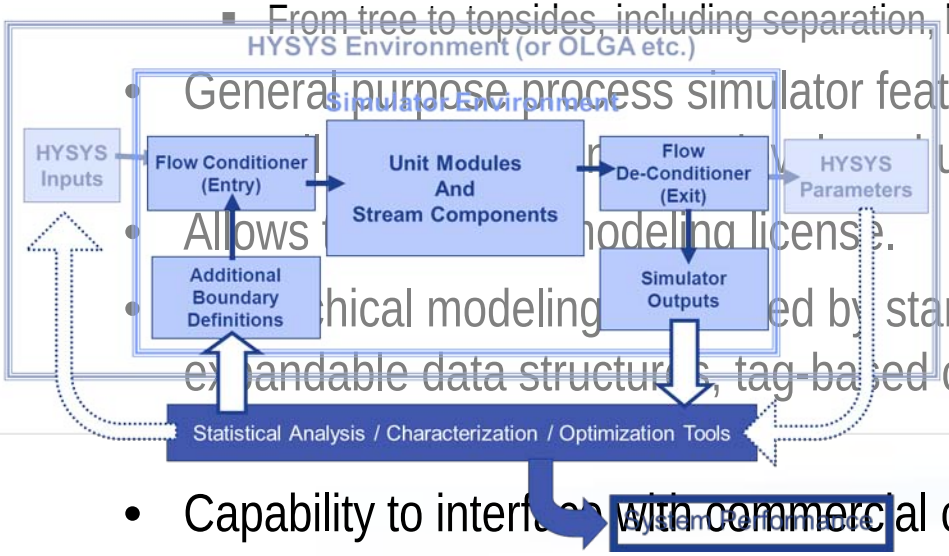
Wireless Subsea Communications – GE Global Research

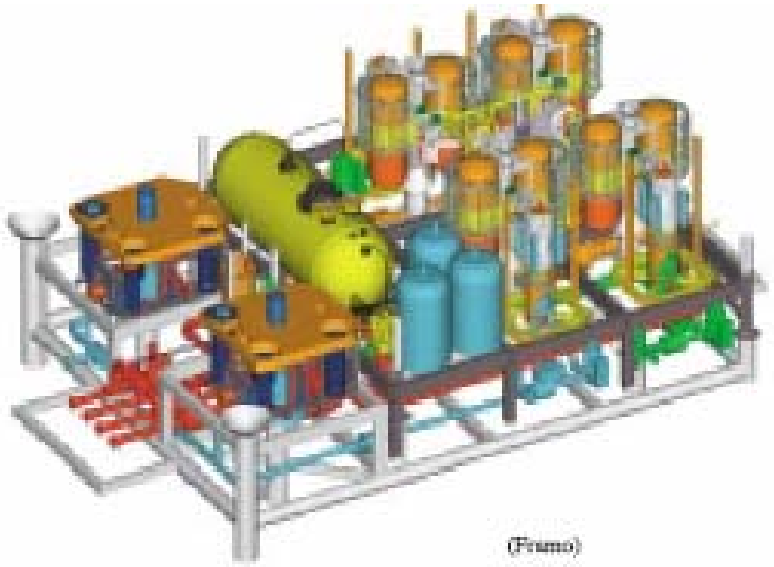
- Significant Findings
  - High data rate communications is possible through sea water using a mechanism that is more tolerant to variation in alignment and environment while utilizing small antenna elements.
  - This has the potential to replace connectors required for subsea applications and also allow temporary connection of mobile devices such as ROVs.
- Safety & Environment Impact
  - *Eliminate connectors and improved system reliability.*
  - *Resistant to subsea environmental issues (turbidity, fouling, multipath).*
  - *Speed deployment, enable cost efficient retrofits.*
  - *Robust and adaptive wireless communications - crosscutting technology with benefits to DOE.*
  - *Improved productivity of subsea production fields through subsea asset intelligence, equipment health monitoring and maintenance.*

RPSEA
Research Partnership to Secure Energy for America

Subsea Systems Engineering Integration – GE Global Research

- Accomplishments
  - Architectural model developed on which subsea processing simulations can be developed.
    - From tree to topsides, including separation, he
  - General purpose process simulator featur
  - Allows modeling license.
  - chical modeling ed by stanc
    expandable data structures, tag-based ca
  - Capability to interface with commercial co
  - Validated via a flow loop with three-phase separator.





RPSEA
Research Partnership to Secure Energy for America

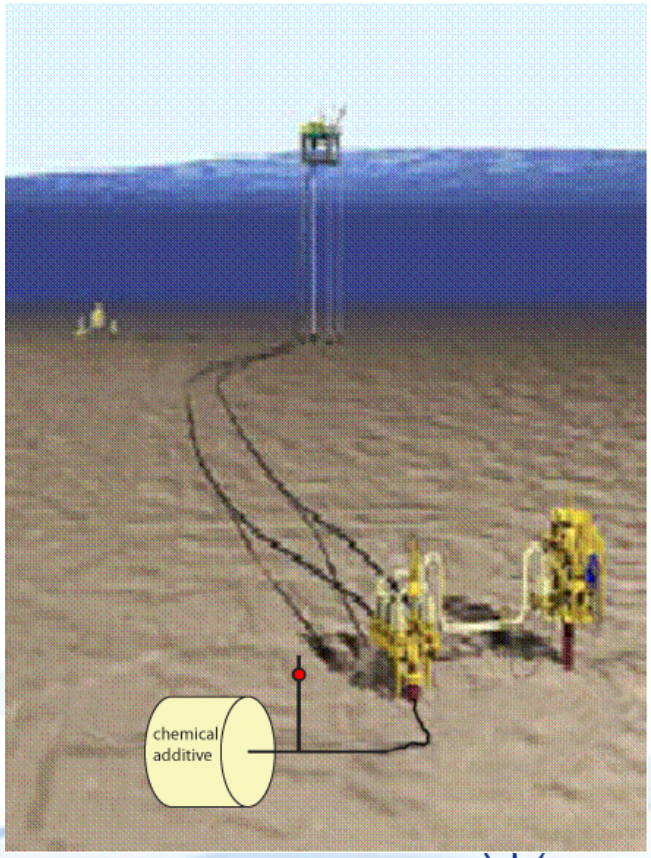
Subsea Systems Engineering Integration – GE Global Research

- Significant Findings
  - General purpose process simulator featuring minimal architectural overhead that puts all functionality in user-developed unit models can be used universally
  - Two logical next steps are to tackle a process that more closely simulates desirable produced flow management requirements in the GOM & to simulate fluids that come closer to real produced fluids.
- Safety & Environmental Impact
  - *Ease of simple modeling.*
  - *Transferable between companies and seemingly incompatible systems – managed by AspenTech (established & reputable firm).*
  - *Risk reduction through facility Design for Reliability will improve SS processing field development utilization.*
    - *Tool can be used to verify subsea – topsides controls, search for errors, add redundancies, and instantaneously view results to determine capabilities and feasibilities.*

RPSEA
Research Partnership to Secure Energy for America

Technologies of the Future for Pipeline Monitoring and Inspection – Tulsa University

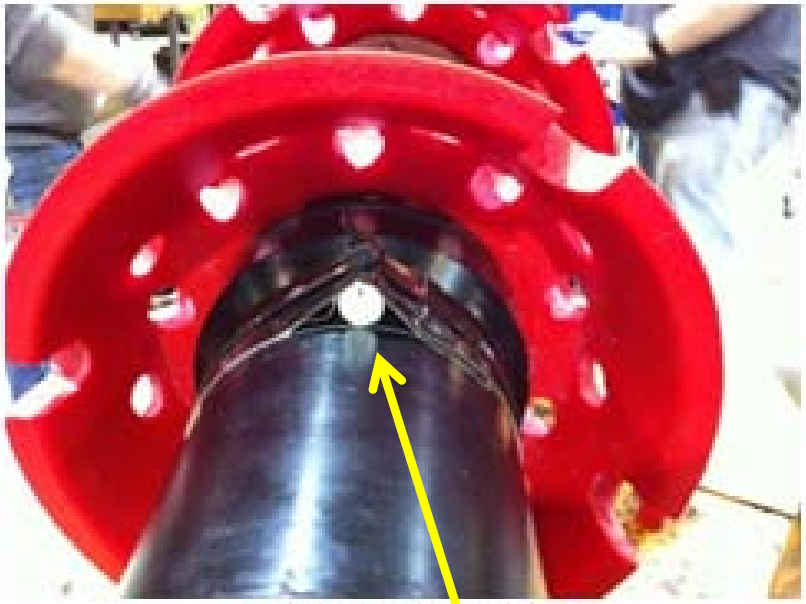
- Accomplishments
  - Small-scale sensing technology inside pipeline maintenance pigs of any size & configuration in order to measure fluid conditions, map pipeline features, and identify potential wall buildup or defects.
  - Tool can be used in pipelines where conventional in-line-inspection tools cannot traverse, while significantly reducing deployment cost and risk.
  - Can also be used to provide near real-time monitoring of critical pipeline characteristics.
  - Pill-shaped housing containing the sensing elements can collect data on multiple variables, including but not limited to, pressure, temperature, 3-axis tilt, & acceleration.
  - Multiple tests were conducted using the technology mounted onto pigs in a 12-inch flow loop with single-phase gas and liquid media. Results from the sensing device consistently identified known bends and wall-thickness changes as small as 0.125 inches.
  - Also deployed in a free-floating arrangement without a carrier pig in the flow loop filled with water. This design enabled the sensing device to travel the length of the line without a pig, indicating a potential inspection solution for fully un-piggable pipelines.



RPSEA
Research Partnership to Secure Energy for America

Technologies of the Future for Pipeline Monitoring and Inspection – Tulsa University

- Significant Findings
  - Work confirmed preceding studies suggesting a potential weight savings of 40-50 % in comparison to all steel construction for pig electronics when used with pigs.
  - Full-diameter prototypes demonstrated manufacturability and sufficient margins of safety with respect to burst strength, fatigu
  - Leak detection in small tubulars suc
  - Regular inspection (weekly / daily) r ls
- Safety & Environmental Impact
  - *Can be used in any pipeline.*
  - *Used as verification in carrier pig.*
  - *Replace pipeline pig as first line*
    - eliminate pipeline pig sticking.
  - *Early detection of fill or plugging.*



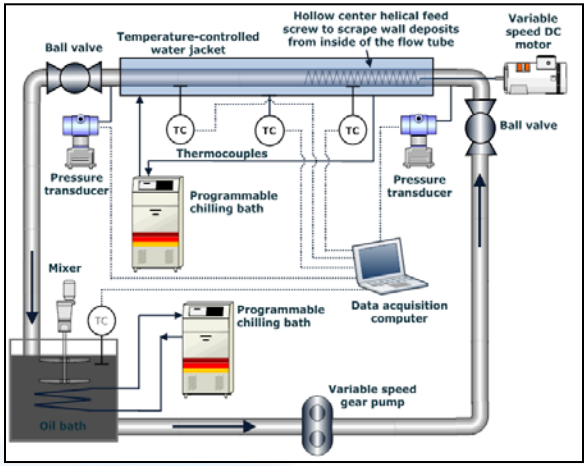
ILI and sensor pill

RPSEA
Research Partnership to Secure Energy for America

Safety & Environmental Sustainability: Stabilized Flow & Flow Assurance

Wax Control in the Presence of Hydrates – University of Utah

- Accomplishments
  - Examined and evaluated: a) Cold Seeding and/or production chilling strategies, b) Injected chemicals or internal coatings, c) Chemical Inhibition / dissolution, d) Sonic management methods, e) Pigging, f) Bio-degradation (microbial), g) Coiled tubing for flowline and export line remediation, h) Active heating (flowline, export line, etc.), and i) Innovative technologies.
  - Completed flow loop design, measured model oil properties, identified a particle analysis system for purchase, designed and built a steel loop, calibrated pressure transducers, completed heat exchanger design, identified a model oil with a wide difference between wax appearance temperature & pour point, & completed stainless pipe-in-pipe heat exchanger.
  - Then tested several mixtures and developed it findings and recommendations.



RPSEA
Research Partnership to Secure Energy for America

Wax Control in the Presence of Hydrates – University of Utah

- Significant Findings
  - The feasibility of cold flow was demonstrated.
  - Small thermal flux also did not lead to significant deposits. One possible reason for this was the cloud point depression that was caused by the precipitation and deposition of wax in the reservoir.
  - The restart process under cold flow conditions was compared with the restart process in conventional shutdowns (oil temperature starting above the wax appearance temperature). *It was shown that the restart pressures for cold flow were lower than those under conventional conditions, and core failures were possible with cold restart.*
- Safety & Environment
  - *Project will enable better understanding of long distance tie-backs with bare steel flowlines with improved operational performance, without the need for expensive insulation or external heating.*
  - *Therefore, it reduces reliance on external energy sources and helps prevent plugging and dangerous plug removal or pipe bursts.*

RPSEA
Research Partnership to Secure Energy for America

Safety & Environmental Sustainability: Met-ocean

Effect of Climate Change on Hurricane Activity - NCAR

- Accomplishments
  - Assessed the threat that climate change will increase Gulf hurricane activity.
  - Performed sensitivity study to better understand the factors governing wave generation in very severe hurricanes.
  - Surmised that most hurricane impacts can be mitigated with proper planning, provided we know far enough in advance what to expect.

RPSEA
Research Partnership to Secure Energy for America

Effect of Climate Change on Hurricane Activity - NCAR

- Significant Findings
  - Extreme value analysis allows assessment of potential changes in the most extreme hurricanes.
  - Results show the largest percentage increase in storm numbers for the strongest storms.
  - For the GOM, results are less clear, in part due to the limited number of storms that form in or enter.
  - Work is currently underway to develop more robust statistics for future changes in GOM storms and their impacts.*
- Safety & Environment Impact
  - *An accelerating increase in number of North Atlantic (including GOM) hurricanes; a shift in the region of maximum storm activity and formation; and a modest increase of average intensity of approximately 2 m/s, but a more marked increase in the number and intensity (approximately 3.5 m/s) of the most intense hurricanes that can be resolved by the model (Cat 3) over the next 50 years.*

**Note: Follow-on project in progress.*

RPSEA
Research Partnership to Secure Energy for America

Projects Completed in 2012

RPSEA Contract Number	Project Name	Company	Principal Investigator	Start Date	End Date	Total Project Cost	RPSEA Cost Budget	Cost Share Total
08121-2902-07 COMPLETE	Fiber Containing Sweep Fluids for Ultra Deepwater Drilling Applications	University of Oklahoma	Dr. Ramadan M. Ahmed	01/05/10	01/04/12	$150,031	$119,971	$30,060
09121-3500-02 COMPLETE	Fatigue Testing of Shrink-fit Riser Connection for High Pressure Ultra Deepwater Risers	Subsea Riser Products	Johnny Shield (UK) / Karim Jan (US) / Paul Brett	04/03/11	01/28/12	$616,563	$348,563	$248,000
09121-3300-05 COMPLETE	Autonomous Inspection Of Subsea Facilities	Lockheed Martin	Dan McLeod	09/10/10	02/10/12	$3,088,407	$1,302,113	$1,786,294
08121-2902-04 COMPLETE	Replacing Chemical Biocides with Targeted Bacteriophages in Deepwater Pipelines and Reservoirs	Phage Biocontrol, LLC	Dr. Neil Summer	01/21/10	02/21/12	$159,443	$120,000	$39,443
07121-1403 COMPLETE	Fatigue Performance of High Strength Riser Materials in Sour Environments	Southwest Research Institute (SwRI)	Steven Hudak	12/15/08	03/16/12	$1,000,000	$800,000	$200,000
07121-1801 COMPLETE	Effect of Global Warming on Hurricane Activity	National Center for Atmospheric Research	Dr. Greg J. Holland	02/23/09	04/01/12	$684,085	$544,085	$140,000
08121-2101-02 COMPLETE	New Safety Barrier Testing Methods	Southwest Research Institute	Shane Siebenaler	01/19/10	04/19/12	$160,000	$128,000	$32,000
07121-1301 COMPLETE	Improvements to Deepwater Subsea Measurements	Letton-Hall Group	Winsor (Chip) Letton, III	10/27/08	05/15/12	$4,500,158	$3,600,126	$900,032
07121-1603d COMPLETE	Robotic MFL Sensor for Monitoring and Inspection of Deepwater Risers	Williams Marsh Rice University	Satish Nagarajaiah, Ph.D.	10/16/08	06/01/12	$150,000	$120,000	$30,000
09121-3100-01 COMPLETE	Ultra Deep Water Seabed Discharge of Produced Water and/or Solids	Fluor Offshore Solutions	Tim Daigle	12/03/10	06/01/12	$561,195	$448,956	$112,239
TOTALS						$11,069,882	$7,531,814	$3,518,068

10 completed projects

RPSEA
Research Partnership to Secure Energy for America

Projects Completed in 2012: Additional Information – Links – 1 of 2

RPSEA Contract No.	Project Name	NETL Project Factsheets & Reports
08121-2902-07 COMPLETE	Fiber Containing Sweep Fluids for Ultra Deepwater Drilling Applications	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW29027-UofOklahoma.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/08121-2902-07-final-report.pdf
09121-3500-02 COMPLETE	Fatigue Testing of Shrink-fit Riser Connection for High Pressure Ultra Deepwater Risers	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/09121350002-SubseaRiser-Abstract.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/09121-3500-02-final-report.pdf
09121-3300-05 COMPLETE	Autonomous Inspection Of Subsea Facilities	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/09121330005-Lockheed-Abstract.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/09121-3300-05-final-test-report-p1.pdf http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/09121-3300-05-p2-final-report.pdf
08121-2902-04 COMPLETE	Replacing Chemical Biocides with Targeted Bacteriophages in Deepwater Pipelines and Reservoirs	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW29024-PhageBio.html
07121-1403 COMPLETE	Fatigue Performance of High Strength Riser Materials in Sour Environments	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1402B-HOE.html http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1403-SRI-Abstract.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/07121-1403-final-report.pdf

Projects Completed in 2012: Additional Information – Links – 2 of 2

RPSEA Contract No.	Project Name	NETL Project Factsheets & Reports
08121-2101-02 COMPLETE	New Safety Barrier Testing Methods	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW2101-SRI.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/08121-210102-final-report-safety-barrier.pdf
07121-1301 COMPLETE	Improvements to Deepwater Subsea Measurements	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1301-LettonHall.html http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1301-LettonHall-Abstract.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/07121-1301-final-report.pdf
07121-1603d COMPLETE	Robotic MFL Sensor for Monitoring and Inspection of Deepwater Risers	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1603D-RiceU.html http://www.netl.doe.gov/kmd/RPSEA_Project_Outreach/07121-1603d-Andrew-Lynch-MS-Thesis-S-03-30-10.pdf http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/07121-1603d-final-report-risers-monitoring.pdf
09121-3100-01 COMPLETE	Ultra Deep Water Seabed Discharge of Produced Water and/or Solids	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/09121310001-Fluor-Abstract.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/09121-310001-final-report-prod-water.pdf

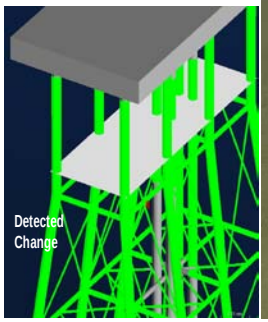
RPSEA
Research Partnership to Secure Energy for America

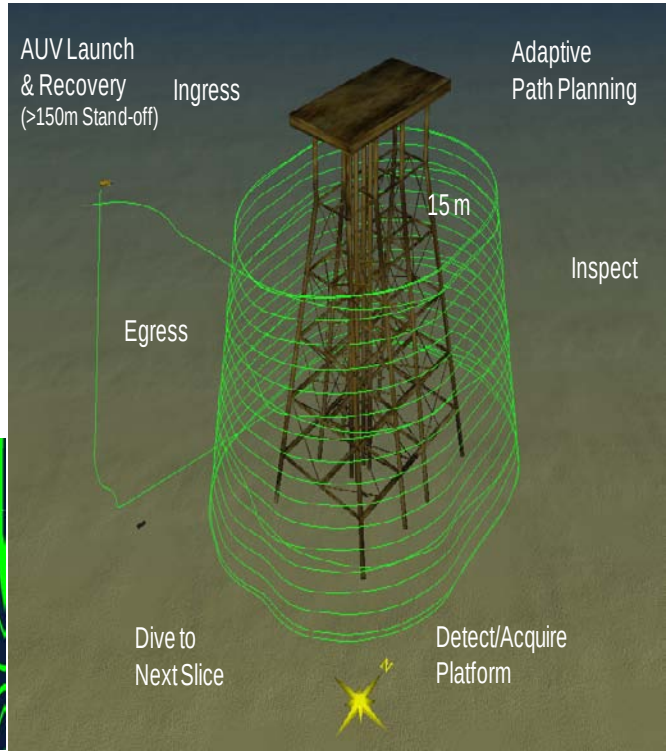
Safety & Environmental Sustainability: Subsea Systems – Processing/Pressure Boosting/Instrumentation

Autonomous Inspection Of Subsea Facilities – Lockheed Martin

- Accomplishments
  - Developed, integrated, & tested autonomous technology needed to conduct pre/post hurricane Inspection of a facility
  - Performed autonomous imaging and real-time 3D reconstruction of underwater facility
  - Detected and highlighted changes to underwater facility
  - Used feature based navigation
  - Local offshore testing from Lockheed Martin facility in Florida

Lockheed Martin Marlin™ AUV





The Platform Inspection mission profile involves successive passes around the platform at a 15m standoff, with 50% overlap of 3D sonar scans between passes.

RPSEA
Research Partnership to Secure Energy for America

Autonomous Inspection Of Subsea Facilities – Lockheed Martin

- Significant Findings
  - Advanced autonomy coupled with Marlin ™ AUV provides industry with a commercial capability to complete subsea inspections in hours instead of days.
  - Provides accurate 3D geo-registered models within hours of completing inspection.
  - Autonomous detection of structural changes in real-time is achievable
- Safety & Environment Impact
  - *Fast deployment in emergencies.*
  - *On on-site assessment of platform structural integrity and/ or post-storm damage assessment.*
  - *No need for vessel directly over AUV.*
  - *Can be coupled with specialized detectors.**

** Note: New project is combining AUV with LIDAR.*

RPSEA
Research Partnership to Secure Energy for America

New Safety Barrier Testing Methods – SWRI

- Accomplishments
  - Current state-of-the-art for testing safety valves monitor s pressure at the SS tree and is largely blind to the dynamics of the fluid column. Pressure-decay curves do not account for temperature & other effects of long tubing depths.
  - Comprehensive set of CFD models was evaluated to determine the behavior of a pseudo-static column during leak tests of safety valves.
  - The CFD work highlighted some areas of computational weakness.
  - The more-straightforward analytical model provides improved uncertainty when evaluating pressure measurements from the field.

RPSEA
Research Partnership to Secure Energy for America

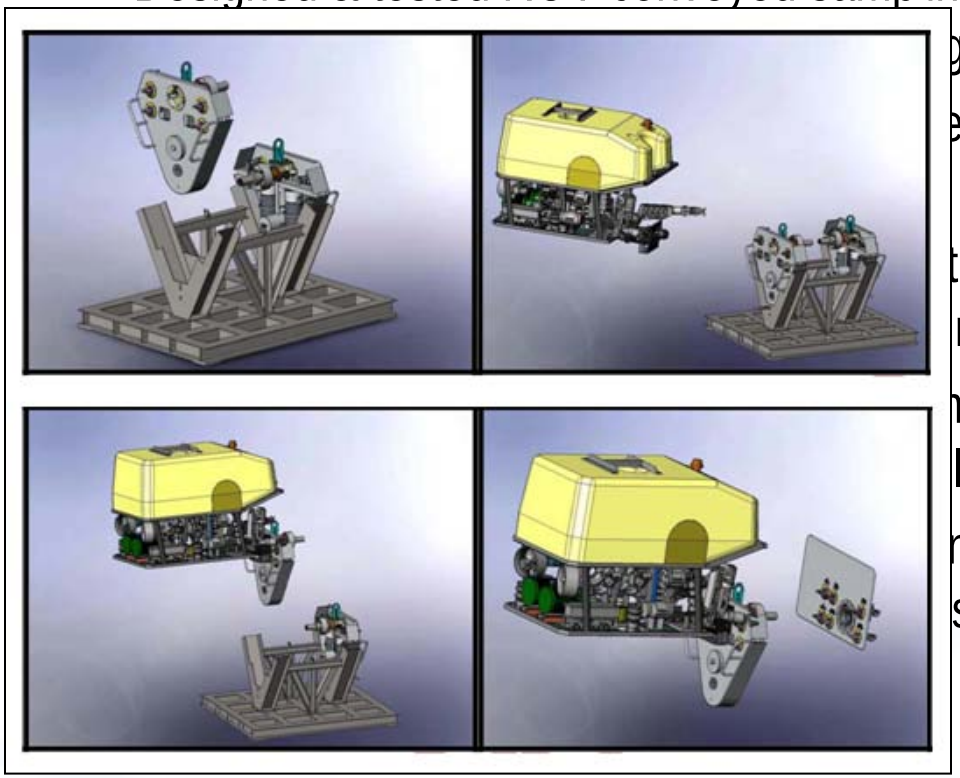
New Safety Barrier Testing Methods – SWRI

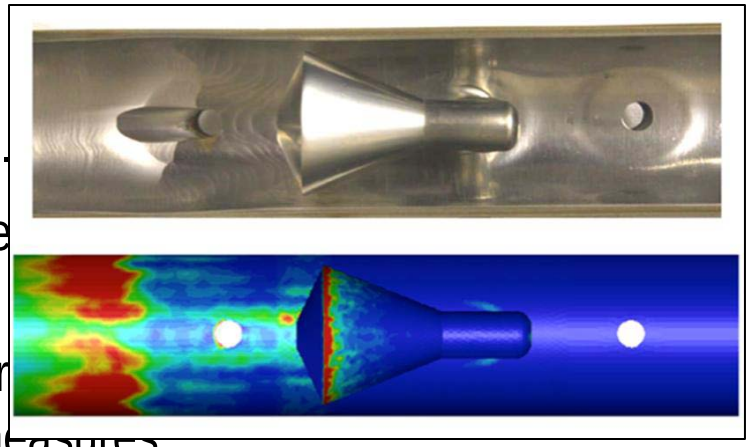
- Significant Findings
  - During safety valve tests when the column has stratified & there is a gas cap at the top, the gas pressure:
    - Decreases as the gas cools
    - Decreases as the liquid column cools and shrinks, expanding the gas
    - Increases as leaked product enters the column.
  - Modeling can be used to generate trending curves for evaluation of the valve integrity.
  - Various normalizations of some parameters allows the same model to be used on the same well family over the course of its life with little modification.
  - Further study of the temperature of the fluid is needed for understanding.
- Safety & Environment Impact
  - *Model results in:*
    - *Increased certainty of measurement*
    - *More quantitative assessment of leakage*
    - *Reduced sensitivity to parameters (temperature, multiphase, etc.)*

RPSEA
Research Partnership to Secure Energy for America

Improvements to Deepwater Subsea Measurements – Letton Hall Group

- Accomplishments
  - Designed & tested ROV-conveyed sampling
    gh-
    e e
    ter
    measures.
    mperat sensor for
    ly chal
    n tool f rtainty of
    s appli uction





RPSEA
Research Partnership to Secure Energy for America

Improvements to Deepwater Subsea Measurements – Letton Hall Group

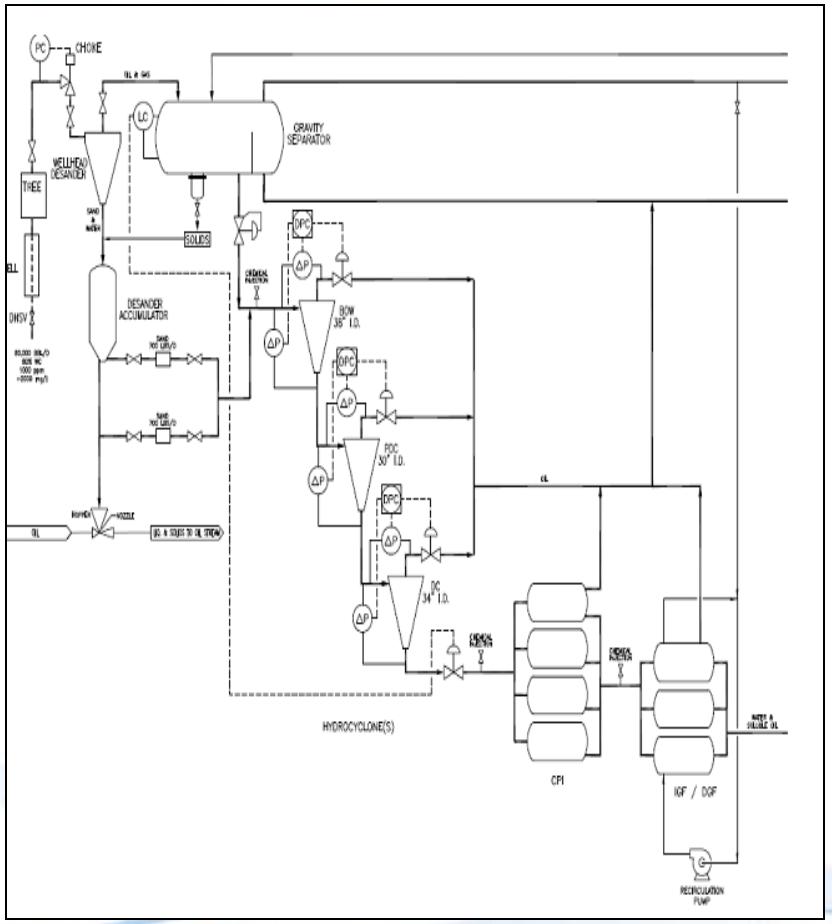
- Significant Findings
  - Lessons in ROV-conveyed sampling and measurement tasks & major portions of the designs.
  - Effects of erosion and scale buildup can be modeled for predictions.
  - VFM performance varies widely among vendors.
  - Measurement of differential pressure at 250ºC was achieved, as was high-pressure operation (10,000 psi). Operation at 15,000 psi is yet to be achieved, as is concurrent operation at both 250ºC and 15,000 psi.
  - Additional work is needed to meet the goals of the project.*
- Safety & Environment Impact
  - *Subsea measurement equipment can be adapted to wells, flowlines, and almost any situation to increase the accuracy of measurement.*
  - *Erosion & scale buildup information can be used to ensure that related leaks are avoided or minimized.*

**Note: Follow-on project in progress.*

RPSEA
Research Partnership to Secure Energy for America

Ultra Deep Water Seabed Discharge of Produced Water and/or Solids - Fluor

- Accomplishments
  - A team of subject matter experts (SMEs) was assembled to review challenges facing seabed discharge of produced water and/or solids.
    - Researched many different sources to properly address the challenges. First, an experienced working committee was selected to support the study.
    - Representatives first defined a basis of design to guide the study.
    - Thorough assessment of regulations for industry produced water discharge.
    - Seabed & marine life studied at target water depths of 5000 to 8000 feet.
  - State of the art review into the produced water treatment process and analytical requirements.
  - Completed series of conceptual design workshops to produce an initial conceptual design for treating & discharging produced water at the seabed.



Research Partnership to Secure Energy for America

Ultra Deep Water Seabed Discharge of Produced Water and/or Solids - Fluor

- Significant Findings
  - Identified latest techniques that can be used for subsea processing.
  - Technological advances are being made at a rapid pace in the area of water quality monitoring for subsea use, which will help in the implementation of the technology.
- Safety & Environment Impact
  - *Identified new technologies with fewer moving parts or that are better able to withstand higher operating pressures in remote areas for subsea processing.*
  - *Identified uncertainties, risks, and technological gaps in equipment and sensors.*
  - *Shared findings with BSEE.*

RPSEA
Research Partnership to Secure Energy for America

Safety & Environmental Sustainability: Floating Facilities & Risers

Fatigue Testing of Shrink-fit Riser Connection for High Pressure Ultra Deepwater Risers – Subsea Riser Products

- Accomplishments
  - Proved the manufacturability of the Shrink-Fit connection.
  - 100% of samples (12/12 connections across 6 samples) passed the hydrotest with no sealing issues.
  - Fatigue life of the connection proven comparable to a DNV-RP-C203, C1 class weld with a stress concentration factor of 1.46.
    - This is better fatigue resistance than is normally considered for welded connections of this type used on deepwater drilling risers (typically E-Class 1.3).

RPSEA
Research Partnership to Secure Energy for America

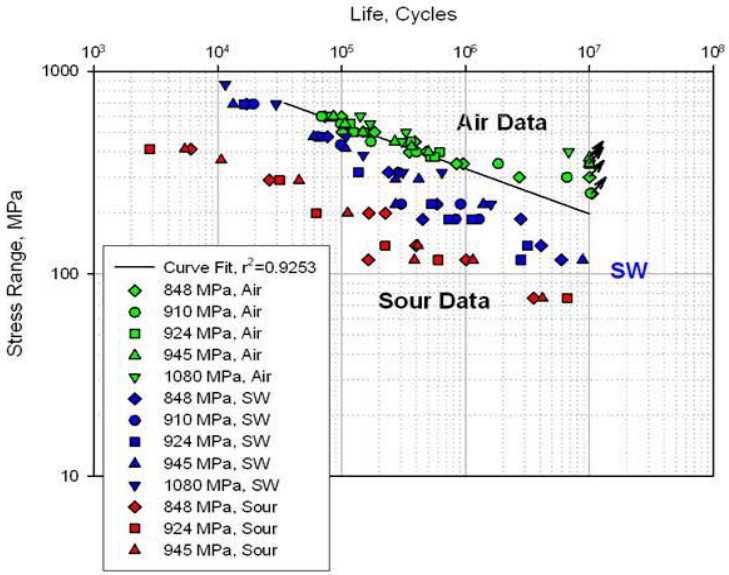
Fatigue Testing of Shrink-fit Riser Connection for High Pressure Ultra Deepwater Risers – Subsea Riser Products

- Significant Findings
  - The connection can be qualified to very high pressures comparable to pipe yield and has fatigue performance equivalent to a good quality weld.
  - Need to incorporate NACE compliant titanium alloys (e.g., ASTM B861 Grade 29) into steel welded SCR production.
    - Currently inclusion of titanium joints are especially long lead & expensive, since an entire forged joint of titanium is created including flanges, or titanium flanges are welded onto the titanium pipe.
- Safety & Environment Impact
  - *Shrink-Fit will enable operators the flexibility to avoid complex & difficult welding in in titanium & other high pressure joints & to join dissimilar materials to weldable (steel) end-caps.*
    - *Will enable light-walled, flexible quad or hex joints, stress joints, & touch down zone joints to be created in preparation for welding in an S-Lay or J-Lay welding environment.*

RPSEA
Research Partnership to Secure Energy for America

Fatigue Performance of High Strength Riser Materials in Sour Environments - SWRI

- Accomplishments
  - First-ever corrosion-fatigue data on new high-strength riser materials were generated under representative cycling loading UDW frequencies & environments.
    - Addressed fracture toughness, crack growth and S-N curve tests on strip specimens of riser materials.
    - Stress corrosion cracking (SCC) and hydrogen environment embrittlement (HEE) tests were also be conducted for simulated service conditions.
  - These results are critical for proper selection of riser materials, as well as for preliminary design & structural integrity assessment of UDW risers.



Fatigue Performance of High Strength Riser Materials in Sour Environments - SWRI

- Significant Findings
  - Both increasing steel strength level & decreasing cyclic loading frequency were found to significantly degrade the corrosion-fatigue crack growth performance.
  - However, the S-N fatigue performance was less significantly affected by these same variables.
  - Although several hypotheses were formulated to explain this difference in performance, the root cause has not yet been unequivocally identified.
  - Phase 2* plan to develop a safe, effective full-scale testing system to qualify risers in sour brine environment. The plan also includes the development of an analytical fatigue model to assess T&C connections in both inert and sour environments. This analytic model can potentially reduce the amount of full-scale testing required in the future, thereby saving cost & time, while at the same time resulting in a more robust riser design qualification process.
- Safety & Environment Impact
  - *Currently, new high-strength steel risers cannot be joined by welding. Thus, threaded and coupled (T&C) connections will be required to use these new materials as risers.*
  - *T&C connections for this purpose need to be qualified. Presently, it is standard industry practice to qualify new riser designs with full scale testing.*
  - *Full-scale testing has never been attempted in sour brine environment and presents significant technical challenges, as well as safety hazards due to the high loads required & the toxic nature of the H2S environment.*

*Note: Phase 2 recommendation was rejected by DOE.

Robotic MFL Sensor for Monitoring and Inspection of Deepwater Risers – Rice University

- Accomplishments
  - Developed new system identification techniques using robotic Magnetic Flux Leakage (MFL) sensor to:
    - Estimate dominant modes of vibration & to estimate the fatigue damage location (depth)
    - Perform local monitoring at the most likely fatigue damage location (depth).
  - Proposed strategy with combined global & local monitoring techniques was found to enhance fatigue damage estimation.
  - Global monitoring using newly developed WT-SOBI & fatigue estimation was verified by field data from Gulf Stream (2006) test performed by researchers at MIT.
    - The travelling wave properties of the VIV were confirmed by frequency analysis.
    - Demonstrated that fatigue damage location in DW risers can be estimated by the developed WT-SOBI & fatigue analysis.
    - After the fatigue damage location was estimated from global vibration measurements, a MFL sensor was deployed at the estimated damage location (depth) to determine the extent of damage and then, maintenance decisions were made.

RPSEA
Research Partnership to Secure Energy for America

Robotic MFL Sensor for Monitoring and Inspection of Deepwater Risers – Rice University

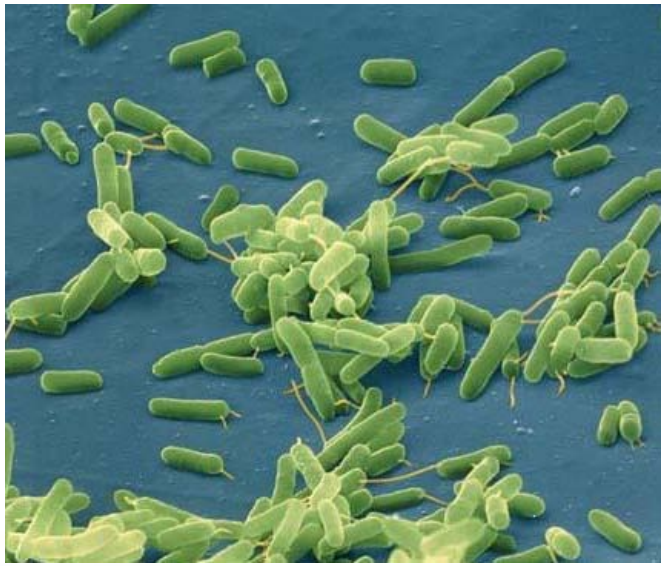
- Significant Findings
  - Local monitoring using MFL sensors was experimentally proven to be effective in detecting wall thickness changes as small as 0.2mm. Such high resolution results show the potential applicability of MFL sensors in deepwater risers.
- Safety & Environment Impact
  - *Innovative combination of vibration-based global monitoring, fatigue estimation, & MFL based local monitoring is a feasible solution for deepwater riser monitoring.*
    - *The global monitoring estimates the most likely location (depth) of fatigue damage.*
    - *The high resolution local monitoring using MFL sensors can effectively detect the wall thickness change caused by cracks due to fatigue damage (or due to other reasons such as corrosion etc.).*
  - *The proposed SHM method can also be used to perform fatigue estimation in other offshore floating structures.*

RPSEA
Research Partnership to Secure Energy for America

Safety & Environmental Sustainability: Systems Engineering

Replacing Chemical Biocides with Targeted Bacteriophages in Deepwater Pipelines and Reservoirs - Ecolyse

- Accomplishments
  - Diversity of bacteria in samples was determined using next generation sequencing approach.
    - Individual SRB monocultures were isolated & cultured from separate samples.
    - Naturally occurring phages were found, isolated, & determined to be effective first against co-cultures & then against bacterial concentrates.
  - Individual phage were found to not only markedly inhibit SRB growth by 6 orders of magnitude or better, but ,unlike chemicals biocides, the test vials have remained clear for months, indicating that the inhibition is long lasting and active.



RPSEA
Research Partnership to Secure Energy for America

Replacing Chemical Biocides with Targeted Bacteriophages in Deepwater Pipelines and Reservoirs - Ecolyse

- Significant Findings
  - Phage have similar inhibitory effects on active SRB cultures as do currently used chemical biocides.
  - Since phage treatments proved to control SRB levels for long periods of time, it thus holds promise as a bio-pesticide for use in the petroleum industry to reduce the need for chemical biocides.
  - Additional work is needed to identify or develop phage with expanded host ranges and to study any possible side effects.
- Safety & Environment Impact
  - *Phage biocontrol treatments are naturally "green,.*
  - *Phage have a longer lasting inhibitory effect, implying that phage based biocontrol can provide a better treatment option for the petroleum industry to counter microbially influenced corrosion.*
  - *The chance to reduce or eliminate H2S gas, turning sour wells into sweet wells can be an economic wonder, eliminating high corrosion common in sour service equipment.*

Projects In Progress 2007 - 09

RPSEA Contract Number	Project Name	Company	Principal Investigator	Start Date	End Date	Total Project Cost	RPSEA Cost Budget	Cost Share Total
09121-3300-02	Displacement & Mixing in Subsea Jumpers – Experimental Data and CFD Simulations	University of Tulsa	Michael Volk, Jr.	12/14/10	12/14/12	$343,922	$254,952	$88,970
08121-2301-03	Deepwater Open Water Riser Intervention System (RIS)	DTC International, Inc.	Bill Parks	01/06/10	12/28/12	$4,315,890	$3,382,017	$933,873
09121-3500-07	Deepwater Subsea Test Tree and Intervention Riser System	DTC International, Inc.	Bill Parks	01/24/11	12/28/12	$1,939,049	$1,551,239	$387,810
09121-3300-08	Sensors and Processing for Pipe, Riser, Structure, and Equipment Inspection to Provide Detailed Measurements, Corrosion Detection, Leak Detection, and/or Detection of Heat Plumes from Degraded Pipeline Insulation	Blueview Technologies	Lee Thompson	12/14/10	12/31/12	$585,600	$468,463	$117,137
08121-2701-03	Ultra-Deepwater Resources to Reserves Development and Acceleration Through Appraisal	The University of Texas at Austin	Sanjay Srinivansan	01/28/10	12/31/12	$250,632	$200,331	$50,301
08121-2902-06	Enumerating Bacteria in Deepwater Pipelines in Real-Time at a Negligible Marginal Cost Per Analysis: A Proof of Concept Study	Livermore Instruments Inc.	Dr. David P. Fergenson	01/25/10	12/31/12	$294,418	$200,557	$93,861
09121-3500-01	Intelligent Production System for Ultra Deepwater with Short Hop Wireless Power and Wireless Data Transfer for Lateral Production Control and Optimization	Tubel, LLC	Paulo Tubel	01/28/11	01/28/13	$1,424,400	$1,103,000	$321,400
09121-3700-02	A 1,000 Level Drill Pipe Deployed Fiber Optic 3C Receiver Array for Deep Boreholes	Paulsson, Inc.	Bjorn N. P. Paulsson	02/16/11	02/16/13	$2,798,479	$1,994,329	$804,150
09121-3500-10	Gyroscope Guidance Sensor for Ultra-Deepwater Applications	Laserlith	Chopin Hua	01/24/11	04/24/13	$619,346	$489,346	$130,000
07121-1401	Composite Riser for Ultra Deepwater High Pressure Wells	Lincoln Composites Inc.	Don Baldwin/Chet Dawes	12/05/08	06/03/13	$3,208,070	$2,071,507	$1,136,563
07121-2001	Geophysical Modeling Methods	SEAM Corporaton	Peter Pangman	06/15/09	06/30/13	$3,291,705	$2,633,364	$658,341
09121-3300-06	High Resolution 3D Laser Imaging for Inspection, Maintenance, Repair, and Operations	3D at Depth	Carl Embry	01/13/11	11/19/13	$3,517,738	$2,214,828	$1,302,910
08121-2901-01	Ultra-Reliable Deepwater Electrical Power Distribution System and Power Components	GE Global Research	~~Rajib Datta/ Satish Gunturi/~~ Rixin Lai	11/24/09	11/23/13	$6,249,959	$4,999,967	$1,249,992
08121-2801-02	GOMEX 3-D Operational Ocean Forecast System Pilot Project	Portland State University	Christopher Mooers	03/11/10	03/01/14	$1,560,000	$1,248,000	$312,000
09121-3300-10	Development of Carbon Nanotube Composite Cables for Ultra-Deepwater Oil and Gas Fields	Los Alamos National Lab	Terry Holsinger/ Kenneth Marken/ Susan Brockway/ Leigh House	04/25/11	04/25/14	$2,500,000	$2,000,000	$500,000
08121-2201-02	Heavy Viscous Oil PVT	Schlumberger	Afzal Memon/ Jinglin Gao	07/27/11	07/27/14	$666,658	$502,961	$163,697
TOTALS						$33,565,866	$25,314,861	$8,251,005

Projects In Progress 2007 - 09
Additional Information – Links – 1 of 3

RPSEA Contract No.	Project Name	NETL Project Factsheets & Reports
09121-3300-02	Displacement & Mixing in Subsea Jumpers – Experimental Data and CFD Simulations	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/09121330002-UTulsa-Abstract.html http://www.rpsea.org/attachments/contentmanagers/5786/09121-3300-02-PFS-Displacement_Mixing_Subsea_Jumpers_Data_CFD_Simulations-07-06-12.pdf
08121-2301-03	Deepwater Open Water Riser Intervention System (RIS)	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW2301-DTC.html http://www.rpsea.org/attachments/contentmanagers/4871/08121-2301-03-PFS-Riserless_Intervention_System-07-06-12.pdf
09121-3500-07	Deepwater Subsea Test Tree and Intervention Riser System	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/09121350007-DTC-Abstract.html http://www.rpsea.org/attachments/contentmanagers/5804/09121-3500-07-PFS-Deepwater_Subsea_Test_Tree-07-06-12.pdf
09121-3300-08	Sensors and Processing for Pipe, Riser, Structure, and Equipment Inspection to Provide Detailed Measurements, Corrosion Detection, Leak Detection, and/or Detection of Heat Plumes from Degraded Pipeline Insulation	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/09121330008-Blueview-Abstract.html http://www.rpsea.org/attachments/contentmanagers/5794/09121-3300-08-PFS-Sensors_Processing_Pipe_Riser_Structure_Equipment_Inspection_Measurements_Corrosion_Leak-07-06-12.pdf
08121-2701-03	Ultra-Deepwater Resources to Reserves Development and Acceleration Through Appraisal	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW27013-UTA-Abstract.html http://www.rpsea.org/attachments/contentmanagers/5773/08121-2701-03-PFS-Ultra_Deepwater_Reserves_Development_Acceleration_Appraisal-07-06-12.pdf

Projects In Progress 2007 - 09
Additional Information – Links – 2 of 3

RPSEA Contract No.	Project Name	NETL Project Factsheets & Reports
08121-2902-06	Enumerating Bacteria in Deepwater Pipelines in Real-Time at a Negligible Marginal Cost Per Analysis: A Proof of Concept Study	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW29026-Livermore.html http://www.rpsea.org/attachments/contentmanagers/4894/08121-2902-06-PFS-Enumerating_Bacteria_Deepwater_Pipelines_Cost_Analysis-07-06-12.pdf
09121-3500-01	Intelligent Production System for Ultra Deepwater with Short Hop Wireless Power and Wireless Data Transfer for Lateral Production Control and Optimization	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/09121350001-Tubel-Abstract.html http://www.rpsea.org/attachments/contentmanagers/5800/09121-3500-01-PFS-Ultra_Deepwater_Short_Hop_Wireless_Power_Data_Transfer_Lateral_Production_Control_Optimization-07-09-12.pdf
09121-3700-02	A 1,000 Level Drill Pipe Deployed Fiber Optic 3C Receiver Array for Deep Boreholes	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/09121370002-Paulsson-Abstract.html http://www.rpsea.org/attachments/contentmanagers/5811/09121-3700-02-PFS-1000_Level_Drill_Pipe_Fiber_Optic_3C_Receiver_Array_Deep_Boreholes-07-06-12.pdf
09121-3300-06	High Resolution 3D Laser Imaging for Inspection, Maintenance, Repair, and Operations	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/09121330006-3D-Abstract.html http://www.rpsea.org/attachments/contentmanagers/5790/09121-3300-06-PFS-3D_Laser_Imaging_Inspection_Maintenance_Repair_Operations-07-06-12.pdf http://www.rpsea.org/attachments/contentmanagers/5790/09121-3300-06-FR-Phase_1_High_Resolution_3D_Laser_Imaging-03-13-12_P.pdf
09121-3500-10	Gyroscope Guidance Sensor for Ultra-Deepwater Applications	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/09121350010-Laserlith-Abstract.html http://www.rpsea.org/attachments/contentmanagers/5808/09121-3500-10-PFS-Gyroscope_Guidance_Sensor_Ultra_Deepwater_Applications-07-06-12.pdf

Projects In Progress 2007 - 09
Additional Information – Links – 3 of 3

RPSEA Contract No.	Project Name	NETL Project Factsheets & Reports
07121-1401	Composite Riser for Ultra Deepwater High Pressure Wells	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1401-Lincoln-Abstract.html http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW1401-Lincoln.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/07121-1401-final-report.pdf http://www.rpsea.org/attachments/contentmanagers/3621/07121-1401-PFS-Composite_Riser_Ultra_Deepwater_High_Pressure_Wells-07-02-12.pdf
07121-2001	Geophysical Modeling Methods	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW2001-SEG-Abstract.html http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/07121DW2001-SEG.html http://www.rpsea.org/attachments/contentmanagers/3647/07121-2001-PFS-Geophysical_Modeling_Acquisition_Processing_Deepwater_Gulf_Mexico-07-06-12.pdf
08121-2901-01	Ultra-Reliable Deepwater Electrical Power Distribution System and Power Components	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW2901-GEGlobal.html http://www.rpsea.org/attachments/contentmanagers/4882/08121-2901-01-PFS-Deepwater_Electrical_Power_Distribution_Power-07-06-12.pdf
08121-2801-02	GOMEX 3-D Operational Ocean Forecast System Pilot Project	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW28012-PortlandStateU-Abstract.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/08121-280102-final-report-ocean-forecast.pdf http://www.rpsea.org/attachments/contentmanagers/5776/08121-2801-02-PFS-GOMEX_3D_Ocean_Forecast_Pilot-07-06-12.pdf
09121-3300-10	Development of Carbon Nanotube Composite Cables for Ultra-Deepwater Oil and Gas Fields	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/09121330010-LANL-Abstract.html http://www.netl.doe.gov/technologies/oil-gas/publications/EPact/09121-3300-10-phase1-final-report.pdf http://www.rpsea.org/attachments/contentmanagers/5797/09121-3300-10-PFS-Carbon_Nanotube_Composite_Cables_Ultra_Deepwater_Oil_Gas_Fields-07-06-12.pdf
08121-2201-02	Heavy Viscous Oil PVT	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/08121DW2201-Schlumberger.html

New 2010 Projects – 1 of 2

RPSEA Contract Number	Project Name	Company	Principal Investigator	Start Date	End Date	Total Project Cost	RPSEA Cost Budget	Cost Share Total
10121-4202-01	Hydrate Modeling & Flow Loop Experiments for Water Continuous & Dispersed Systems, Phases 1&2/2	Colorado School of Mines	Carolyn A. Koh	08/02/12	08/01/14	$881,003	$701,354	$179,649
10121-4204-01	Corrosion and Scale at Extreme Temperature and Pressure, Phases 2/3	Brine Chemistry Solutions, LLC	Amy Kan	08/30/12	08/29/15	$4,563,835	$3,651,068	$912,767
10121-4302-01	Ultra-High Conductivity Umbilicals: Polymer Nanotube Umbilicals, Phase 2a/c	NanoRidge Materials, Inc.	Christopher Dyke	08/03/12	08/02/15	$3,198,188	$2,558,550	$639,638
10121-4304-01	More Improvements to Deepwater Subsea Measurement	Letton-Hall Group, LLC	Chip Letton	07/03/12	07/02/15	$4,057,391	$3,245,910	$811,481
10121-4306-01	All Electric Subsea Autonomous High Integrity Pressure Protection System (HIPPS) Architecture	GE Global Research	Weston Griffin	Negotiating		$750,000	$600,000	$150,000
10121-4401-02	Ultra-Deepwater Riser Concepts for High Motion Vessels, Phases 1&2/3	Stress Engineering	Brian S. Royer, P.E.	08/21/12	08/20/15	$1,500,000	$1,200,000	$300,000
10121-4402-01	Qualification of Flexible Fiber-Reinforced Pipe for 10,000-Foot Water Depths, Phase 1&2/3 only	GE Global Research	Todd Anderson	08/06/12	08/05/16	$1,299,869	$1,039,876	$259,993
10121-4402-02	Qualification of Flexible Fiber-Reinforced Pipe for 10,000-Foot Water Depths, Phase 1&2/3 only	DeepFlex	Mark Kalman	Negotiating		$461,555	$221,555	$240,000
10121-4404-03	Low Cost Flexible Production System for Remote Ultra-Deepwater Gulf of Mexico Field Development, Phase 1/2	Doris	Sarah Tucker, P.E.	Negotiating		$1,182,283	$945,827	$236,456
10121-4405-02	Ultra-deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico, Phase 2	Det Norse Veritas	Shashikant Sarada Mony	Negotiating		$2,982,822	$2,134,295	$848,527

RPSEA
Research Partnership to Secure Energy for America

New 2010 Projects – 2 of 2

RPSEA Contract Number	Project Name	Company	Principal Investigator	Start Date	End Date	Total Project Cost	RPSEA Cost Budget	Cost Share Total
10121-4406-01	Effects of Fiber Rope - Seabed Contact on Subsequent Rope Integrity, Phases 2/2	Stress Engineering	Ray R. Ayers, PhD, PE	08/21/12	08/20/13	$2,830,421	$590,000	$2,240,421
10121-4407-01	Deepwater Direct Offloading Systems, Phase 1	Remora Technology	Kim Diederichsen	08/16/12	08/15/13	$1,054,471	$843,471	$211,000
10121-4501-01	Smart Cementing Materials and Drilling Muds for Real Time Monitoring of Deepwater Wellbore Enhancement, Phase 3/3	University of Houston	Cumaraswamy Vipulanandan (Vipu)	08/17/12	08/16/15	$3,765,287	$2,580,401	$1,184,886
10121-4502-01	Deepwater Reverse-Circulation Primary Cementing, 2 phases	CSI Technologies, LLC	Jeff Watters	06/22/12	06/21/14	$1,066,507	$798,507	$268,000
10121-4504-01	Intelligent Casing-Intelligent Formation Telemetry System	University of Oklahoma	Harold Stalford	07/31/12	07/30/13	$594,935	$474,935	$120,000
10121-4505-01	Coil Tubing Drilling and Intervention System Using Cost Effective Vessel-**Phase 1**	Nautilus International LLC	Chuck Yemington	07/09/12	07/08/13	$363,273	$283,739	$79,534
10121-4801-01	Synthetic Hurricane Risk Model for the Gulf of Mexico, Phases 3/3	Applied Research Associates		Negotiating		$1,200,915	$875,915	$325,000
10121-4802-01	Effect of Climate Variability and Change in Hurricane Activity in the North Atlantic	University Corporation for Atmospheric Research	Greg Holland	07/03/12	07/02/15	$1,800,000	$1,440,000	$360,000
10121-4903-02	Autonomous Underwater Inspection Using a 3D Laser, phases 1-4/4	Lockheed Martin	Dan McLeod	07/18/12	04/17/14	$2,055,271	$1,642,446	$412,825
TOTALS						$35,608,026	$25,827,849	$9,780,177

RPSEA
Research Partnership to Secure Energy for America

New 2010 Projects
Additional Information – Links – 1 of 2

RPSEA Contract No.	Project Name	NETL Project Factsheets & Reports
10121-4202-01	Hydrate Modeling & Flow Loop Experiments for Water Continuous & Dispersed Systems	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121420201-csm-abstract-hydrate.html
10121-4204-01	Corrosion and Scale at Extreme Temperature and Pressure	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121420401-brine-chemistry-abstract-corrosion.html
10121-4302-01	Ultra-High Conductivity Umbilicals: Polymer Nanotube Umbilicals	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121430201-nanoridge-abstract-umbilicals.html
10121-4304-01	More Improvements to Deepwater Subsea Measurement	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121430401-letton-hall-abstract.html
10121-4306-01	All Electric Subsea Autonomous High Integrity Pressure Protection System (HIPPS) Architecture	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121430601-geglobal-abstract-subsea-electric.html
10121-4401-02	Ultra-Deepwater Riser Concepts for High Motion Vessels	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121440102-stress-abstract-riser-concepts.html
10121-4402-01	Qualification of Flexible Fiber-Reinforced Pipe for 10,000-Foot Water Depths	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121440201-geglobal-abstract-flex-pipe.html
10121-4402-02	Qualification of Flexible Fiber-Reinforced Pipe for 10,000-Foot Water Depths	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121440202-deepflex-abstract-flex-pipe.html
10121-4404-03	Low Cost Flexible Production System for Remote Ultra-Deepwater Gulf of Mexico Field Development	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121440402-doris-abstract-flex-system.html
10121-4405-02	Ultra-deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico, Phase 2	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121440502-dnv-abstract-dry-tree.html

New 2010 Projects
Additional Information – Links – 2 of 2

RPSEA Contract No.	Project Name	NETL Project Factsheets & Reports
10121-4406-01	Effects of Fiber Rope - Seabed Contact on Subsequent Rope Integrity	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121440601-stress-abstract-fiber-rope.html
10121-4407-01	Deepwater Direct Offloading Systems, Phase 1	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121440701-remora-abstract-direct-offloading.html
10121-4501-01	Smart Cementing Materials and Drilling Muds for Real Time Monitoring of Deepwater Wellbore Enhancement	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121450101-houstonu-abstract-smart-cementing.html
10121-4502-01	Deepwater Reverse-Circulation Primary Cementing	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121450201-csi-abstract.html
10121-4504-01	Intelligent Casing-Intelligent Formation Telemetry System	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121450401-oklahomau-abstract-intelligent-casing.html
10121-4505-01	Coil Tubing Drilling and Intervention System Using Cost Effective Vessel- **Phase 1**	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121450501-nautilus-abstract.html
10121-4801-01	Synthetic Hurricane Risk Model for the Gulf of Mexico	
10121-4802-01	Effect of Climate Variability and Change in Hurricane Activity in the North Atlantic	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121480201-ucar-abstract.html
10121-4903-02	Autonomous Underwater Inspection Using a 3D Laser	http://www.netl.doe.gov/technologies/oil-gas/EPAct2005/Projects/UDW/10121490302-lockheed-abstract.html

2011 DOE Annual Plan Objectives

1. *Improved well control technologies and techniques to reduce risk.*
2. *Improved well design and construction to reduce risks for ultra-deepwater wells.*
3. *Improved subsea ultra-deepwater measurement and monitoring instrumentation.*
4. *Improvement of flow assurance, expediting the completion of well control efforts, and reducing the risk of environmental impacts from potential hydrate plugging related ruptures during producing operations.*
5. *Increased understanding of complex fluid phase behaviors that occur under conditions of extreme pressure and temperature, and develop advanced models of hydrocarbon behavior.*
6. *Assess and quantify the risks of environmental impacts from deepwater oil and gas exploration, drilling, and production activity, to include modeling and evaluation of industry systems, based on newly developed technologies.*
7. *Research on sensors, instrumentation, command electronics, and advanced data interpretation technologies.*
8. *Improved reservoir characterization, simulation, and recovery methods which result in lower dependence on new field developments and new wells, thus reducing the physical and environmental footprint, as well as dependency on foreign sources of oil.*

RPSEA
Research Partnership to Secure Energy for America

2011 Approved Project Solicitations – Round 1

TAI	Title	Phases	Duration (mos)	RPSEA Funds	Total Cost ($MM)
5101	**Human Factors Evaluation of Deepwater Drilling, including Literature Review**	3	42	$ 1.68	$ 2.40
5201	Obstruction Remediation without the Ballistic Plug Effect	3	24	$ 3.20	$ 4.00
5302	Construction and Testing of Deepwater Permanent Subsea Pressure Compensated Chemical Reservoir	4	33	$ 1.06	$ 1.70
5502	Layered Measurement System in Drilling Mud for Early Kick Detection	4	30	$ 1.95	$ 3.00
5503	Instrumented BOP Ram: Drill Collar/ Tool Joint Locator	2	30	$ 1.12	$ 1.40
5706	Advanced Borehole Seismic Technology for Deepwater Drilling	2	24	$ 1.63	$ 3.25
TOTAL				**$10.64 (68%)**	**$15.75**

2011 Approved Project Solicitations – Round 2

TAI	Title	Phases	Duration (mos)	RPSEA Funds	Total Cost ($MM)
5401	Carbon-fiber Reinforced Riser for Dry Tree Drilling of High-Pressure Wells (contd 1401)	3	36	$10.1	$16.0
5402	Riser Lifecycle Monitoring System for Integrity Management	3	24	$ 1.3	$ 2.0
5404	VIM Study for Deep Draft Column Stabilized Floaters	2	18	$ 1.2	$ 1.5
5801	Hi-Res Environmental Data for Enhanced UDW Operations Safety	2	36	$ 0.9	$ 1.3
TOTAL				**$13.5 (65%)**	**$20.8**

RPSEA
Research Partnership to Secure Energy for America

2012 DOE Annual Plan – UDW Program Goal

- Ensure that understanding of UDW operations risks keeps pace with industry developed technologies to tap increasingly challenging reserves.
- Assess and mitigate risk in offshore production activities related to controls, safeguards, and environmental impact mitigation procedures in place during drilling and production operations.
- Research topics are expected to include:
  - Development of *improved well control and wild well intervention* techniques;
  - Evaluation of appropriate *safeguards for blowout preventers, cementing and casing*;
  - Evaluation *of instrumentation and monitoring*;
  - Improvement of *flow assurance*;
  - Expediting the *completion of relief wells*; and
  - *Other topics* associated with ultra-deepwater operations.

RPSEA
Research Partnership to Secure Energy for America

2012 DOE Annual Plan - UDW Program Planned Topics - 1

Improved understanding of risks

- Improve understanding of *complex fluid phase behaviors that occur under conditions of extreme pressure and temperature*, and develop advanced models of hydrocarbon behavior.
- Assess and quantify the *risks of environmental impacts from deepwater oil and gas exploration, drilling, and production activity*, to include modeling and evaluation of industry systems, based on newly developed technologies.
- Improve *reservoir characterization* which results in lower dependence on new field developments and new wells, thus *reducing the physical and environmental footprint*.

RPSEA
Research Partnership to Secure Energy for America

2012 DOE Annual Plan - UDW Program Planned Topics - 2

Reduce risk through real-time information

- Improve subsea ultra-deepwater *measurement and monitoring instrumentation*, including technologies for "seeing" through the casing via downhole tools to gauge the cement top and in-situ cement characteristics (thickness, channeling, density (gas or liquid pockets), etc.) to better determine potential failure pathways.
- Research *sensors, instrumentation, command electronics, and advanced data interpretation technologies*.

RPSEA
Research Partnership to Secure Energy for America

2012 DOE Annual Plan - UDW Program Planned Topics - 3

Reduce risk through advanced technology

- Improve *well control technologies and techniques* to reduce risk.
- Improve *well design and construction* to reduce risks for ultra-deepwater wells.
- Improve *flow assurance*, thereby expediting the completion of well control efforts, and reducing the risk of environmental impacts from potential hydrate plugging related ruptures during producing operations.
- Continue *research, development, and demonstration of advanced technologies* to reduce risk.

RPSEA
Research Partnership to Secure Energy for America

2012 DOE Annual Plan - UDW Program Solicitations Influence

The Department will be influenced and informed in large part by:

- The Ultra Deepwater Advisory Committee (UDAC),
- Ongoing risk analysis conducted by the Los Alamos National laboratory, and
- Advice to the Department of the Interior from its Ocean Energy Safety Advisory Committee and its subcommittees on oil spill prevention and containment.

Quantification and assessment of risk will be an integral part of the entire research program.

Therefore, the final 2012 research portfolio may be different.

RPSEA
Research Partnership to Secure Energy for America

Timelines

PROGRAM	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
2009	Project Executions											
2010	DOE Project Approvals		Project Contracting					Projects Commencements		Project Executions		
2011	RFP Creations		NETL Reviews	DOE Approvals			Bid TAIs		Evaluate Bids			NETL Reviews
2012		Solicit CTRs		On Hold for AP				Review CTRs			RFP Creations	

PROGRAM	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
2009	Project Executions											
2010	Project Executions											
2011	DOE Approvals	Project Contracting						Commence Projects	Project Executions			
2012	NETL Reviews	DOE Approvals	Bid TAIs		Evaluate Bids			NETL Reviews	DOE Approvals	Project Contracting		

PROGRAM	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14
2009	Project Executions						Project Closeouts/ Transfers to DOE					
2010	Project Executions						Project Closeouts/ Transfers to DOE					
2011	Project Executions						Project Closeouts/ Transfers to DOE					
2012	Project Contracting			Commence Projects	Project Executions		Project Closeouts/ Transfers to DOE					

Note: This does not indicate that projects awarded but not completed by 9/14 will continue on after sunset.

Research Partnership to Secure Energy for America

RPSEA Administered Cost Share Research Overview: Ultra-Deepwater Program

James Pappas, P.E.

Vice President, Ultra-Deepwater Programs

jpappas@rpsea.org

(281) 690-5511

20th Meeting: Ultra-Deepwater Advisory Committee
Hyatt North Houston, Houston, TX
Wednesday, September 26, 2012