

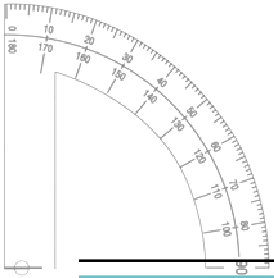


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• **Research**
• **Partnership to**
• **Secure Energy**
• **for America**
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Ultra-Deepwater Advisory Committee
July 15, 2009, 8:00 a.m. EASTERN,
WebEx/Conference Call Meeting

Art Schroeder
Manager, UDW Technology

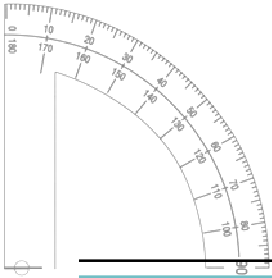
Secure Energy for America



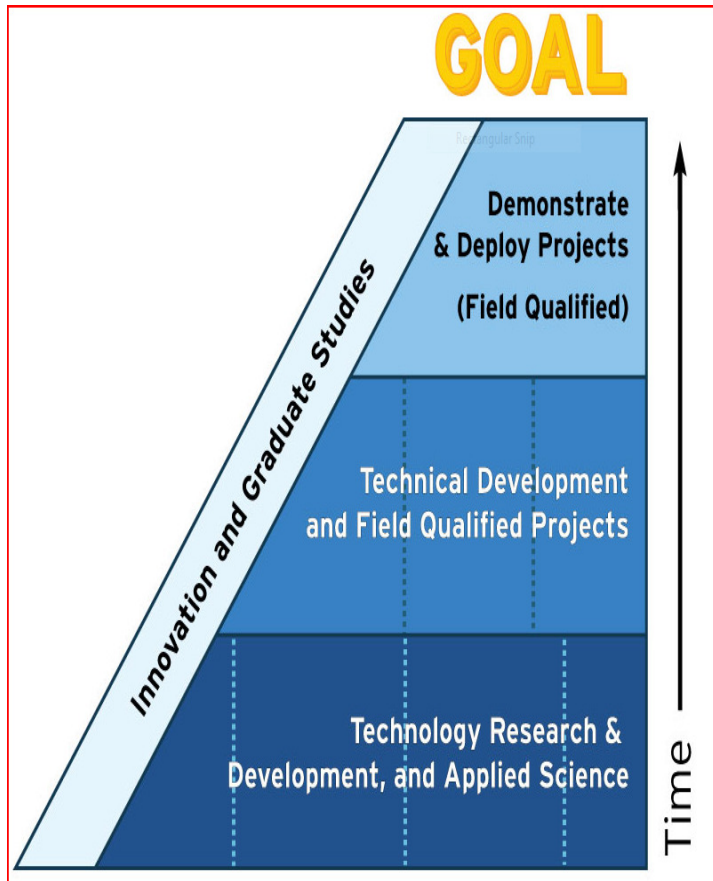
UDW Program Goal

The goal of the UDW is to exploit the ultra-deepwater resource base and to convert currently identified (discovered) resources into economic recoverable (proven) reserves, while protecting the environment, thereby providing the U.S. consumer with secure and affordable petroleum supplies. This goal will be achieved by:

- Increasing the production of ultra-deepwater oil and gas resources
- Reducing the costs to find, develop, and produce such resources
- Increasing the efficiency of exploitation of such resources
- Increasing production efficiency and ultimate recovery of such resources
- Improving safety and environmental performance by minimizing environmental impacts associated with ultra-deepwater exploration and production



UDW Program Objectives



Near Term

Objective 1: Ongoing Identification of Technology UDW Needs

Objective 2: Technology Research & Development, & Applied Science

Objective 3: Awareness and Cost-Share Development.

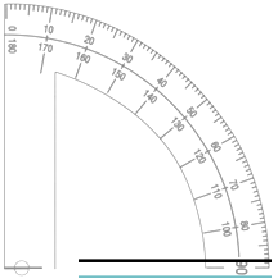
Longer Term

Objective 4: Technical Development and Field Qualified

Objective 5: Environmental & Safety Technology Development & Deployment

Objective 6: Technology Demonstration.

Objective 7: Technology Commercialization and Industry Deployment



Increasing Lag Between Discovery and Development

Proven Reserves Add Value

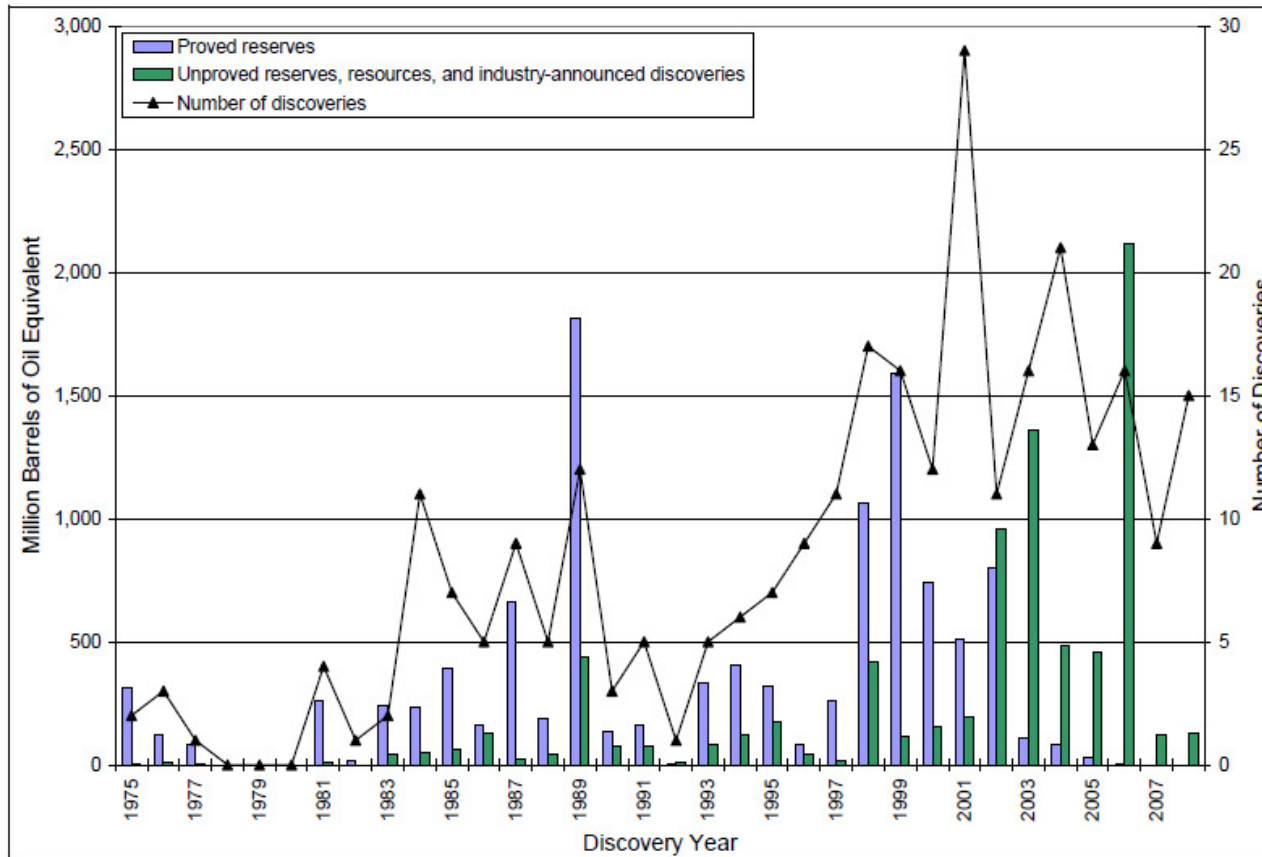
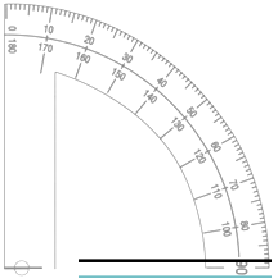
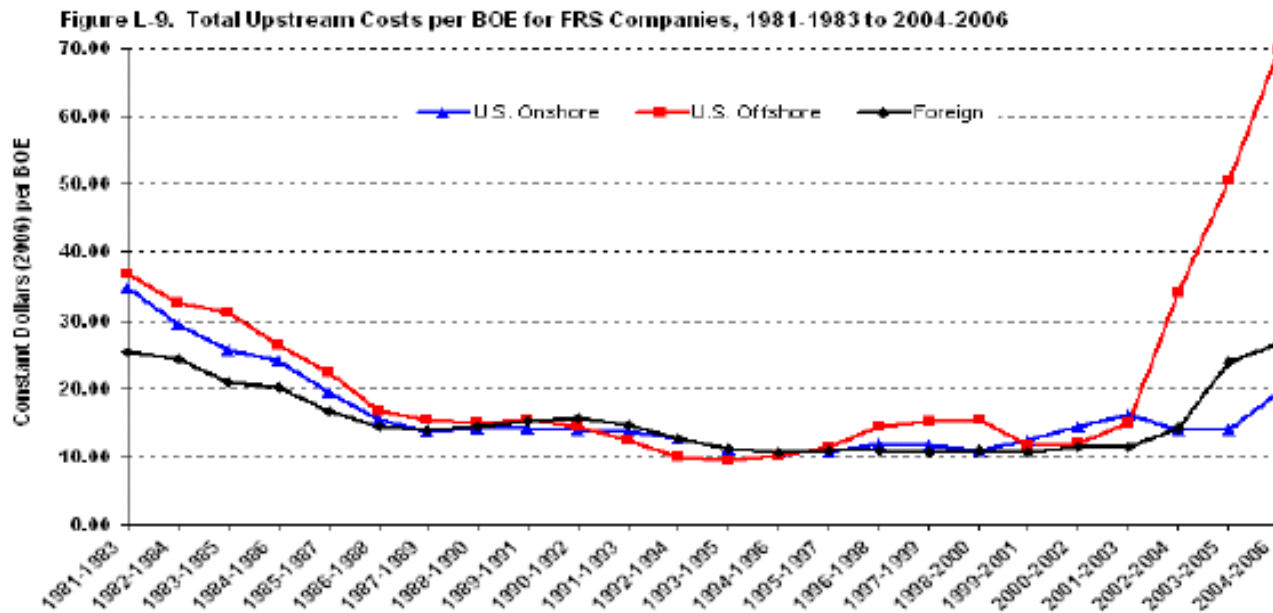


Figure 22. Number and volume of deepwater discoveries. Volumes include MMS reserves, MMS resources, and industry-announced discoveries.

MMS Report 2009 – 016: Deepwater Gulf of Mexico 2009. (continuing trend from 2008-013 report)

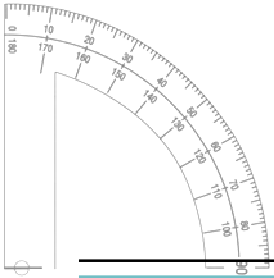


Need to reduce costs



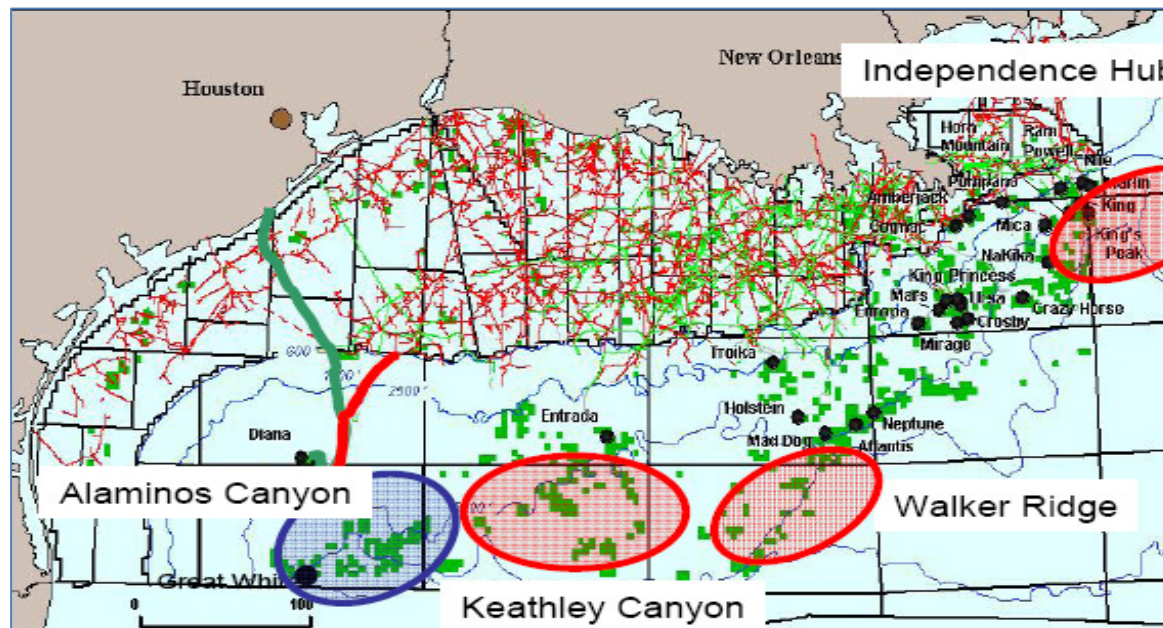
Notes: Costs are the quotient of costs and reserve additions for each three-year period. BOE = Barrels of oil equivalent.
 Source: Energy Information Administration, Form EIA-28 (Financial Reporting System).

Figure 5. Cost per Barrel of Oil Equivalent (BoE) per US Department of Energy, Energy Information Agency (EIA) January 2008, for companies reporting to EIA's Financial Reporting System (FRS). It does not include state-owned oil companies. <http://www.eia.doe.gov/neic/infosheets/crudeproduction.html>



UDW Program Approach

Four base-case field development scenarios



The Challenges

Walker Ridge/Keathley Canyon

- subsalt
- deeper wells
- tight formations

Alaminos Canyon

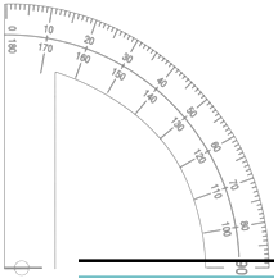
- viscous crude
- lacking infrastructure

Eastern Gulf – Gas Independence Hub

- higher pressure & temperature
- CO₂/H₂S

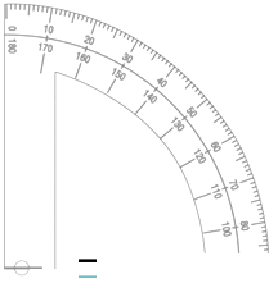
Overall

- higher drilling costs
- challenging economics



UDW Program 'Needs'

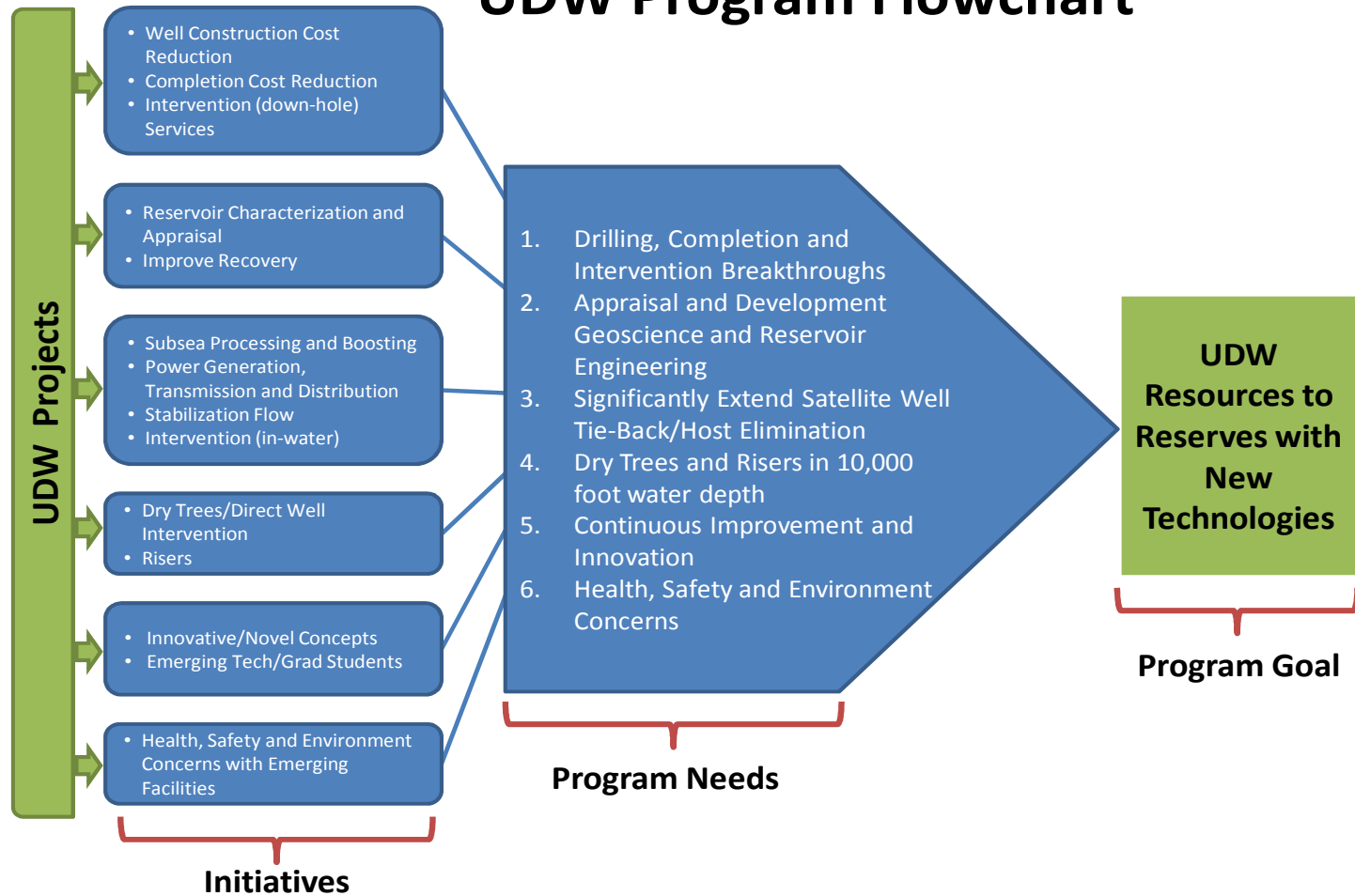
1. Drilling, completion and intervention breakthroughs
2. Appraisal & development geoscience and reservoir engineering
3. Significantly extend subsea tieback distances & surface host elimination
4. Dry trees/direct well intervention and risers in 10,000' wd
5. Continuous improvement / optimize field development
 - Per wellbore recovery
 - Cost reduction
 - Reliability improvements
 - Efficiency improvements
6. Associated safety and environmental trade-offs

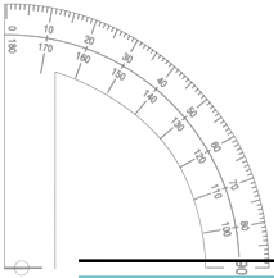


UDW Program Approach



UDW Program Flowchart



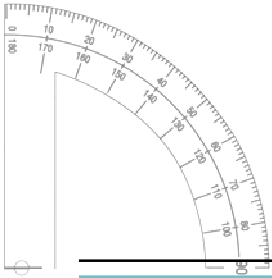


2007 UDW projects

Project	Project Title	Number of bids	Selected	Award (RPSEA max)
DW1201	Wax Control	3	University of Utah	\$400,000
DW1301	Improvements to Deepwater subsea measurements	2	Letton Hall Group	\$3,564,000
DW1302	High Conductivity Umbilicals	2	Technip	\$448,000
DW1401	Composite Riser for UDW High Pressure Wells	3	Lincoln Composites	\$1,680,000
DW1402	Deepwater dry tree system for drilling production	4	FloTec / Houston Offshore	\$936,000
DW1403	Fatigue Performance of High Strength Riser Materials	2	SwRI	\$800,000
DW1501	Extreme Reach Development	2	Tejas	\$200,000
DW1603	Design investigation xHPHT, SSSV	6	Rice Univ.	\$120,000
DW1603	Robotic MFL Sensor; monitoring & inspecting risers		Rice Univ.	\$120,000
DW1603	Hydrate Plugging Risk		Tulsa Univ.	\$120,000
DW1603	Hydrate Characterization & Dissociation Strategies		Tulsa Univ.	\$120,000
DW1701	Improved Recovery	2	Knowledge Reservoir	\$1,600,000
DW1801	Effect of Global Warming on Hurricane Activity	1	NCAR	\$560,000
DW1901	Subsea processing System Integration	2	GE Research	\$1,200,000
DW1902	Deep Sea Hybrid Power Systems:	1	HARC	\$480,000
DW2001	Geophysical Modeling Methods	2	SEG	\$2,000,000

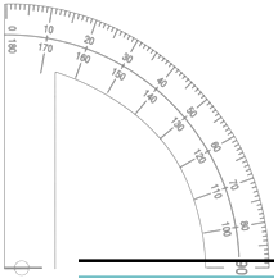
summary

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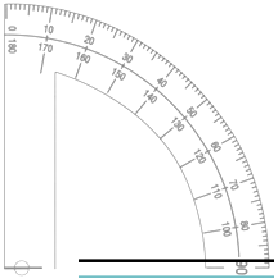
2008 UDW projects

TAC Number	Impact	2008 RPSEA Max Share
DW 2101	New Safety Barrier Testing Methods	\$ 128,000
DW 1202	EOS improvement for xHPHT	\$1,600,000
DW 2201	Viscous Oil PVT	\$460,000
DW 2301	Deepwater Riserless Light Well Intervention	\$3,411,500
DW 1502	Coil Tubing Drilling & Intervention	\$820,000
DW 2501	Early Reservoir Appraisal, Utilizing a Low Cost Well Testing System - Phase 1	\$880,000
DW 2502	Modeling and Simulation; MPD	\$384,000
DW 2701	Resources to Reserves Development and Acceleration through Appraisal	\$400,000
DW 2801	Gulf 3-D Operational Current Model Pilot	\$1,248,000
DW 2901	power distribution & components (Component Qualification)	\$4,811,000
10 Projects	Totals	\$14,142,500



UDW Program status

Categories	2007 Proposals	2007 selected	2007 awarded	2008 proposals	2008 selected	2008 awarded
Universities		5	5	8	3	
National Laboratories		-	-	-		
Nonprofit Corporation		4	4	1	1	
For Profit Corporation		8	7	16	8	
Total	32	17	16	25	12 out of 16(10 + 6)	0

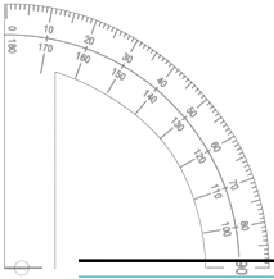


2009 UDW Plan Strategy

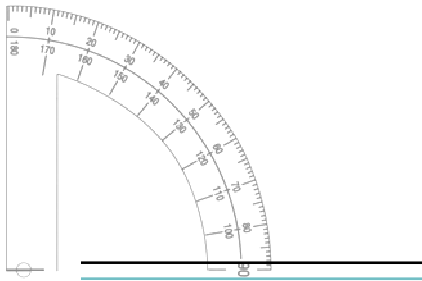
- 6 Initiative-based RFPs (6 to 10 project awards)
- Unlike 2007 and 2008, UDW TACs have not voted for individual projects. Rather, the TACs prioritized project ideas by initiatives.
- This input was evaluated by the PAC to decide appropriate balance for 2009 UDW program.
- UDW 2009 RFPs will consist of both specific projects and broader initiative-based requests.
- Timing; anticipate release of RFPs mid August 2009 with 60 day clock, selection November / December 2009 and awards 1Q2010

2009 UDW Funding

RPSEA YR3 Funding Allocation (2009)		Funding Distribution (\$k)		
	Title / Description	Low	High	Average
Need #1	Drilling Completion and Intervention Breakthroughs			6,250
1	Drilling	2,000	5,000	3,500
2	Completions	1,000	3,000	2,000
3	Intervention (Downhole Services)			-
4	Intervention (In-Water IMR)	500	1,000	750
5	Extended Well Testing			-
Need # 2	Appraisal & development geosciences and reservoir engineering			1,500
6	Reservoir Surveillance	1,000	2,000	1,500
Need #3	Significantly extend subsea tieback distances / surface host elimination			3,625
7	Stabilized Flow	750	1,500	1,125
8	Subsea Power			-
9	Subsea Processing, Pressure Boosting, Instrumentation and Controls	2,000	3,000	2,500
Need #4	Dry trees / Direct well intervention and risers in 10,000' wd.			-
10	Riser Systems			-
11	Dry Tree Structures			-
Need #5	Continuous Improvement / Optimize field development			3,000
12	Long Term Research and Development and Graduate Student Program	1,000	2,000	1,500
13	Sensors, tools and Inspection Processes	1,000	2,000	1,500
	Bridging and Contingency	500	750	625
Need #6	Associated Safety and Environmental Concerns			500
14	Environmental Issues	250	750	500
		10,000	21,000	14,875

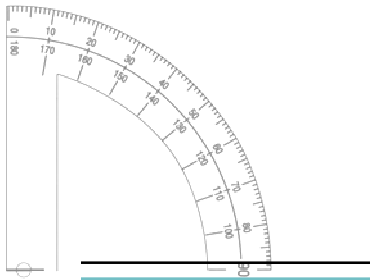


Back-ups



2007 UDW Projects

PROJECT	AWARDEE	DURATION/ RP&EA FUNDING	DESCRIPTION	PARTICIPANTS
DW1201: Wax Control	The University of Utah	24 months \$400,000	Evaluate current and new flow assurance technologies to develop options for flowline cold stable flow without pipe insulation	SINTEF Petroleum Research, BP, StatoilHydro, University of Tulsa
DW1301: Improvements to Deepwater Subsea Measurements	Letton-Hall Group	24 months \$3,654,000	Address gaps in the deployment and use of multiphase and wet gas meter technology in deepwater production systems.	Chevron, Shell, Total, ConocoPhillips, BHP, StatoilHydro, Petrobras, Oceaneering, Multiphase Systems Integration Welker Engineering, Lake Charles Instruments/Neffmer Asept, Intertek, BP, Southwest Research Institute, ENI, Anadarko, Devon, Schlumberger, Weatherford
DW1302: Ultra-High Conductivity Umbilicals	NanoRidge Materials	12 months \$448,000	Engineering prototype of a working ultra-high conductivity 'wire' (conductor) utilizing nanotube technology and test and analytical data	Technip, Rice University, Duco
DW1401: Carbon Fiber Wrapped High Pressure Drilling and Production Riser Qualification Program	Lincoln Composites	24 months \$400,000	Develop and qualify composite reinforced metal tubulars for 15 ksi WP riser service in 10,000 fsw	Stress Engineering
DW1402A: Ultra-Deepwater Dry Tree System for Drilling and Production	Houston Offshore Engineering	Stage 1 3 months \$106,000 (Optional additional stages)	Feasibility design of a (low motion) semisubmersible qualified to support dry tree risers in the GOM which can be integrated with its topside quayside	Keppel Fels, Kiewit Offshore Services
DW1402B: Ultra-Deepwater Dry Tree System for Drilling and Production	Floatech	Stage 1 3 months \$234,000 (Optional additional stages)	Feasibility design of a (low motion) semisubmersible qualified to support dry tree risers in the GOM which can be integrated with its topside quayside	Seadrill Americas, Inc., GE/VetcoGray, 2H Offshore
DW1403: Fatigue Performance of High Strength Riser Materials	Southwest Research Institute	18 months \$800,000	Testing and material qualification program will collect fatigue performance data for high strength materials for riser design	



2007 UDW Projects

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW1601: Extreme Reach Development	Tejas Research & Engineering	9 months \$200,000	Study, conceptualize tools and service capabilities required to safely drill, complete, produce, maintain, and abandon reservoirs located up to 20 miles away from the surface facilities	Total, Chevron
DW1603-A: Graduate Student Design Project. Design of Extreme High Pressure and High Temperature Subsurface Safety Valve	Rice University	24 months \$150,000	Project will contribute to goals of the drilling and completions initiative	
DW1603-B: Graduate Student Design Project. Robotic MFL Sensor for Monitoring and Inspection of Deepwater Risers	Rice University	24 months \$150,000	Project will contribute to the goals of the dry trees/direct well intervention and risers in 10,000' water depth	ITRobotics
DW1603-C: Graduate Student Design Project. Hydrate Plug Characterization and Dissociation Strategies	The University of Tulsa	24 months \$150,000	Project will contribute to the goals of the stabilized flow initiative	BP
DW1603-D: Graduate Student Design Project. Flow Phenomena In Jumpers	The University of Tulsa	24 months \$150,000	Project will contribute to the goals of the stabilized flow initiative	Chevron
DW1701: Improved Recovery	Knowledge Reservoir	18 months \$1,600,000	Identification of improved recovery opportunities in the early stages of field development planning	Anadarko
DW1801: Effect of Global Warming on Hurricane Activity	National Center for Atmospheric Research (UCAR)	12 months \$560,000	Study to assess the threat that global on Gulf of Mexico hurricane activity (intensity and/or frequency)	Georgia Institute of Technology
DW1901: Subsea Processing System Integration Engineering	GE Global Research	12 months \$1,200,000	Process simulator for a subsea production system	GE/VetcoGray
DW1902: Deep Sea Hybrid Power System	Houston Advanced Research Center	12 months \$480,000	Evaluate alternative methods for locally generating significant electrical power on the seafloor near large consumption points	Lawrence Livermore National Laboratory, Naval Facilities Engineering Service Center, Yardney Lithion, GE, Shell, Chevron
DW2001: Synthetic Benchmark Models of Complex Salt	SEAM	24 months \$2,000,000	Project will generate realistic benchmark geological models, associated synthetic seismic and potential field data	3DGeo Development, Anadarko, BHP Billiton, OGGV Vertas, Chevron, Conoco Phillips, Devon, EMGS ASA, Eni, Exxon Mobil, Geobraces Technologies, Hess Corporation, ION, Landmark Graphics, Maersk Oil, Marathon Oil, Petrobras, PGS Americas, Repsol Services, Rock Solid Images, StatoilHydro, Total, WesternGeo

RPSEA DW 2001- Synthetic Benchmark Models of Complex Salt

Description: Develop one or more synthetic data models to be used to benchmark new processing methods and tools to image reservoirs under complex salt structures.

Application: This data set will enable the quality verification and testing of imaging tools with a known result.



Objectives:

This project will contribute to geophysical imaging technology evolution. It will provide realistic benchmark geological models and associated synthetic seismic together with potential field data.

Value / Impact:

These models will allow industry to effectively and efficiently assess seismic (and other) acquisition and processing techniques for generating images of hydrocarbon reservoirs beneath massive, complex salt bodies.

Results / Accomplishment: The deliverables include this benchmark data set to be used by the developers of complex seismic processing tools.

Champion: P Williamson (Total) & C. Meeder (Marathon)

Contractor: SEAM

Budget: \$2,500,000

RPSEA: \$ 2,000,000



RPSEA DW 1201- Wax Control

Description: Develop wax management technologies for use in cold slurry flow scenarios.

Application: Deepwater flowline tie-backs over long distances



Objectives: Evaluate and improve wax management technologies to:

- Minimize wall wax deposition rates.
- Improve techniques to effectively remove deposition
- Improve cold slurry flow technologies as they apply to hydrates and waxes

Value / Impact:

Will enable long distance tie-backs with bare steel flowlines with improved operational performance. Will not need expensive insulation or external heating.

Results / Accomplishment

Expect resulting technologies to deliver a true comprehensive cold flow strategy without pipe insulation.

Champion: G. Shoup (BP)

Contractor: University of Utah

Budget: \$500,000

RPSEA: \$ 400,000



RPSEA DW 1301- Improvements to Deepwater Subsea Measurement

Description: Perform six related tasks to improve subsea sensors and multiphase meter measurements →

Application: Multiphase measurements are required for reservoir management and for fiscal allocation among various stakeholders.



Scale in Meter Sensor Port

- Objectives:** Improve reliable performance through:
- Deepwater Sampling
 - ROV-Assisted Metering (Check meter service)
 - HP/HT Sensor Qualification
 - Meter Alteration Effects
 - Metering System Uncertainty
 - Evaluation of Flow Modeling

Value / Impact: Improved monitoring enables greater reservoir recovery.

Results / Accomplishment: A set of standards and designs will be produced and qualified to improve overall meter and sensor service.

Champion: Robert Webb (BP)

Contractor: Letton Hall Group →

Budget: \$4,455,000

RPSEA: \$ 3,564,000



RPSEA DW 1302- Ultra-High Conductivity Umbilicals

Description: Develop concepts and a plan-forward for deepwater power umbilicals →

Application: Required to deliver large amounts of power subsea for major deepwater field developments.



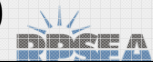
Objectives: Conceptualize power umbilical technologies to increase power capacity and decrease size and weight of umbilicals. Technologies may include nano-tubes and other promising alternatives.

Value / Impact: Efficient delivery of subsea power is required for major deepwater developments.

Results / Accomplishment: Various technologies will be evaluated and a plan forward established to develop these efficient power umbilicals

Champion: Akin Oke (CVX)
Budget: \$560,000)

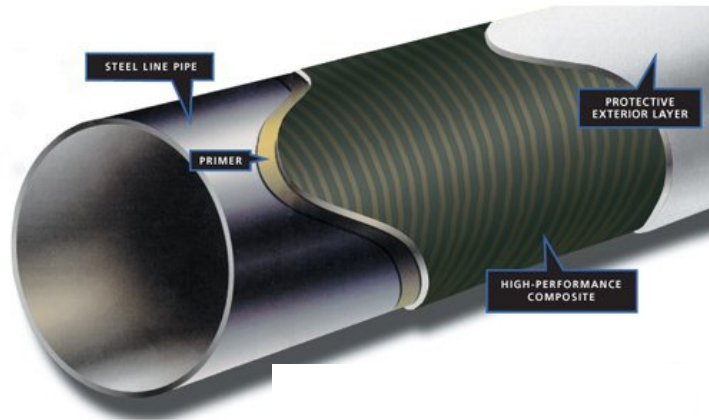
Contractor: Nano Ridge
RPSEA: \$ 448,000



RPSEA DW 1401- Composite Riser for Ultra-Deepwater High Pressure Wells

Description: Develop and qualify fiber reinforced XHP riser tubulars. Build prototypes for field trials in the GOM. →

Application: Light weight tubulars for use in drilling and production service.



Objectives: Determine, through large scale tests, if carbon fiber wrapped steel riser pipe (steel /composite hybrid) is suitable for long-term use in the harsh environment of deep water offshore

Value / Impact: Composite Risers expected to:

- Water depth capability in excess of 10,000 feet
- Operating pressure rating beyond 15,000 psia
- Provide a 50% reduction in the in-water weight of a comparable steel riser

Results / Accomplishment: Qualify design, fabrication and testing methodologies. Deliver some prototypes for field service in next phase.

Champion: Roy Shilling (BP) & Tom Walsh (Shell)

Contractor: Lincoln Composites

Budget: \$2,100,000

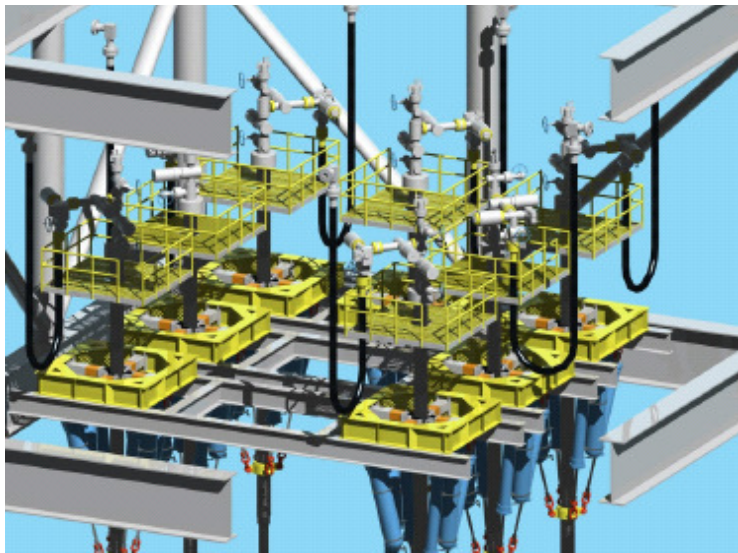
RPSEA: \$ 1,680,000



RPSEA DW 1402- Ultra-deepwater Dry Tree System for Drilling and Production in GOM, Phase 1

Description: Conceptually design and evaluate 2 hulls and 2 payloads for dry-tree ultra-deepwater structures. →

Application: Ultra-deepwater field developments with lower costs



Dry Tree Riser Tensioner System

Objectives: Define the potential and gaps for developing a dry tree semi or similar hull to a feasible and competitive floater solution for GOM in 8,000 ft water depth with moderate to large payloads

Value / Impact: The market is currently limited to a single concept. A competitive alternative will spur improvement and cost reduction in current dry tree hosts for ultra deep water.

Results / Accomplishment: Designs, trade-offs, cost estimates, model tests, workshops and Phase 1 project documentation will be produced.

Champion: Paul Devlin (CVX); Shell & Statoil

Contractor: FloTech/ Houston Offshore

Budget: \$1,170,000
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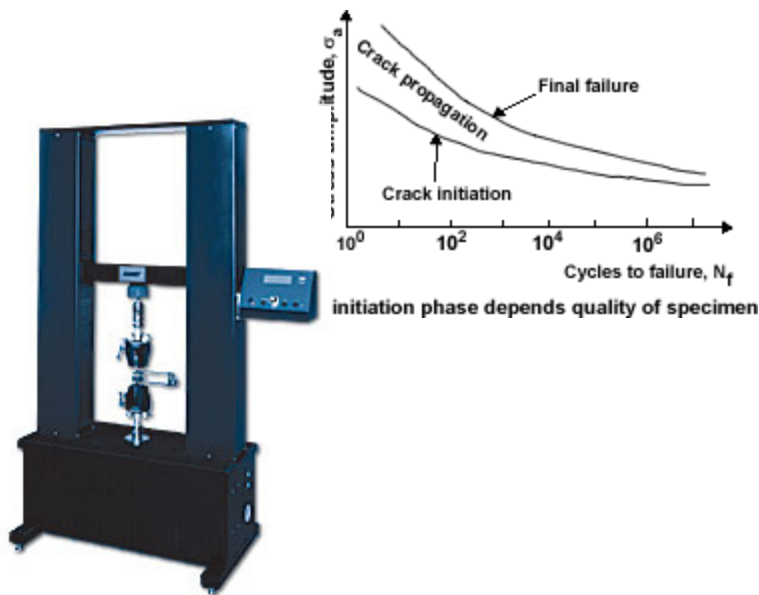
RPSEA: \$ 936,000 →



RPSEA DW 1403- Fatigue Performance of High Strength Riser Materials

Description: Measure fatigue and crack growth properties for high strength steels and newer materials to qualify them for deepwater riser service. →

Application: Ultra-deepwater Riser service optimized for weight and strength



Objectives: Address fracture toughness, crack growth and S-N curve tests on strip specimens of riser materials. Stress corrosion cracking (SCC) and HEE would also be conducted for simulated service conditions.

Value / Impact: Prequalification of high strength materials for risers will enable deepwater riser development and reduce the risk for use of such materials.

Results / Accomplishment: Design information detailing fatigue crack growth rates and SN curves for the materials tested.

Champion: Himanshu Gupta and Steven Shademan (BP)

Contractor: SwRI

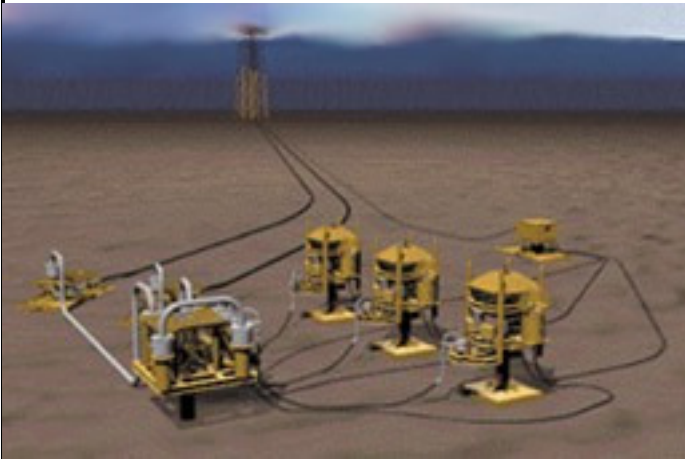
Budget: \$1,000,000

RPSEA: \$ 800,000

RPSEA DW 1501- Extreme Reach Development

Description: Conceptualize new integrated drilling, completion and production technologies which are capable up to a 20 mile offset reservoir development.

Application: Any location where vertical surface reservoir access may be limited.



Objectives: Start with “clean” paper, establish a design basis and then conceptualize and document the required facilities and all operating procedures for reservoir development scenarios having offsets up to 20 miles

Value / Impact: Grand Challenge programs focus innovative (out-of-the-box) thinking having potential to enable some field developments or to reduce the cost of existing methods.

Typical Subsea Satellite Field

Results / Accomplishment: A conceptual design defining new (breakthrough) technologies offering alternative methods for satellite marginal field developments.

Champion: Phil V. Clark (CVX)

Budget: \$ 250,000

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Contractor: Tejas

RPSEA: \$ 200,000





RPSEA; Graduate Student Design Projects

DW 1603 – Design investigation xHPHT, SSSV; Rice University

DW 1603 b– Robotic MFL Sensor; monitoring & inspecting risers;
Rice University

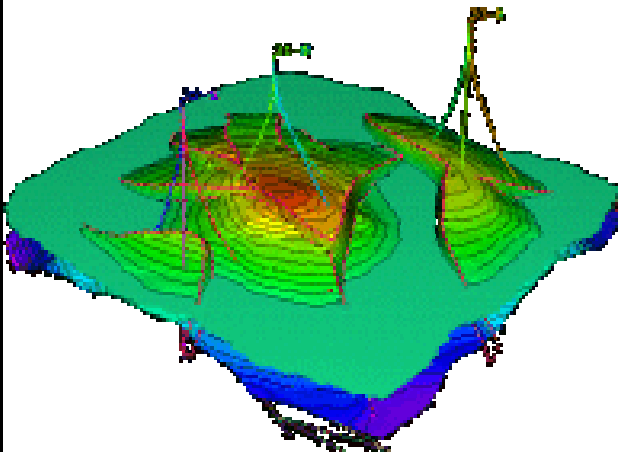
DW 1603 c – Hydrate Plugging Risk; Tulsa University

DW 1603 d –Hydrate Characterization & Dissociation Strategies;
Tulsa University

RPSEA DW 1701-Improved Recovery (Reservoir)

Description: Systematically determine the potential and technical gaps to the application of improved reservoir recovery technologies to deepwater GOM.

Application: Improve recovery factors from the 15-25% currently achieved in these GOM reservoirs.



Objectives: Perform initial 2 phases of a 5 phase program to improve recovery factors. Document the incentives and technical needs for improving recovery. Establish baseline information. High grade applicable recovery techniques through analogue studies and lab tests.

Value / Impact: Determining effective recovery techniques early allows field developments to be configured to implement the technologies.

Results / Accomplishment: Characterize reservoirs by category, reserves, and recovery factor and estimate improved recovery potential. Identify the causes of trapped reserves and techniques (with gaps) to improve recovery. Plan next phases to close gaps and validate effectiveness of IOR.

Champion: Anadarko/Chevron/Total/BP

Contractor: Knowledge Reservoir

Budget: \$ 2,000,000

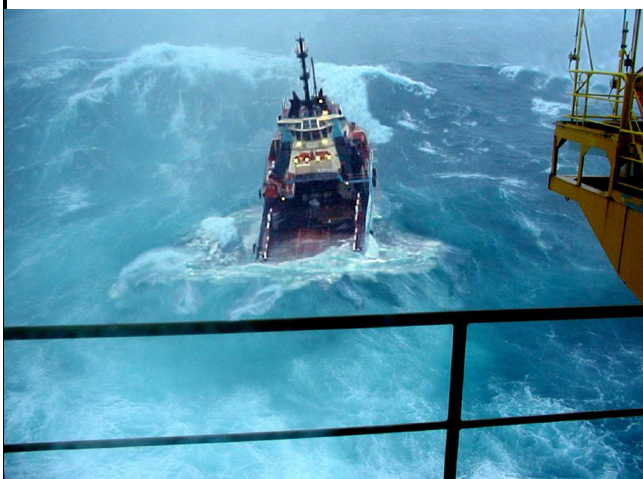
RPSEA: \$ 1,600,000



RPSEA DW 1801- Effect of Global Warming on Hurricane Activity

Description: Using recent models hindcast hurricane activity and then under different scenarios forecast hurricane impact and compare to GOM facility design criteria.

Application: Determine if GOM facility design criteria is adequate for different weather scenarios.



Tropical Depression Bill (GOM)

Objectives: Assess the threat that global warming will increase Gulf hurricane activity.

Perform a sensitivity study to better understand the factors governing wave generation in very severe hurricanes.

Value / Impact: Most hurricane impacts could be mitigated with proper planning provided we know far enough in advance what to expect.

Results / Accomplishment: Two reports, one documenting the climate modeling and the other, the wave modeling

Champion: C Cooper (CVX) & D Driver (BP)

Contractor: UCAR

Budget: \$ 700,000
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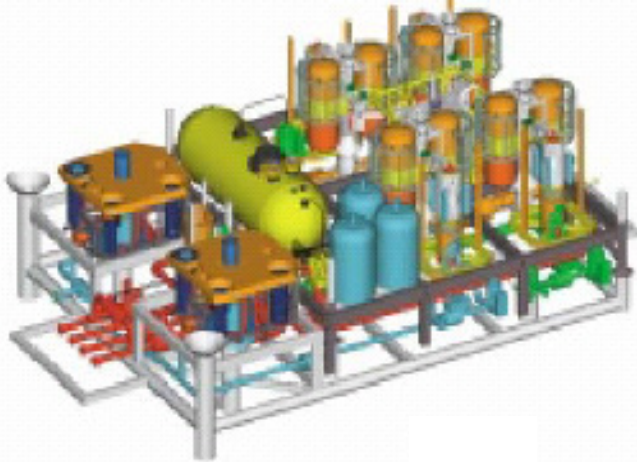
RPSEA: \$ 560,000



RPSEA DW 1901- Subsea Processing System Integration Engineering

Description: Identify and address the technologies and any gaps for the Coyote field development using subsea production technology. →

Application: Risk reduction through facility Design for Reliability will improve SS processing field development utilization.



Objectives: Through field development studies demonstrate the facility arrangements and technical readiness levels of SS production systems. Determine field economics and how future expansion of SS system would enhance development.

Value / Impact: Integrates existing SS Processing work to demonstrate readiness and risk levels. Areas needing further work will be identified.

Results / Accomplishment: SS Processing field development studies using Design for Reliability techniques will quickly demonstrate the technology readiness and directions for any more work.

Champion: C Haver (CVX)

Contractor: GE →

Budget: \$ 1,500,000

RPSEA: \$ 1,200,000



RPSEA DW 1902- Deep Sea Hybrid Power Systems (Initial Study)

Description: Evaluate various seafloor based power production facilities to support field developments. →

Application: SS power generation may power SS production facilities and has potential to produce environmentally friendly power for surface facilities.



Fuel Cells and Nuclear Propulsion

Objectives: Perform a feasibility assessment of various SS based generation and energy storage devices capable of providing power as required by production facilities.

Value / Impact: Improves potential for standalone SS developments. May provide environmentally friendly power to surface facilities. Such seabed facilities would reduce facility topside loads.

Results / Accomplishment: A technical screening of alternative power systems complete with a risk assessment will recommend a suitable system. Further development plans will be prepared.

Champion: C Haver (CVX)

Contractor: HARC →

Budget: \$ 600,000

RPSEA: \$ 480,000

