Ultra-Deepwater Advisory Committee (UDAC)

January 19, 2012

Seventeenth Meeting

Meeting Minutes

A Federal Advisory Committee to the U.S. Secretary of Energy

Ultra-Deepwater Advisory Committee

I hereby certify that this transcript constitutes an accurate record of the Ultra-Deepwater Advisory Committee meeting held on January 19, 2012.

Dan Daulton, Chair
Ultra-Deepwater Advisory Committee

July 07, 2012
Date

Ultra-Deepwater Advisory Committee (UDAC) Meeting
January 19, 2012, Hilton Houston North, 12400 Greenspoint Drive, Houston, TX 77060

The meeting was called to order at 8:00 am by Daniel Daulton, the Chair of the UDAC. Next, he called for introductions, and introduced, in turn, each presenter according to the agenda (Attachment 1). Mr. Daulton then welcomed all visitors and staff and reported that 11 of 13 UDAC members were present and a quorum was in effect (Attachment 2). No members of the general public were present.

The Chair handed over the meeting to Elena Melchert, DOE Program Manager for Oil and Gas Production Research, and UDAC Committee Manager (CM). Ms. Melchert briefed the Committee on future assignments and deadlines, then provided an overview of Title IX, Subtitle J of the Energy Policy Act of 2005 commonly referred to as "Section 999" by the Committee.

The Chair delayed comments from Christopher Smith, the Deputy Assistant Secretary of the Office of Oil and Natural Gas and Designated Federal Officer (DFO) for UDAC as his arrival was postponed until after lunch.

Presentation by Roy Long, Technology Manager, National Energy Technology Laboratory (NETL) (Attachment 3)

Mr. Long summarized the "Section 999" implementation process. He discussed how DOE is meeting statutory requirements and streamlining the subcontracting process. He summarized the RPSEA 2011 solicitations, the Complementary Program elements, and the Traditional Program. Within the Traditional Program he discussed the 2010 funded ongoing projects and the 2012 appropriations. He finished by discussing the Integrated Technology Transfer Program with a focus on the Knowledge Management Database (KMD) and the statistics they have been measuring to monitor its use.

The UDAC then engaged in discussion with Mr. Long.

Presentation by Kelly Rose, Office of Research and Development, NETL (Attachment 4)

Ms. Rose presented the Committee with an overview of NETL's Ultra-Deepwater Research Program. She gave background on the Office or Research and Development, some of the regions their research is pushing into, and the research areas they're focused on. Ms. Rose also described NETL Complementary Program's FY 2012 ultra-deepwater (UDW) research themes:

1. Behavior of metal-based controls in extreme environments
2. Behavior of cement barriers used in ultra-deep water systems
3. Complex fluid-phase properties under HPHT and HPLT conditions
4. Concerns over potential impacts to environmental system

Ms. Rose closed her presentation by reviewing the main goals, key milestones, and deliverables of several current projects at NETL based on those themes. The presentation was followed by Committee discussion.

Presentation by Dasari V. Rao, Division Leader, Decision Applications, Los Alamos National Laboratory (LANL) (Attachment 5)

Dr. Rao presented on the topic of risk informed decision support for ultra-deepwater drilling to the Committee. His presentation covered several areas:

1. Risk Informed Decision Support (RIDS) framework for analyzing UDW drilling operations in the Gulf of Mexico (GOM)
2. Context for the study and insights gained from previous incident reports, studies/workshops and expert elicitations
3. Phenomenological considerations of importance to UDW Drilling in GOM
4. Status, accomplishments, and schedule

He provided the risk assessment methods LANL uses to the Committee. Dr. Rao closed by discussing the tasks LANL faces and an upcoming schedule of their efforts. Dr. Rao was then engaged in discussion by the Committee.

Presentation by Mr. James Pappas, Vice President, Ultra-Deepwater Program, RPSEA (Attachment 6)

After lunch, Mr. Pappas described the RPSEA organization, its membership, structure/organization, how its advisory committees work, and the RPSEA process flow for development of the RPSEA Draft Annual Plan (DAP). Mr. Pappas provide a detailed description of RPSEA's approach taken to build the Ultra-Deepwater Research Program, and ended by giving a status update of the current project portfolio. This was followed by a discussion and question/answer session.

Overview of the 2012 Draft Annual Plan Process

Once the presentations were complete, the CM then explained to the Committee how they are required to develop a document of Findings and Recommendations as written comments on the DOE *2012 Annual Plan* (*http://www.fossil.energy.gov/programs/oilgas/ultra_and_unconventional/2011-2012_Committees/Draft_2012_Annual_Plan_1-10-12.pdf).* Ms. Melchert described the process in which changes were made to the prior year plan to arrive at the current version. Discussion regarding the process for fulfilling the requirement then followed.

At this point of the meeting the DFO Christopher Smith was present and proceeded to make comments. Mr. Smith provided the Committee with an update on the issue of risk assessment since the last meeting. He talked about his participation with the Ocean Energy Safety Advisory Committee and their four subcommittees. The Spill Prevention Subcommittee is currently handling many of the risk assessment issues the UDAC was looking at facing. Mr. Smith's

remarks were followed by Committee discussion which focused on the Risk Assessment Subcommittee formed by the UDAC in the 2011 plan year. After the discussion, the Chair asked for a vote from the Committee to abolish the Subcommittee on Risk Assessment as standing subcommittee within UDAC for the 2012 plan year. The vote passed 9-2 in favor of removing the subcommittee.

Establishment of *ad hoc* Review Subcommittees
The Chair then led the Committee in establishing *ad hoc* review subcommittees and membership. After some discussion, the two review subcommittees and their members were:

R&D Program Portfolio
- Mr. James D. Litton, Chair
- Dr. Nagan Srinivasan, Vice Chair
- Dr. Hartley H. Downs
- Dr. George A. Cooper
- Mr. D. Stephen Pye
- Mr. Elmer P. Danenberger, III

Editing
- Mr. Daniel J. Daulton, Chair
- Ms. Mary Jane Wilson, Vice Chair
- Dr. Lesli J. Wood
- Dr. Quenton R. Dokken
- Dr. Luc T. Ikelle

Mr. William C. New (absent)
Dr. Douglas J. Foster (provide feedback on geosciences area to Portfolio subcommittee)

The members were asked to organize and draft findings and recommendations for presentation at the next meeting on March 1, 2012 in Houston, Texas.

Following the establishment of the subcommittees, Elena Melchert discussed some administrative topics related to the next meetings

No members of the public made requests for public comments.

The meeting was adjourned at 5:00 p.m.

Attachments

	Presenter	Topic
1	For the Record	Meeting Agenda
2	For the Record	Committee Members and Meeting Participant Attendance
3	Mr. Roy Long	DOE Oil and Gas Research Program Overview
4	Ms. Kelly Rose	DOE Ultra-Deepwater Research Program
5	Dr. Dasari V. Rao	Risk Assessment
6	Mr. James Pappas	Ultra-Deepwater Draft Annual Plan

Attachment 1

17th Meeting

Ultra-Deepwater Advisory Committee

January 19, 2012

Hilton Houston North, 12400 Greenspoint Drive, Houston, Texas 77060

Meeting Room: DaVinci

AGENDA

7:30 am Sign in		
8:00a	Call to Order, Welcome, Introductions	Dan Daulton, Chair
8:15	Administrative Topics --Overview of "Section 999"	Elena Melchert Committee Manager (CM)
8:30	Remarks --Ultra-Deepwater Update --Committee Assignment and Deadline	Deputy Assistant Secretary Christopher Smith Designated Federal Officer
	Committee Discussion	Chair
9:00	**DOE Oil and Gas Research Program** --Ultra-Deepwater Research --Risk Assessment	Roy Long, Technology Manager, NETL Kelly, Rose, NETL Dasari V. Rao, LANL
	Committee Discussion	Chair
10:15		*BREAK*
10:30	--Cost Shared Research ---Results and Accomplishments to date Ultra-Deepwater Research Program	Bob Siegfried, President, RPSEA James Pappas, Vice President, Ultra-Deepwater, RPSEA
	Committee Discussion	Chair
Noon		*WORKING LUNCH*
1:15p	**Overview: *Draft 2012 Annual Plan***	E. Melchert, Senior Program Manager, DOE
	Committee Discussion	Chair
2:15		*BREAK*
2:30	Establish ad hoc Review Subcommittees Appoint of Subcommittee Chairs	Chair/Facilitator
4:45	Administrative Topics	CM
5:00p	Adjourn	Chair

APPROVED: _____ 13 Jan 2012

Christopher A. Smith, Designated Federal Officer — Date

Attachment 2

Ultra-Deepwater Advisory Committee Meeting
Sign-In Sheet - January 19, 2012

Last Name	First Name	Organization	Attendance
Cooper*	George A.	University of California, Berkeley	PRESENT
Danenberger, III*	Elmer P.	Offshore Consultant	PRESENT
Daulton	Daniel J.	Baker Hughes	PRESENT
Dokken	Quenton R.	Gulf of Mexico Foundation	PRESENT
Downs	Hartley H.	Baker Hughes	PRESENT
Foster	Douglas J.	ConocoPhillips	PRESENT
Ikelle*	Luc T.	Texas A&M University	PRESENT
Litton*	James D.	Litton Consulting Group, Inc.	PRESENT
New	William C.	New Industries, Inc.	UNABLE TO ATTEND
Pye*	Stephen D.	Consultant	PRESENT
Srinivasan	Nagan	Deepwater Structures, Inc.	PRESENT
Wilson*	Mary Jane	WZI Inc.	UNABLE TO ATTEND
Wood*	Lesli J.	Bureau of Economic Geology	PRESENT

* Special Government Employee

Ultra-Deepwater Advisory Committee Meeting Attendees
January 19, 2012

U.S. Department of Energy – Office of Oil and Natural Gas

Christopher Smith Deputy Assistant Secretary	Designated Federal Officer
Elena Melchert	Committee Manager

National Energy Technology Laboratory

Roy Long	Strategic Center for Natural Gas & Oil
Eric Smistad	Strategic Center for Natural Gas & Oil
Jamie Brown	Office of Research & Development
Kelly Rose	Office of Research & Development

Los Alamos National Laboratory

Dasari V. Rao	Division Leader, Decision Applications Division

Contractors

Bob Siegfried, RPSEA	President
James Pappas, RPSEA	Vice President, Ultra-Deepwater
Rob Matey, IBM	Meeting General Support
Jennifer Presley, LTI	Registration Support

Attachment 3

NATIONAL ENERGY TECHNOLOGY LABORATORY

NETL Sec. 999 Implementation Overview

Roy Long, Technology Manager, NETL

17th URTAC & UDAC Meetings, Houston, Texas

U.S. DEPARTMENT OF ENERGY

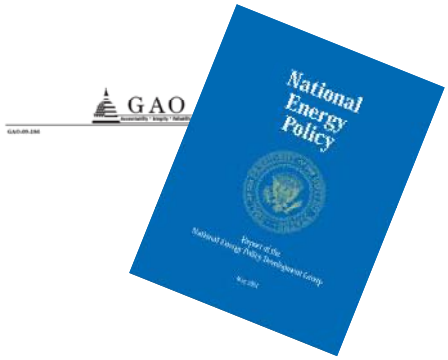
January 18, 2012

Outline: FY11 Implementation Overview

- **Meeting Statutory Requirements**
- **Streamlined Subcontracting Process**
- **RPSEA 2011 Solicitations**
- **Complementary Program Elements**
- **Traditional Program**
  - **FY10 Funded Ongoing Projects**
  - **FY12 Appropriations**
- **Integrated Technology Transfer Program**
  [Focus on Knowledge Management Database (KMD)]
  - KMD Statistics Measurement

Meeting Statutory Requirements

- Technical Committee Review Meeting
- Compliance Audits
- RPSEA Contract Management



Streamlined Subcontracting Process

Research Partnership to Secure Energy for America

Robert W. Siegfried II
President

Subcontract Notification and Certification Form under Prime Contract DE-AC26-07NT42677

In accordance with the Energy Policy Act of 2005 (EPAct 2005), RPSEA shall oversee the implementation of subcontracts under Section 999 of EPAct 2005, consistent with Subtitle J, Section 999, the Annual Plan, including disbursing funds and monitoring activities carried out under such subcontracts for compliance with the terms and conditions of the prime contract.

Subcontractor Name:			
Subcontractor's Address:			
Consortium Partners:			
Title of the Project:			
Access ID:			
Subcontract No:			
Subcontract Technical Representative:			
RPSEA Technical Representative:			
Technical Readiness and Compliance with EPAct 2005, Section 999:			
Subcontract Amount:	RPSEA Share		
Harvard Petroleum, Well Enhancement	Industry Cost Share		
	Total Project Cost		
RPSEA has reviewed and analyzed all proposed cost share. To the best of my knowledge, the cost share as reviewed and analyzed is allowable, allocable, verifiable, appropriately valued and from non-Federal sources.			
Industry Cost Share:			
Source (Name of the Organization):	Amount:	Nature: (Cash or In-kind)* Source:	
NM Institute of Mining and Technology		In-Kind	
Harvard Petroleum			
Well Enhancement Services			
RPSEA has included in the subcontract all prime contract award flow down requirements including Intellectual Property Provisions as appropriate.			
All negotiation issues were reviewed, discussed and mitigated.			

09123-03- New Mexico Institute of Mining and Technology
Notification and Consent Form

Research Partnership to Secure Energy for America

Department of Energy (DOE) Environmental Questionnaire (NETL Form 451.1-1/3) has been submitted to the NETL Contracting Officer's Representative for the proposed Subcontractor (as well as for any lower tier Subcontractor(s)).

In accordance with EPAct 2005, Section 999(c), 2.5% of the total amount of the subcontract has been designated for technology transfer and outreach activities.

*An in-kind contribution is a non-cash input which can be given a cash value. Examples include but are not limited to personnel, fringe benefits, travel, etc.

Attached is the approved Scope of Work for the above referenced project. Attached is a full listing of anticipated Subcontractor acquired property.

I, Robert W. Siegfried II, President of RPSEA, hereby certify that the information outlined above is current, accurate and factual. I request DOE's approval to enter into a binding subcontract with the New Mexico Institute of Mining and Technology.

Sincerely,

Robert W. Siegfried II
Date:

09123-03- New Mexico Institute of Mining and Technology
Notification and Consent Form

17th Sec.999 FACA Review Meeting

RPSEA 2011 Solicitations

2011 Small Producer Solicitation

- Opened: December 13, 2011
- Closes: February 27, 2012

2011 Unconventional Resources Solicitation

- Opened: December 20, 2011
- Closes: March 6, 2012

2011 UDW Solicitation

- Planned opening in March/April timeframe

EPAct Complementary Program FY12 Research Portfolio

FY12 Complementary Program Unconventional Resources Overview

1. Characterize baseline environmental signals - Field
2. Fugitive air emissions - Field + Modeling
3. Produced water - Field + Laboratory
4. Fluid-gas-rock interactions in shale - Field + Laboratory
5. Prediction of fracture propagation - Existing Data + Laboratory + Modeling
6. Coupling microseismic measurements and geomechanical models - Existing Data + Field + Modeling
7. Naturally-occurring isotope tracers - Field + Laboratory
8. High-TDS water and gas in shallow reservoirs - Existing Data + Modeling
9. Integrated assessment model for predicting potential risks to groundwater - Field + Existing Data + Laboratory + Modeling

FY12 Complementary Program Ultra-Deepwater Overview

10. Metallic components & cement barriers - Existing Data + Laboratory + Modeling
11. Multiphase Fluids in HPHT systems - Existing Data + Laboratory + Modeling
12. Flow assurance & quantification - Field + Existing Data + Laboratory + Modeling
13. Systems Models for Risk Prediction & Response (subsurface, wellbore & water column) - Existing Data + Modeling

Traditional Program Overview
(Supported by FY10 Funding)

- **67 Projects (excludes Hydrates and Section 999 projects)**
- **$121 MM Total Value ($85 MM Gov't. Share, $36 MM Cost-Share)**
- **Current projects from prior year funding:**
  - Fracture Flowback & Produced Water Treatment and Mgmt.
  - Environmental Impact Mitigation
  - Water Resources Management
  - Enhanced Oil Recovery
  - Unconventional Oil Production
  - Increasing Domestic Oil and Gas Production
  - Reservoir Characterization
  - Drilling/Completion/HPHT Downhole Tools
  - Seismic Technology
  - Oil and Gas Infrastructure-Related
  - Technology Transfer

Traditional Program Overview
(FY12 Appropriations)

$20 million in FY12

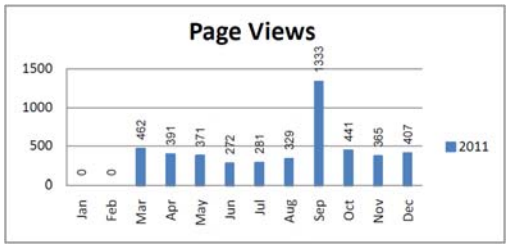
- **$10 million hydrates**
- **$5 million (balance of NG)**
  - ➢$2 million for GWPC/RBDMS
- **$5 million (Unconventional FE technologies: CO^2 EOR)**

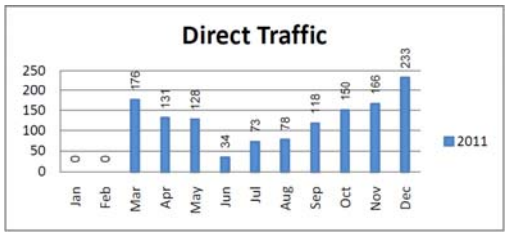
Integrated Technology Transfer Program
[Focus on Knowledge Management Database (KMD)]

Knowledge Management Database (KMD):

FE's First "One Stop Shopping" for all Current and Historical DOE Oil & Gas R&D

More than 30,000 records and reports of R&D in upstream oil and gas





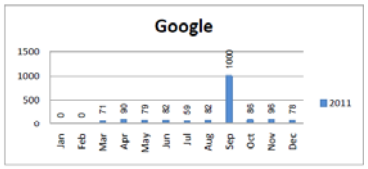
9 NATIONAL ENERGY TECHNOLOGY LABORATORY

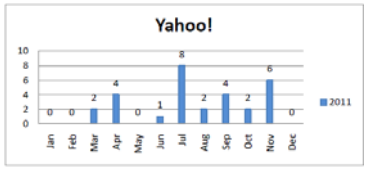
www.netl.doe.gov/kmd

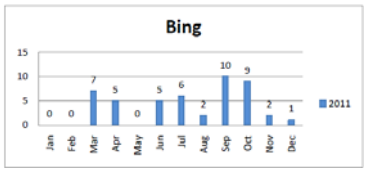
Integrated Technology Transfer Program
[Focus on Knowledge Management Database (KMD)]

Knowledge Management Database (KMD):

Monitoring Referrals from Major Search Engines







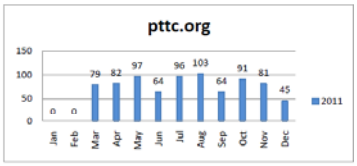
10 NATIONAL ENERGY TECHNOLOGY LABORATORY

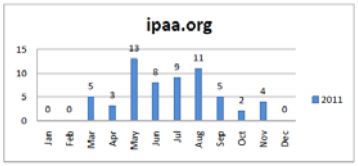
www.netl.doe.gov/kmd

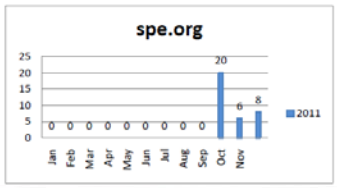
Integrated Technology Transfer Program
[Focus on Knowledge Management Database (KMD)]

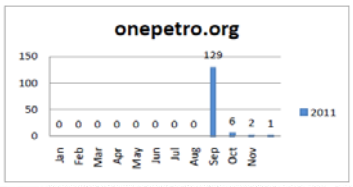
Knowledge Management Database (KMD):

Monitoring Referrals from Industry Stakeholders







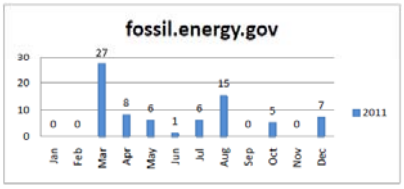


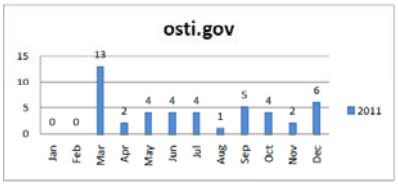
www.netl.doe.gov/kmd

Integrated Technology Transfer Program
[Focus on Knowledge Management Database (KMD)]

Knowledge Management Database (KMD):

Monitoring Referrals from Our Federal Stakeholders



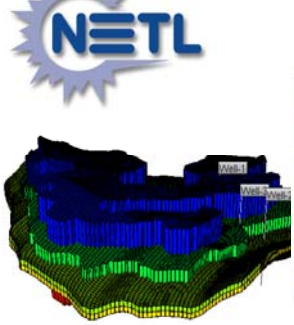


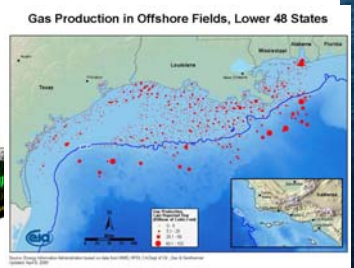
www.netl.doe.gov/kmd

Questions

Attachment 4

NATIONAL ENERGY TECHNOLOGY LABORATORY





EPAct Complementary Program
Deepwater Resources FY12 Briefing

Office of Research and Development

January 19, 2012

U.S. DEPARTMENT OF ENERGY

Office of Research and Development

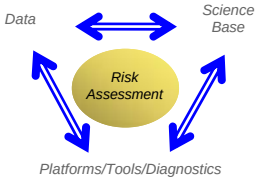
EPAct Complementary Program:

Focus Area Lead: George Guthrie

Technical Coordinator:

Ultra-Deep Offshore/Frontier Regions: Kelly Rose

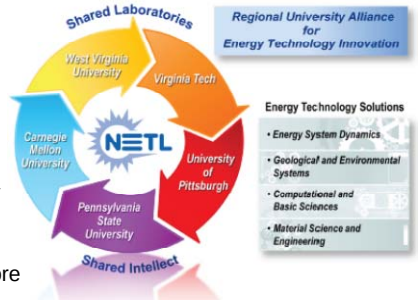
Federal Project Manager: Jamie Brown



Focus Area Lead: George Guthrie

Focus Area Coordinators:

- Reservoirs and Resources: Kelly Rose
- Wellbores and Drilling: Brian Strazisar
- Water Resources: Dan Soeder
- Natural Systems Monitoring: Rick Hammack
- Fluid-Rock Geochemistry: Alexandra Hakala
- Fluid-Rock Geophysics: Grant Bromhal
- Geomaterials Science: Angela Goodman
- Integrated Assessment Modeling: Bob Dilmore



Pushing into new territory…

- **Increasingly focused on deepwater, ultra-deepwater, and frontier regions**
  - UDW GOM
  - Alaska offshore
  - Great Lakes
  - Atlantic margin
  - Eastern GOM
- **Revised Complementary Mission, 2012-2014:**
  - Conducting research to help reduce risk and assess environmental impacts associated with oil & natural gas development in sensitive areas


Los Angeles Times | ENVIRONMENT

LOCAL U.S. WORLD BUSINESS SPORTS ENTERTAINMENT HEALTH LIVING TRA

L.A. NOW POLITICS CRIME EDUCATION O.C. WESTSIDE NEIGHBORHOODS ENVIR

IN THE NEWS: BRITISH OPEN | DALAI LAMA | CASEY ANTHONY | WOMENS WORLD CUP | CARMAGE

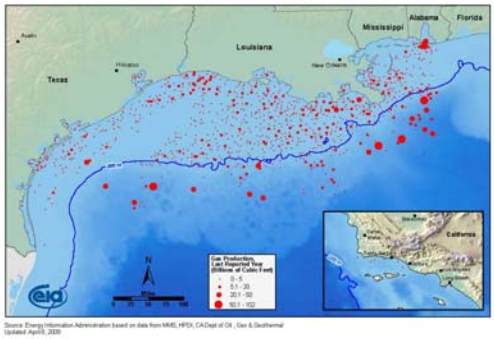
ENVIRONMENTAL NEWS FROM CALIFORNIA AND BEYOND

« Previous | Greenspace Home | Next »

Drilling in Arctic waters? Scientists aren't sure if it is safe

June 24, 2011 | 4:00 pm

Gas Production in Offshore Fields, Lower 48 States



Focusing the research, Overarching Risk-Issues for Deep/Frontier Offshore O/G

Concern - potential impacts from loss of control at well

Concern - potential impacts from drilling activities

Concern - potential impacts to ocean chemistry

- Impacts to fish, fishing, etc.
- Impacts to coastal environments
- Ocean acidification as a result of methane oxidation

Concern - differentiating between natural leakage vs. anthropogenic-induced

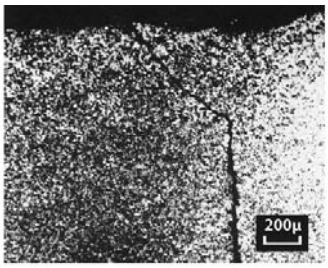
- Natural gas, gas hydrate, and oil seeps

Concern – the near & long-term integrity of installations & repeat-use systems

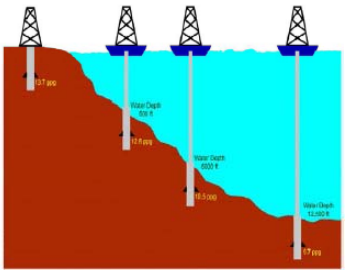
- Drill pipe, seafloor pipeline systems, BOP's, wellbore cement issues

Concern - increasingly deep, remote location of operations/drilling, "Frontier" exploration

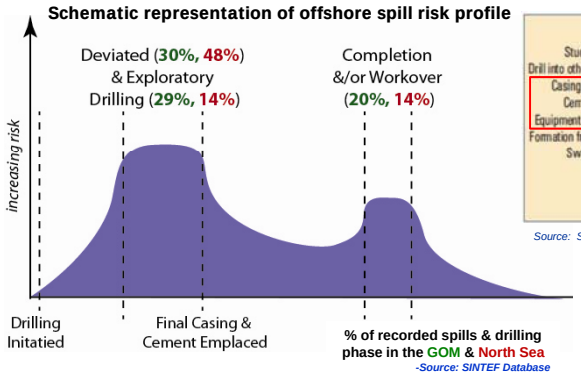
- Distal to infrastructure to mitigate unexpected events
- Increasing interest in U.S. Arctic drilling (Beaufort, Chukchi Seas), spills under ice….
- Increasing interest in other "Frontier" regions (Great Lakes, Atlantic margin, etc.)

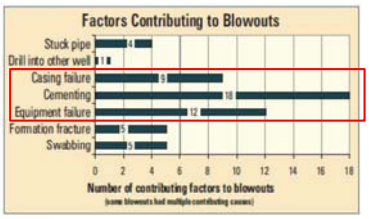


Crack propagation in S-135 drill pipe after sour service



FY12 - NETL Research Targets Top Offshore Spill Risks





Source: SINTEF Blow Out Database

- **Cementing Failures**
- **Equipment & Casing Failures**
- **Higher risk targets, "exploratory" systems**

Technical Challenges Identified by Spill Prevention Subcommittee

- **Operating offshore**, particularly in deep water and in **offshore frontier** areas like the **Arctic**, creates production risks that are fundamentally distinct from onshore operations .
- **Drilling** is the **phase** of development in which the operator must manage the greatest number of risks and uncertainties.
- Concerns about fracturing the formation can have a big impact on well design, lost circulation, and loss of well control.
- Well design incorporating **multiple barriers are essential** to safety.
- Human factors

NETL Complementary Research - FY12 UDW Research Themes

Behavior of metal-based controls in extreme environments

–Knowledge of the performance and integrity of materials used for deep offshore infrastructure

Behavior of cement barriers used in ultra-deep water systems

–Knowledge of cement performance for risk assessment activities

Complex fluid-phase properties under HPHT and HPLT conditions

–Improve accuracy of EOS models at HPHT conditions for better characterization of reservoir fluids and dynamic properties

–Fluid behavior and properties with rapid transition from HPHT to HPLT environments

Concerns over potential impacts to environmental systems

–Impacts due to exploration and production activities

–Integrate risk assessments from borehole to region

- From NETL-ORD EPACT Complementary Plan, June 2011

NETL Point of Contact
Ultra-Deep Offshore: Kelly Rose
(Kelly.Rose@netl.doe.gov)

GOM chemosynthetic community on the seafloor, - source Ian MacDonald

GOM Seafloor pipelines, - source, Google

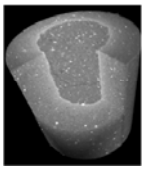
NETL- ORD Research for Fossil Energy

Evaluating & improving material performance for extreme conditions

Assess, examine, and identify failure issues associated with metal components & cement barriers used in subsurface E&P infrastructure

NETL researcher asked by DoJ to provide technical expertise on wellbores & cement for Macando inquiry

Present research focuses on 2 of the top causes of oil/gas well blow outs, casing failures and cement failures



NETL has over 67 years of advanced materials experience

Kroll Process based technology at NETL 1945-present

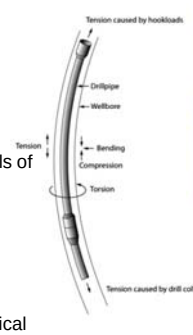
Armstrong Titanium Reduction Process (2007 R&D 100 Award winner)

2.1 Materials Properties and Integrity for Metallic Components Used in Deepwater Drilling, Completion, and Production

- **PI: Jeff Hawk; FAC: Brian Strazisar**
- **Main Goals**

  To assess and examine potential failure issues associated with metal components used in offshore infrastructure

  - **Phase I:** assessment of current equipment and materials of construction for drilling, completion & production (e.g., BOP's, risers, pipelines, etc.); primary failure mechanisms/frequency, **root causes**, etc.; potential workshop with stakeholders to identify issues
  - **Phase II:** Experimental & simulation studies to mitigate persistent issues identified in Phase I; materials characterization, assessment, & corrosion testing in typical deep (sweet & sour) and ultra-deep (sour) environments
- **Key Milestones/Deliverables**
  - Phase 1 report on persistent issues related to deepwater & ultra-deepwater well drilling & production
  - Completion of materials characterization activities
  - Phase 2 publications focus on corrosion and fatigue crack studies



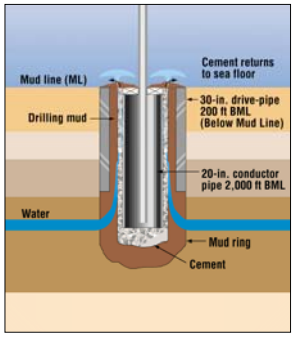
Washout caused by pitting and corrosion fatigue in a drill pipe

GOM Seafloor pipelines, - source, Google

Task 2.2 Properties and Integrity of Cements Used in High Pressure and Temperature Deepwater Wells

- **Co-PIs: Bill O'Connor, Barb Kutchko; FAC: Brian Strazisar**
- **Main Goals**

  To characterize the physical and chemical behavior of typical cements used in deepwater and ultra-deepwater completions, including both near-term behavior and long-term behavior (over life of wellbore)
  - **Phase 1:** Characterize behavior and performance with a particular emphasis on identifying potential failure pathways during both setting and post-setting
  - Assess performance relative to standards developed for these types of well completions
  - **Phase 2:** Experimental studies to assess long-term cement integrity and the likelihood of leakage up the annulus throughout the lifetime of a deep marine well.
- **Key Milestones/Deliverables**
  - Report on persistent issues for deep & ultra-deep well cementing
  - Completion of initial set of experiments on near-term cement (FY12)
  - Performance under extreme conditions (FY12, FY13)
  - Completion of initial set of experiments on long-term cement performance under extreme conditions (FY12, FY13)

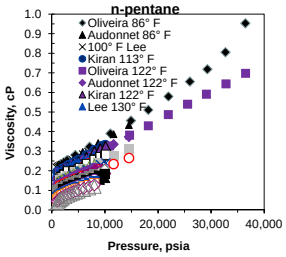


NETL ORD - Research for Fossil Energy

Multi-phase Flow & EOS Analysis

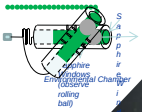
Accurate EOS & multi-phase flow models at extreme conditions allow for better characterization of reservoir fluids and the dynamics of these fluids

…thus decreasing the uncertainty associated with predictions of fluid quantity, fluid flow



NETL-developed PIV imaging technology key to hydrocarbon leak rate estimates

- *Expanding Equation of State (EOS) for Extreme Temperatures & Pressures*
- *Conventional EOS models are rather erroneous*
- *NETL EOS models are significantly more accurate*



- *Deepwater Horizon response, Flow Estimation Group received Secretary of Energy Achievement Award*
- *Existing expertise and experience with multi-phase systems, including gas hydrates over past 10 years*

Task 2.3 Multiphase Fluids at High Pressure and High Temperature

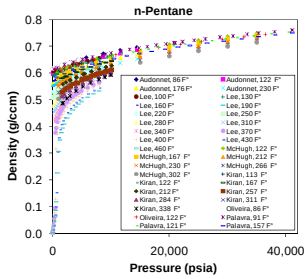
- **PI: Bryan Morreale; FAC: Angela Goodman**
- **Main Goal**

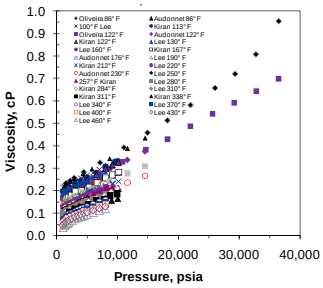
  To address technological challenges through a focused experimental program emphasizing the development of a comprehensive database and EOS correlations for thermodynamic and transport properties (PVT, PmT) at extreme conditions

- **Conditions and species**
  - Temperatures up to 500oF, Pressures up to 40kpsi
  - Constituents of interest:
    - C1, C3, nC5, nC10, nC16, CO2, H2O
    - C7H8 (toluene)
    - C8H16 (cyclooctane)
    - C8H18 (isooctane)
    - nC18H38 (octadecane)
    - nC20H42 (eicosane)

- **Key Deliverables**
  - **FY12:** A widely accessible, comprehensive and accurate database of viscosity and density values of "model" compounds at conditions of interest to UDW applications…and other natural engineered systems
  - **Beyond FY12**
  - A suite of EOS integrated into industrial reservoir models that accurately describe the transport and thermodynamic properties of pertinent fluids over a wide range of environments
  - Globally accepted and utilized viscosity standards for use in industrial laboratory and field settings

High Pressure, High-Temperature Fluid Properties





2.4 Flow assurance
Hydrate-Oil-Water-Gas Flow Behavior

- **PI: Bob Warzinski; FAC: Kelly Rose**
- **Goal**

  To improve leak flow rate estimates & detection by determining the optimal imaging technique to quickly quantify the release rate from a hydrocarbon leak.

  This will be achieved by producing simulated hydrocarbon leaks under deep-sea conditions and testing various imaging techniques.

- **General Approach**
  - Experiments to improve estimates of fluid flow from plume observations in the presence of hydrates
  - Improve particle imaging velocimetry (PIV)
    - Will allow for more accurate quantification of hydrocarbon fluid-release rates into deep water using direct observations
- **Initial Results**
  - Improved imaging techniques for accurate determination of hydrocarbon gas release rates under deepwater conditions that have the potential for formation gas hydrates.
  - Out-year plan for development of ROV compatible advanced imaging protocols for accurate determination of deep-sea hydrocarbon leak rates.

Methane bubble without hydrate

NETL Water Tunnel Experimental Apparatus

Hydrocarbons (oil and natural gas) escaping from the end of the riser tube, after it was severed on June 3 immediately above the Macondo well Blowout Preventer (BOP) stack.

Risk assessment requires predicting the potential for a deleterious event as well as its consequence

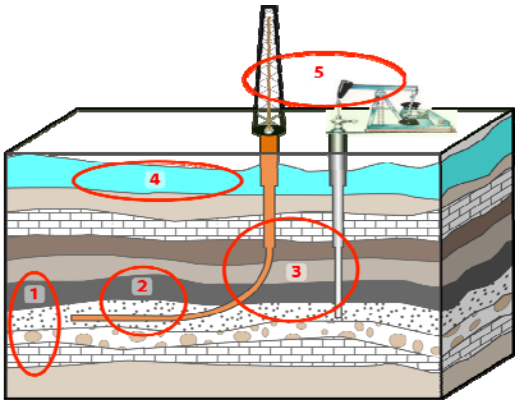
Data ⟷ Science Base

Risk Assessment

Platforms/Tools/Diagnostics

Risk = probability X consequence

site performance × *impact of event*



Focus for FY12 Research:

- *Field Data to establish baselines and impacts of processes*
- *Laboratory Data for simulations and confirmation of field data*
- *Computational Tools to characterize and predict system baselines and behavior*

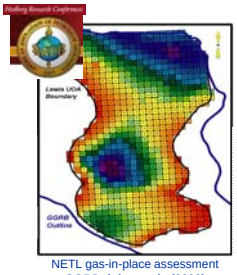
NETL-ORD Research for Fossil Energy

Resource characterization & managing risks

Generating information necessary to characterize domestic resources for energy security, risk, & environmental monitoring

Risk & Response

- Part of Flow Rate Technical Group & Nodal Analysis Team for Macando
- Lead and participant in NRAP



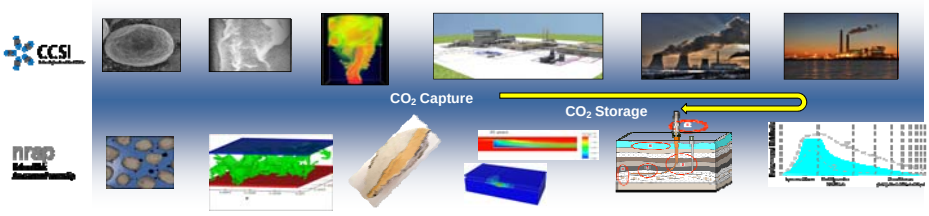
NETL gas-in-place assessment GGRB **tight sands (2002)**

NETL R&D (1970's to present)

*Developed **environmental technology, refined assessments,** and **resource prediction for**:*

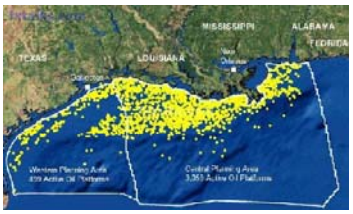
- Shale gas
- Tight gas
- Gas hydrates

- Field studies on environmental baselines
- Leading multi-institutional & multi-organizational research teams at sites

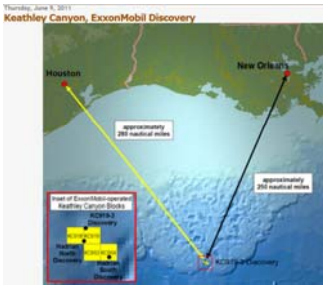


Evaluation of the Deep/"Frontier" Offshore
– Assessing Risk, Environmental, and Social Factors

- **Principal Investigator** PI: K. Rose; FAC: K. Rose
- **Main Goal**
  - Evaluate impacts & risks to economic interests and the environment for deep water loss of control events.
- **Approach**
  - Compiling key seafloor and subseafloor natural and engineered attributes to allow team to conduct assessments of potential social, environmental and risk factors, technology needs, and assist in responses to unexpected events (e.g. Macando disaster)
  - Keep track of UDW O/G development in GOM & Arctic
- **Deliverables**
  - Preliminary risk assessments for base case, GOM scenarios (wellbore and reservoir) (w/ **LANL**, FY12); Refined/advanced RA (FY13, FY14)
  - **EDW**, Compilation of spatial resources needed for integrated risk assessments of the GOM and U.S. Arctic (FY12, FY13)
  - Link to task 2.4, models for the flow of hydrocarbons and the distribution of dispersants in the water column on the sea surface (OSU, NETL) (FY12, FY13)
  - Flow models will be overlain with models of species distributions, including commercial and threatened species, to determine potential economic impacts. (OSU, NETL, NOAA)
  - Surrogate models (wellbore & reservoir) in support of risk & environmental assessments (FY12, FY13, FY14) (NETL,WVU)

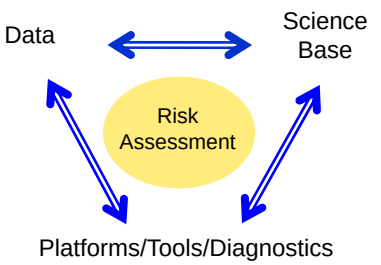


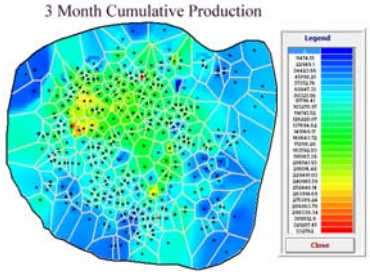
Existing well distribution in the GOM



June 2011, ExxonMobil announces ultra-deep water discoveries in 7000' water depth (~2000' more than Macando well)

Evaluation of the Deep/"Frontier" Offshore
– Assessing Risk, Environmental, and Social Factors





Example Surrogate Reservoir Model, Shahab et al.

Risk assessment for deep offshore requires predicting the behavior of several coupled engineered & natural systems.

Tools/Platform Needs for Risk Assessment

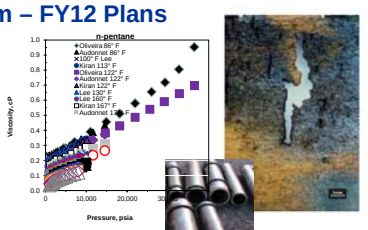
1. **Surrogate models for reservoir flow (task 2.5)**
   – reduced-order models to allow rapid assessment of impact of variability and heterogeneity on uncertainty
2. **Reservoir-wellbore coupling (all tasks)**
   – improved representation of flow from reservoir into well (impact of skin, screen length, etc.)
3. **Ocean/Lake-floor dynamics (tasks 2.4, 2.5)**
   – improved prediction of hydrate formation as related to gas release, plume quantification, etc.
4. **Integrated Assessment Model (task 2.5 + LANL)**
   – Coupled system model for predicting potential hydrocarbon flow rates for various reservoir conditions and engineered (facility) systems

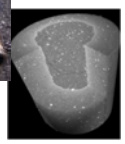
Los Alamos NATIONAL LABORATORY EST. 1943 NETL

Ultra-Deepwater & Frontier Regions Program – FY12 Plans

Ultimately, NETL will provide science-based information regarding short and long-term wellbore stability and risk assessment thru:

- **Improve metal-based controls in extreme environments**
  - Improve knowledge, technology, performance and integrity of metal-based materials used for deep offshore infrastructure
  - This work may result in new materials or new practices
  - **Reduce risk of spills and blow outs, ensure appropriate materials are used**
- **Improve cement barriers in ultra-deep water systems**
  - Improve knowledge and practices for UDW cement performance
  - This work may result in new materials or new practices
  - **Reduce risk of spills and blow outs by ensuring proper practices and types of cement are used**
- **Improve prediction & evaluation of complex fluid-phase properties under HPHT and HPLT conditions**
  - Improve accuracy of EOS models at HPHT conditions for better characterization of reservoir fluids and dynamic properties
  - Improve understanding and characterization of fluid behavior and properties with rapid transition from HPHT to HPLT environments
  - **Results in better prediction of reservoir properties, reduce likelihood of kicks, blowouts, etc.**
  - **More accurate & rapid leak estimates of blow out plumes**
- **Identify & reduce risks and potential impacts to environmental systems**
  - **Develop systems models** (reservoir, wellbore, water column) **to predict, prevent, and respond** to impacts due to exploration and production activities, goal is rapid assessments
  - **Reduce data gaps** that impede rapid response, development & deployment of the *Energy Data Warehouse* (summer 2012 ETA)
  - Collaborative approach (multi-agency, multi-organizational)



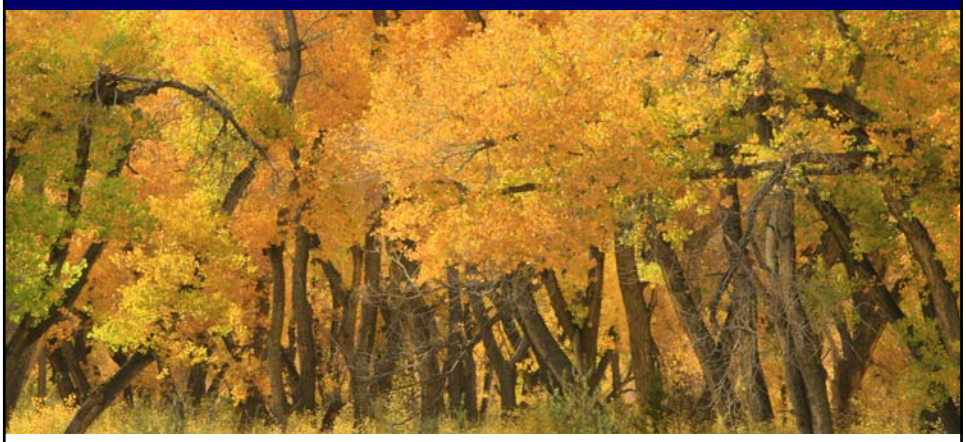


***NETL Point of Contact*: Kelly Rose**
Kelly.Rose@netl.doe.gov

Attachment 5

Risk Informed Decision Support for UDW Drilling

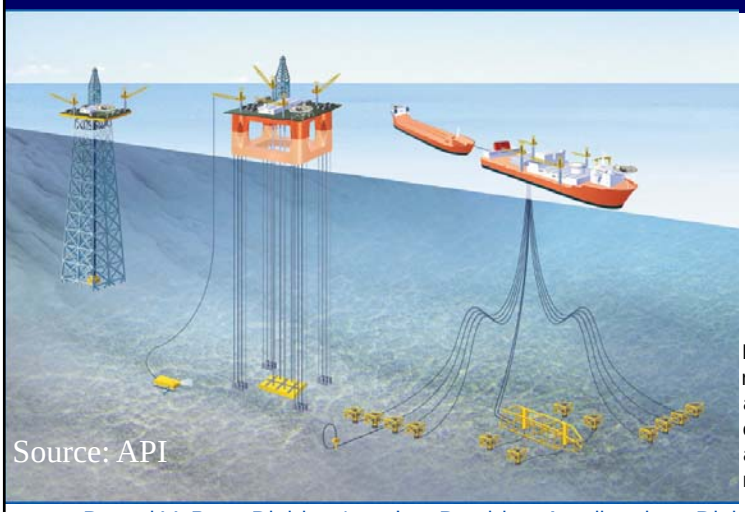
Oil and Natural Gas



Dasari V. Rao, Division Leader, Decision Applications Division
Chris Smith and Elena Melchert, DOE Program Oversight

Risk Informed Decision Support for UDW Drilling

Oil and Natural Gas



Technical Contributors:
Rajesh Pawar, Dean Sanzo, Kelly Rose, J. Pappas, and Roy Long

Data, figures, and results presented are compiled to explain the risk assessment methodology.

Dasari V. Rao, Division Leader, Decision Applications Division
Joint LANL and NETL Project

Presentation Overview

Oil and Natural Gas

- Risk Informed Decision Support (RIDS) framework for analyzing ultra deep-water drilling operations in GOM
- Context for the study and insights gained from previous incident reports, studies/workshops and expert elicitations
- Phenomenological considerations of importance to UDW Drilling in GOM
- Status, accomplishments and schedule

LANL Proposed Strategy for RIDS Framework: Built on Expert Recommendations

Oil and Natural Gas

- Integrated end-to-end Probabilistic Risk Assessment should be the first step moving forward (Ref. 1– 4)
  - Integrated risk assessment was ranked highest priority activity for spill prevention
  - Probabilistic models for well control (sensible real time monitoring for critical wells)
  - Reliability based well designs; quantify difference in shallow, deep and ultra-deep
  - Risk framework to prioritize R&D, technology insertion and response strategies
  - Full spectrum events to include demanding environments, technology failures and natural events
- Leverage results of parallel and ongoing industry/vendor analyses
  - Safety and Environmental Management System (SEMS) per 30 CFR 250. Requires Hazards Analysis consistent with API RP 75
  - European regulatory agency require “Quantified Risk Assessment”
  - Numerous reliability and risk studies based on reported incidents (SINTEF)
- Incorporate science based understanding of underlying phenomena/processes
  - Quantify uncertainties associated with phenomenological issues specific to Gulf of Mexico and ultra-deep water drilling
  - Examine probabilistic basis for impacts of extreme operational environments (e.g., HTHP) and external events (mudslides, seismic activity, and vessel collisions)
  - Use QMU method to fuse scientific analyses with reliability assessments

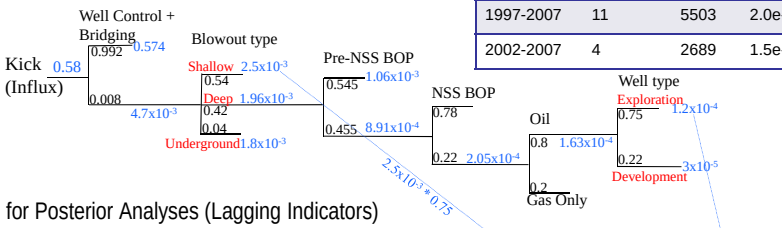
References (an abbreviated list):
1. Deepwater Horizon Study Group: Risk Assessment and Management Recommendations for Future Implementation
2. Huston Advanced Research Center Whitepaper to RPSEA: Research and Technologies for Deepwater Development (www.harc.edu)
3. Organizational Design for Spill Containment in Deepwater Drilling Operations in the Gulf (NETL/RFF DP 10-63)
4. Precursor Analysis for Offshore Oil and Gas Drilling (NETL/RFF DP 10-61); RFF is Resources for the Future

Example of a Top-Down Analysis
Data-driven risk assessment for performance assessment

Oil and Natural Gas

- Rich data history managed by SINTEF and MMS
  - Nearly 30,000 off-shore wells (20,000 in GOM)
  - John Weiss, Deepwater Drilling Risk Reduction Assessment, BOEMRE, 2010
  - D. Izon, E. P. Danenberger, M. Mayes, MMS, 2007

Period	# Well Release	# Wells	Freq
1980-2007	41	15800	2.6e-3
1987-2007	29	11530	2.5e-3
1997-2007	11	5503	2.0e-3
2002-2007	4	2689	1.5e-3



- Suited for Posterior Analyses (Lagging Indicators)
  - Cost-Benefit Analysis
  - Quantitative lessons learned
- Will miss future trends (Not predictive)
  - Ultra deepwater versus deepwater
  - High Pressure High Temperature
  - Managed Pressure Drilling

Operation	Category	average	gas well	oil well
Exploration drilling	Shallow Gas	1.85E-03	-	-
Exploration drilling, deep (normal wells)	Blowout	1.12E-04	1.02E-04	1.23E-04
	Well release	2.44E-03	2.23E-03	2.70E-03
Exploration drilling (HPHT wells)	Blowout	6.92E-04	6.32E-04	7.65E-04
	Well release	1.52E-02	1.38E-02	1.68E-02
Development drilling, deep (normal wells)	Blowout	2.37E-05	2.16E-05	2.62E-05
	Well release	5.18E-04	4.73E-04	5.73E-04
Development drilling, deep (HPHT wells)	Blowout	1.47E-04	1.34E-04	1.62E-04
	Well release	3.21E-03	2.93E-03	3.55E-03
Completion	Blowout	1.49E-04	2.1E-04	8.4E-05
	Well release	2.9E-04	4.2E-04	1.7E-04

Los Alamos NATIONAL LABORATORY EST. 1943

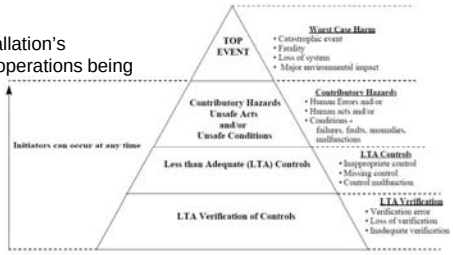
Operated by the Los Alamos National Security, LLC for the DOE/NNSA

NNSA

Hazards and Risk Analysis
(SEMS API RP 14J provides required guidance)

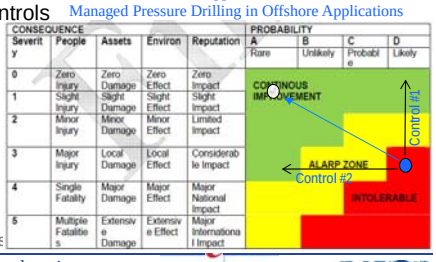
Oil and Natural Gas

1. Hazard identification:
   - Hazard identification specific to the installation's equipment and systems, as well as the operations being carried out
2. Causes of the hazard
   - Inadequate design/const of Barriers
   - Failures and faults in Systems
   - Human Errors
3. Consequences of Hazard (Severity)
4. Likelihood of Consequence
5. Unmitigated Risk Bin
6. Mitigating Structures, Systems and Controls
   - FMECA and/or Fault Trees
7. Mitigated Consequence
8. Mitigated Likelihood
9. Mitigated Risk
10. Action Items (Verification, Q/A, etc)



Ref: FAA System Safety Handbook (Order 8040.4)

Ref.: A Probabilistic Approach to Risk Assessment of Managed Pressure Drilling in Offshore Applications



Safety and environment management system

Los Alamos NATIONAL LABORATORY EST. 1943

Operated by the Los Alamos National Security, LLC for the DOE/NNSA

NNSA

LANL Proposed Approach
Scenario based end-to-end integrated risk assessment

Oil and Natural Gas

Components of a top-down analysis for BOP R&D Prioritization by SINTEF for MMS

SINTEF Database → Relevant to UDW/GOM → ASP Analysis → Failure Modes and Reliability → Quantify impact of Tech. Insertion → Baseline risk & risk reduction

Drilling
Completion
Production
Workover

Define Objectives

Quantification
(Integrate ET, FT with data)

Uncertainty Analysis
(Stochastic & Epistimic)

System Familiarization

Accident Progression Modeling
(Science-Based hydraulics)

Interpretation of Results
(vs Objectives)

Initiating Event Identification

Systems Modeling
(Logic Modeling)

Risk Reduction Technology Insertion

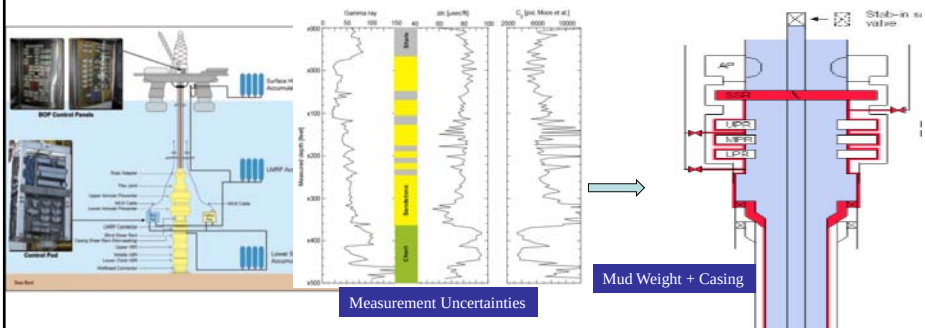
P& ID for the Plant → Unmitigated Hazards Analysis → Unmitigated Risk → Controls and Safety SSC → Mitigated Risk → Risk Management

Components of a typical bottom-up SEMS analysis (API RP 75 Operational Risk Management)

NNSA

System Familiarization – Design & Control

Oil and Natural Gas



Measurement Uncertainties

Mud Weight + Casing

SOSA including systems modeling and QMU

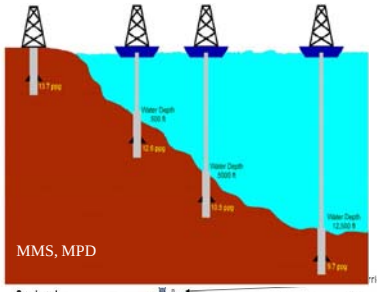
- Active primary barrier → Managed Pressure Drilling
- Reliability based well and auxiliary systems performance
- Engineering analysis will be used for quantifying design and performance uncertainties associated with the BOP
- Hazards depend on exploratory, abandoned and production stages o operation

Los Alamos NATIONAL LABORATORY EST. 1943

NNSA

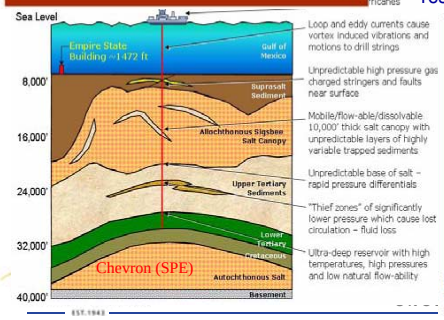
System Familiarization – Controlling Phenomena

Oil and Natural Gas



Phenomenological understanding is vital

- GOM 50% blow outs occur in shallow region (high pressure gas stringers in sandy salt sediments)
- Increasing water depth and overburden narrows the window for safe operation. Large "lost circulation" and "stuck pipe" scenarios leading to blowout
- Long-term issues related to corrosion in HTHP environment for production stage of operation
- Farther from shore. Difficult to coordinate emergency response



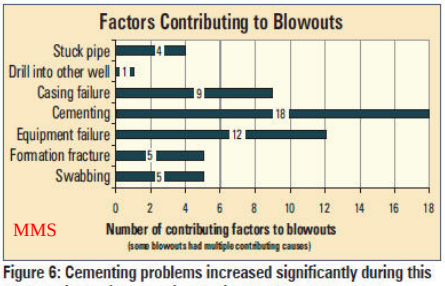


Figure 6: Cementing problems increased significantly during this study period, being associated with 18 of the 39 blowouts.

Foci for Natural Phenomena Elicitation

Oil and Natural Gas

- High pressure blow-down – implications to blow-down management and consequences (bounds and uncertainty)
- Gas hydrates – implication to safety
- Unconsolidated sedimentation – measurement uncertainty in characterizing fracture gradient (S_v, S_H), and pore pressure ➔ mud weight and zonal isolation
- Multiple pay sands with differing permeability – measurement uncertainty in characterizing reservoir characteristics
- HTHP and corrosion – long term implications on cement, casings and engineered barriers (reliability based well design and performance assessment)
- Mudslides, Sea currents and water depth – hydrodynamic loads on the structures including riser, BOP and wellhead lock-down
- Other phenomena of interest missing from this list

Initiating Event Bins for "Deep Drilling Phase"

Oil and Natural Gas

- Normal Kick
  - Kick during drilling, circulating, etc.
  - All systems functioning normally at the time of kick
- Tripp Kick
  - Kick during tripping, swabbing, stuck-pipe, drilling break, while casing run
  - Drill pipe location unknown (wrt location of influx)
  - Mud pumps are throttled and likely gas cut mud
- Abnormal Kick
  - Kick during ballooning, annular losses, fracture repair, fishing the tool, plugged drill pipe, mud pump failure
  - Drill pipe location unknown
  - Formation losses complicate circulating out

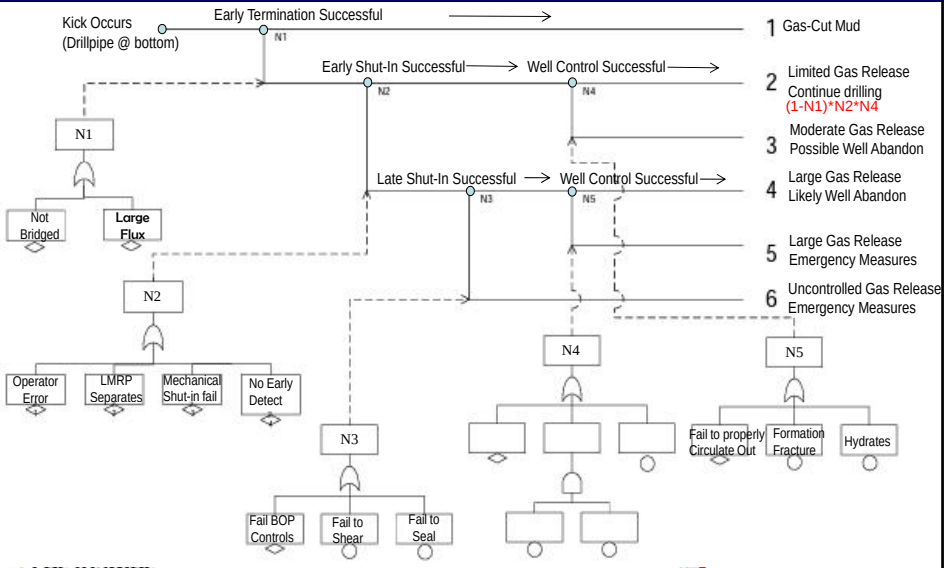
Kick = Influx

- Natural/External Events
  - Collisions
  - Mudslides
  - Explosions/Fire

LMRP separation
Hydraulic Controls

Integration of Event Tree with Fault Trees

Oil and Natural Gas

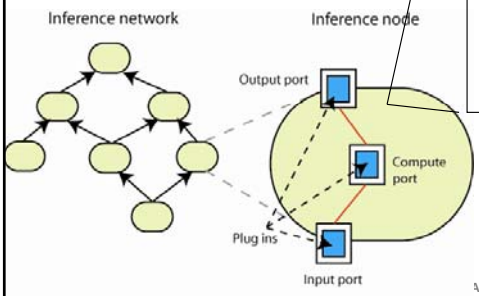


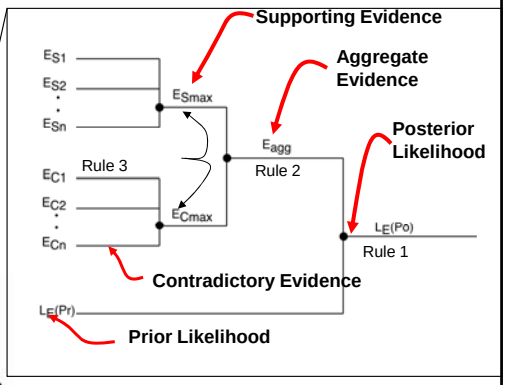
Strategy: Use proven LANL Tools

Oil and Natural Gas

At each node inferencing engine can fuse data from different sources:

- Fault-tree type system models with vendor data
- Expert Elicitation ("aggregate realistic")
- Physics Based Models ("physics output corrected for operational environment")
- Instrumentation and Control strategies ("intelligent human engagement models)





This tool set is applied routinely for:

1. Nuclear Explosives Safety
2. Protection of National Assets
3. Nuclear Safety

Example accident scenarios

Oil and Natural Gas

- Kick occurs during drilling
- Early Detection by Operator
- Well Shut-in (Regular)
- No LMRP Disconnect
- Drill-Pipe @ Bottom
- Well Control (Regular) *circulate out with increased mud weight*
- No formation losses
- Drill Pipe is not stuck
- Success (Limited In-flux release)

⇩

Continue drilling

- Kick occurs during tripping
- Early Detection by Operator fails
- Fire/Explosion
- Well Shut-in (Regular) fails
- Well Shut-in (Emergency) Succeeds
- Well Sealed Casing/Drill Pipe severed and BOP is not lifted off
- Choke & Kill Vale (ROV) operable
- Top Kill (Variation in Momentum Kill)
- No formation losses
- Well Cap Success
- Fail (Medium In-flux release)

Complete List of Top Events

Oil and Natural Gas

- Kick occurs during drilling
- Early Detection by Operator
- Late Detection by operator
- Fire/Explosion on the rig
- Well Shut-in (Regular)
- Well Shut-in (Emergency & Deadman)
- Well Shut-in (ROV)
- Well Sealed (casing/drill-pipe severed, BOP not lifted off)
- LMRP Disconnect
- Riser Collapse
- Choke & Kill Vale (ROV) operable
- No formation losses
- Formation losses controlled
- Drill-Pipe @ Bottom
- Drill-Pipe out of the hole
- Drill-Pipe Location Unknown
- Well Control (Normal)
- Well Control (Emergency)
- Top Kill (Momentum Kill, junk shot)
- Well Broached
- Relief well success
- Well Capping/Abandoned Success
- Stuck drill pipe during control
- Controlled release
- Uncontrolled release (1-7 days)
- Uncontrolled release (> 7 days)
- Underground blowout

Modeling of Accident Sequences

Oil and Natural Gas

- Most important challenge in Risk Assessment of Complex Systems
  - Steps the sequences may take
  - Timing aspects of the sequences
  - Well response to sudden changes (short duration, metal, cement)
- Thermal and hydraulics models to be used to “bound” well response
  - Coupled with reservoir to predict blowout behavior
  - Originally developed for CO2 sequestration and applied during Deep Horizon response

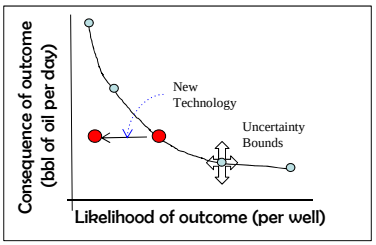
Seq No.	Prob.	Flow Path	Prob	Penetration Depth	Prob	BOP Opening	Prob	Flow Rate (bbl/hr)	Net Prob
6	P1	Drill Pipe	P21	Top 5%	P31	Not Sealed (Cut)	P41	1	P1*P21*P31*P41
						Not cut (100%)	P42	4	
				Middle Region	P32	Not Sealed (Cut)	P43	5	
						Not cut (100%)	P44	250	
				Down to Shoe	P33	Not Sealed (Cut)	P45	10	
						Not cut (100%)	P46	1000	
		Annulus	P22	Top					
				Middle					
				Down to Shoe					
		Hole	P23	xxx					
				yyyy					

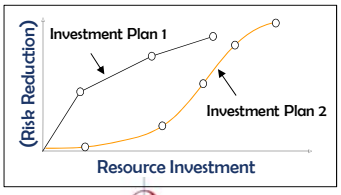
Operated by the Los Alamos National Security, LLC for the DOE/NNSA
NNSA

Risk Assessment and Interpretation

Oil and Natural Gas

- Risk Assessment vis-à-vis risk analysis
- Uncertainty analysis
- Risk worth of proposed technologies
  - Robust BOP with double annular preventer, minimum 3 pipe rams and shear ram. Improved closure reliability and operability
  - Improved operator training & conops
  - Real-time data transfer
  - Sensors for flow, temperature and pressure in the well
  - Direct pore pressure measurement
  - VSP Look ahead
  - Early kick detection system (Microflux)
  - 3-D Seismic & Improved pore pressure prediction during planning
  - Improved well control and response modeling
  - Reliability based well design (vs Worst case discharge)
  - ……. (NETL RPSEA)





LANL Proposed Approach
Scenario based end-to-end integrated risk assessment

Oil and Natural Gas

Components of a top-down analysis for BOP R&D Prioritization by SINTEF for MMS

SINTEF Database → Relevant to UDW/GOM → ASP Analysis → Failure Modes and Reliability → Quantify impact of Tech. Insertion → Baseline risk & risk reduction

"Design" Generic Base case UDW Drilling Operation in GOM

Identify and bin hazards into a set of Initiating Events. Quantify frequency from SINTEF

Blowout accident scenarios and spill rates rate & duration; formation bridging and broaching (Well hydraulics modeling)

Quantify baseline risk. Examine dominant sequences contributing to risk. Assess impact of response, recovery and repair

Develop Fault Trees for each mitigating system with as much details as possible (Generic vs Rig-Specific)

Develop Event Trees to describe accident progression (Timing and sequence of events including repair & recovery)

Accurately capture "epistemic" and "stochastic" phenomena uncertainty. (HPHT, bridging, broaching)

Compile a list of State-of-the-art technologies being developed

Quantify risk worth and overall risk reduction if state-of-the-art technologies are matured and deployed

P& ID for the Plant → Unmitigated Hazards Analysis → Unmitigated Risk → Controls and Safety SSC → Mitigated Risk → Risk Management

Components of a typical bottom-up SEMS analysis (API RP 75 Operational Risk Management)

IE Characteristics

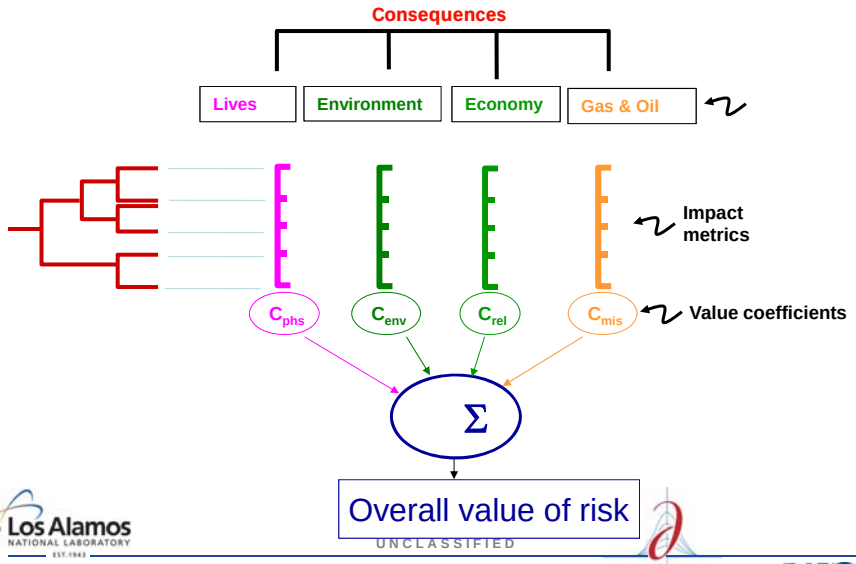
Oil and Natural Gas

- Development drilling versus exploratory drilling (wildcat, appraisal): Knowledge of formation is limited. So large uncertainties in the mud weight estimation and shallow gas
- Water depth: Hydrates, BOP Pressure integrity
- Well depth: ($P_f - P_p$), Likelihood of oil in the kick, gas cut mud likely
- Type of mud: synthetic versus oil-based
- Target zone temperature and pressure: long-term erosion, corrosion and aging effects

Activity	Dev	Expl
Out of hole (displacing mud)	1	1
Cementing shoe		1
Stuckpipe		1
Drilling	2	19
Drilling (making connection)	1	7
Circulating	1	5
Trip out of hole	2	5
Fracturing	1	1

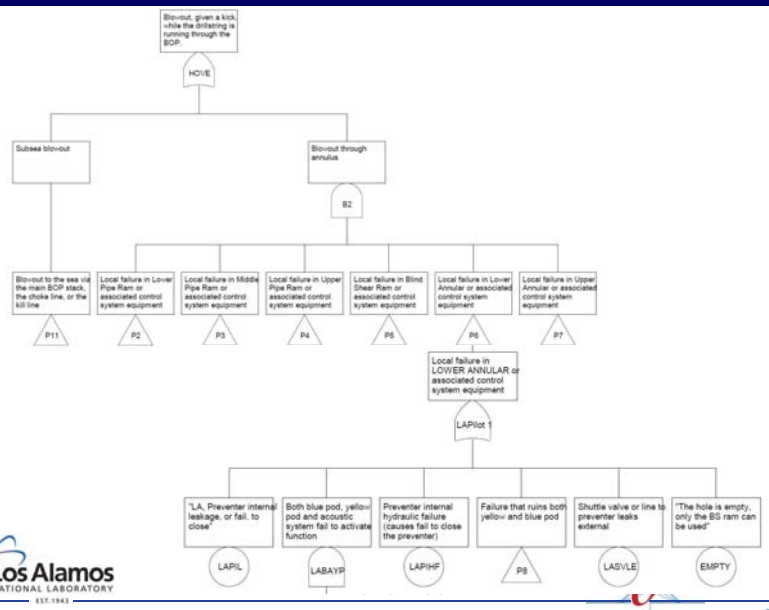
Cost-Benefit Analysis

Oil and Natural Gas



Fault Tree for a BOP

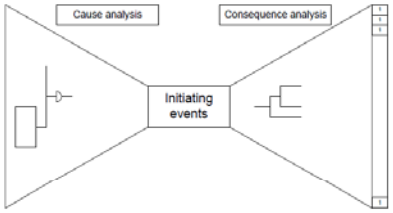
Oil and Natural Gas



Slide 20

Representation of Risk Assessment Process

Oil and Natural Gas



- Bow Tie Diagram [Vinnem]
- Starting point – Identification of IEs
- Next – Cause analysis
- Consequence analysis
  - Modeling of accident sequences
  - Analysis of physical consequences
  - Quantification of consequences

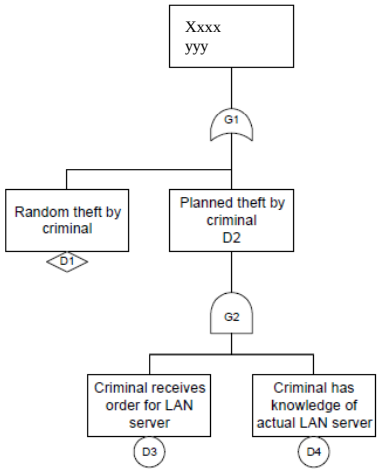
Cause Analysis

Oil and Natural Gas

- Objectives
  - Identification of the combination of causes that may lead to IEs - Qualitative
  - Assessment of probability of IEs – Quantitative
- Qualitative Techniques
  - Hazard and Operability Studies (HAZOP)
  - Fault Tree Analysis (FTA)
  - Preliminary Hazard Analysis (PHA)
  - Failure Mode and Effect Analysis (FMEA)
  - Human Error Analysis techniques
  - Can be used for basis of prevention of accidents if potential causes can be eliminated or controlled
- Quantitative Techniques
  - Fault Tree Analysis (FTA)
  - Event Tree Analysis (ETA)
  - MC Simulation
  - Human Error Quantification techniques
  - Calculation of frequency of IEs from historical statistical data

Example Fault Tree

Oil and Natural Gas



Top Event – D0

Gates – G1, G2
- G1 OR gate
- G2 AND gate

Undeveloped Event – D1
- Causes not developed further

Basic Event – D3; D4
- Lowest level of FT, where reliability data applied

Use Existing Failure Data

Oil and Natural Gas

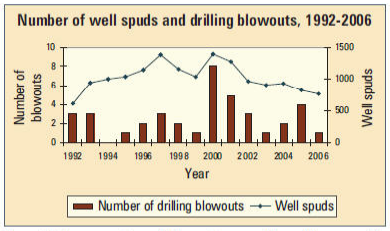


Figure 1: The percentage of blowouts per well spud decreased in 2006.

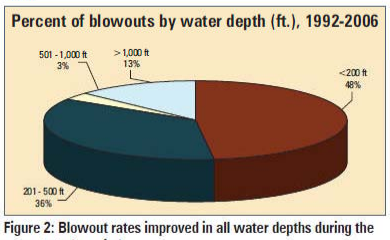


Figure 2: Blowout rates improved in all water depths during the current study period.

- Preliminary data will have SINTEF and MMS Study
- Preliminary data will include assessments by NETL and LANL SMEs
- UDAC experts for bayesian update to data based on expert elicitation

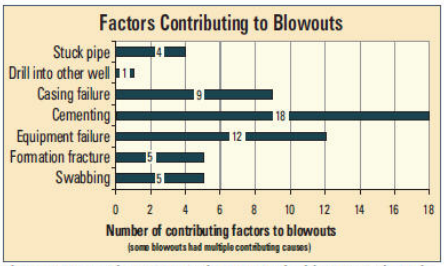


Figure 6: Cementing problems increased significantly during this study period, being associated with 18 of the 39 blowouts.

Use Existing Failure Data

Oil and Natural Gas

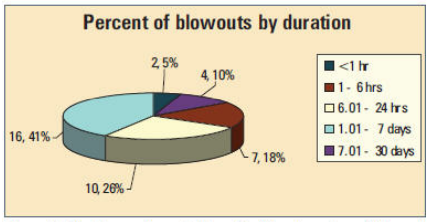


Figure 3: Like the previous study, a significant number of blowout events were of short duration.

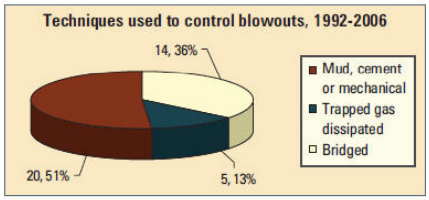


Figure 4: Just over 50% of the blowouts were controlled by pumping mud or cement or by actuating mechanical well control equipment.

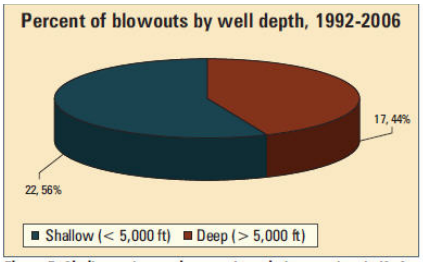


Figure 5: Similar to the previous study period, more than half of the blowouts during the current study period occurred before the well had been drilled to 5,000 ft TVD

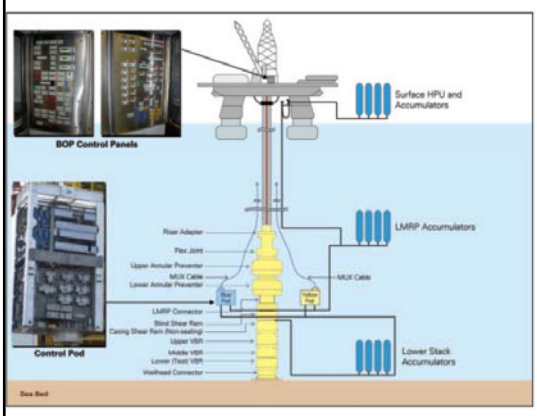
Tasks and Schedules

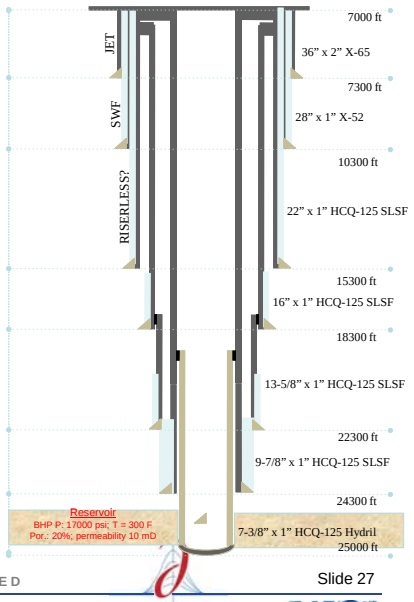
Oil and Natural Gas

1. Develop overall risk assessment methodology
2. Assess and evaluate data for reliability assessment
3. Identify and Bin Initiating Events
4. Develop Accident Progression Events
5. Develop and "engineer" a generic well and materials for use
6. Modeling and simulation of accident progression with time scales (Mid January)
7. Construct fault trees (Mid January)
8. Construct event trees (End of January)
9. Risk estimates for drilling operations (February)
10. Risk estimates for TA, Shut-In, production, and PA
11. Develop methodology for reliability hit due to harsher operating conditions (HPHT wells)
12. Identify and rank R&D efforts underway at NETL by risk worth
13. Documentation

Baseline Drilling Operation

Oil and Natural Gas



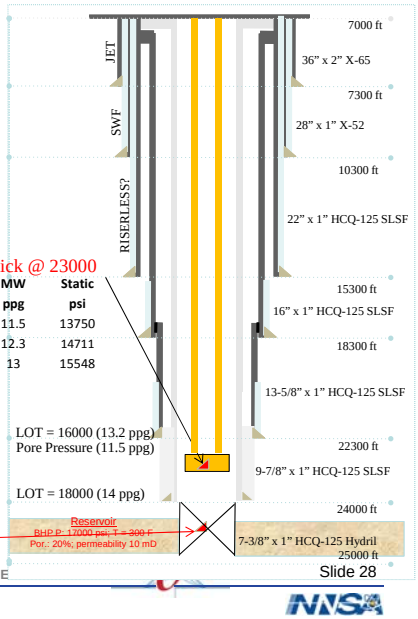


- Meets CFR and API Guidance
- Variation from baseline part of sensitivity and uncertainty analysis

Baseline Scenarios for analysis

Oil and Natural Gas

- Kick at 23000 TVD during normal drilling
  - LOT @ 22300 is measured 13.2 ppg
  - Pore Pressure Estimated 11.5 ppg
  - Chosen mud density 12.3 ppg
  - Slight gas cut mud
  - Drill pipe at the bottom of the whole (Alternate #1 is drill pipe @ 21000 during tripping, Alternate #2 is stuck pipe at 23000)
  - Normal mud circulation: through drill pipe, up the hole, casing string, through BOP, up the riser into the mud handling system
- Kick during cementing at the reservoir
  - Normal mud circulation: through drill pipe, up the hole, casing string, through BOP, up the riser into the mud handling system



Cementing the Bottom Hole

MW ppg	Static psi
8.4	10920
13	16900
13.1	17030
13.4	17420
14	18200

ECD = 13.8 ppg

IE Probability Quantification

Oil and Natural Gas

- Early detection: Before influx enters into the riser. This minimizes release and makes formation pressure and kick size estimates accurate which in turn makes "kill" mud weight estimate more accurate
- Hardware: No automated shut-off system. Sensors.
- Human action: Determine based on (1) sudden increase in the drilling rate, (2) mis-match between mud input and output, (3) pit gain, (4) large gas in the mud handler, shaker, (5) drill pipe pressure change, (6) well flows after mud pump trip, (7) MWD (Temp, pressure, gas etc). Engineering judgment
- Complications: (1) gas cut before kick, (2) ballooning and small annular losses very common, (3) instrumentation, etc

QRA Objectives for Offshore Use [Vinnem]

Oil and Natural Gas

- Estimation of risk in an absolute or relative sense
- Determine design loads and conditions
- Understanding of hazards causation and potential escalation pathways
- Ranking of hazards according to risk potential

PRA Objectives for US Nuclear Reactors [USNRC PRA Procedures Guide]

Oil and Natural Gas

- PRA Includes
  - System reliability analysis
  - Accident sequence classification
  - Assessments of frequencies for classes of accident sequences
  - Estimate of consequences of accident sequences
  - Consequence analysis
- For each of these areas need to identify
  - Acceptable analytical techniques
  - Acceptable assumptions and modeling approximations including the treatment of statistical data, common-cause failures and human errors
  - Treatment of uncertainties
  - Standards for documentation
  - Assurance of technical quality

Methodology for Offshore QRA [Vinnem]

Oil and Natural Gas

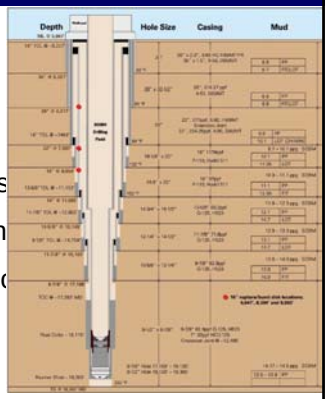
- Focus:
  - Identification of Applicable Hazards
  - Description (including quantification) of applicable risks to personnel, environment, and assets
- Analytical Elements Include all or some of:
  - Identification of Initiating Events (IEs)
  - Cause Analysis
    - Qualitative evaluation of possible causes
    - Probability analysis in order to determine the probability of certain scenarios
  - Consequence Analysis
    - Consequence loads, related to physical effects of accidents
    - Response analysis, related to response of the facilities, when exposed to accidental loads
    - Probability analysis, related to the probability that these loads and responses occur
    - Quantification of consequences in terms of injury to personnel, damage to environment and/or assets

Consequence Loads

Oil and Natural Gas

Consequence loads related to:

- Fire loads from ignited hydrocarbon releases
- Explosion loads from ignition of hydrocarbon
- Structural impact from collisions, falling objec
- Environmental loads



Consequence Analysis

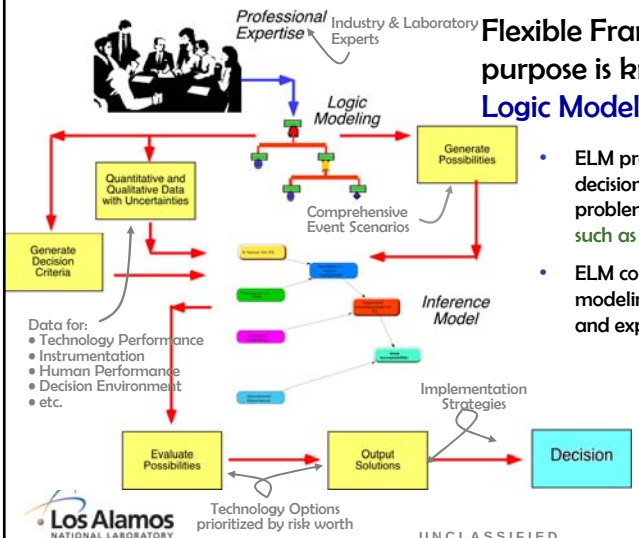
Oil and Natural Gas

Covers series of steps including:

- Accident scenario analysis of possible event sequences
- Analysis of accidental load, related to fire, explosion, impact
- Analysis of the response of the systems and equipment to accidental loads
- Analysis of final consequences to personnel, environment, and assets
- Escalation analysis, relating to how accidents may spread from the initial equipment to other equipment and areas

Proven Methods for Data Integration

Oil and Natural Gas



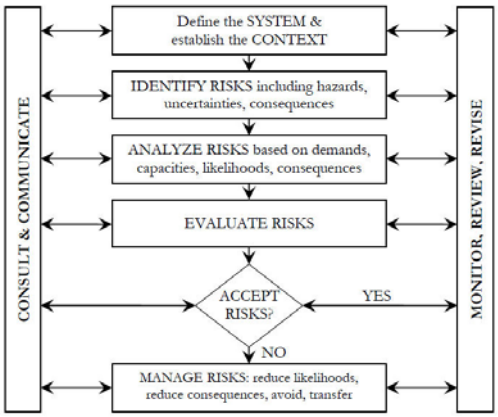
Flexible Framework used for this purpose is known as Evaluated Logic Model

- ELM provides a flexible and robust decision-analysis framework for problems with imprecise knowledge such as operator actions
- ELM combines elements of logic modeling, reliability, graph theory, and expert elicitation.

Risk Assessment – High Level Review

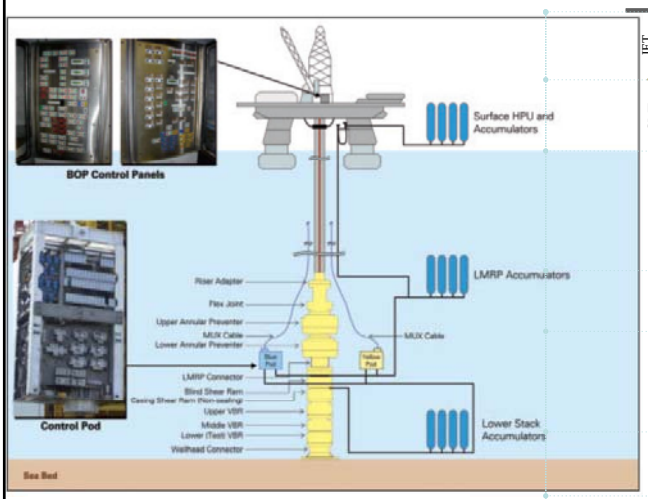
Oil and Natural Gas

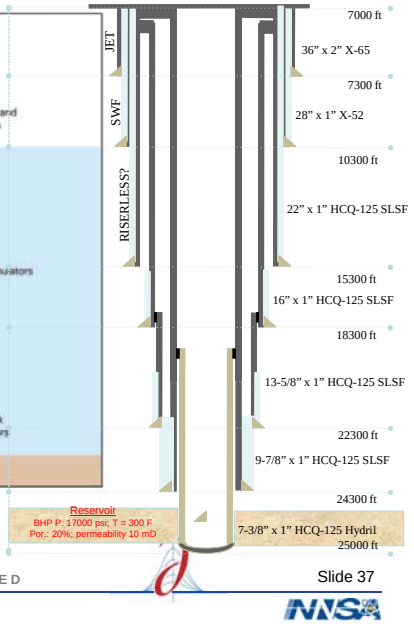
- Numerous industry studies
  - Financial risk
  - Operational Aspects
- MMS requested one study
  - V&V of industry study
- SINTEF Data Base
  - MMS Data
  - North Sea Standard
  - GOM specific
- West Engineering
  - BOP
  - Shear ram performance



Baseline Drilling Operation

Oil and Natural Gas





- Meets CFR and API Guidance
- Variation from baseline part of sensitivity and uncertainty analysis

Attachment 6

Research Partnership to Secure Energy for America

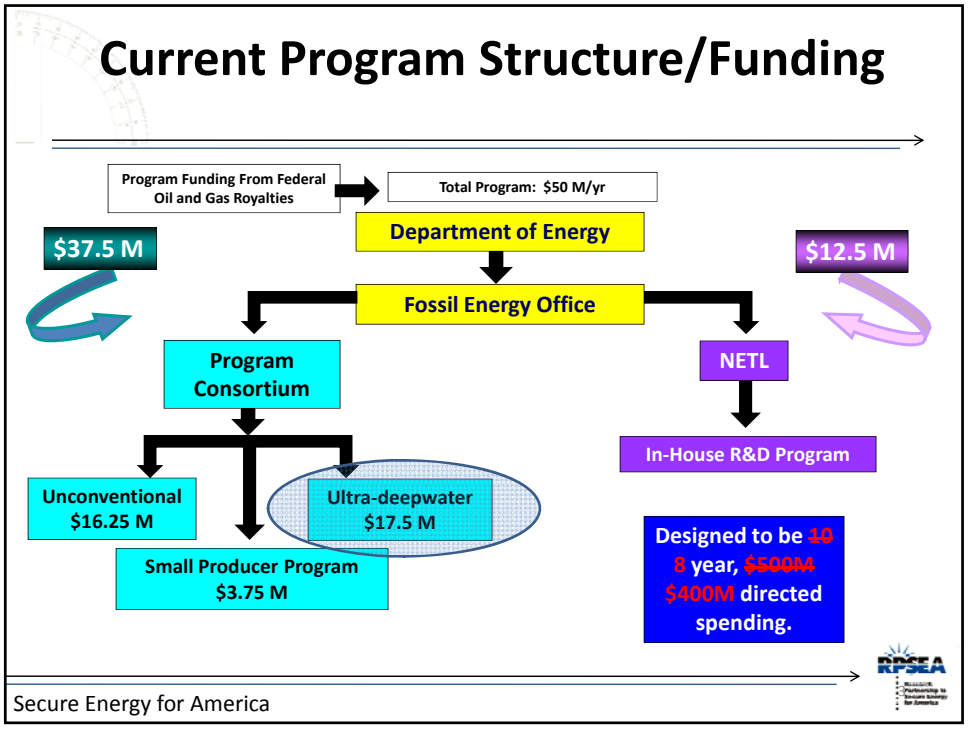
RPSEA Cost Shared Research

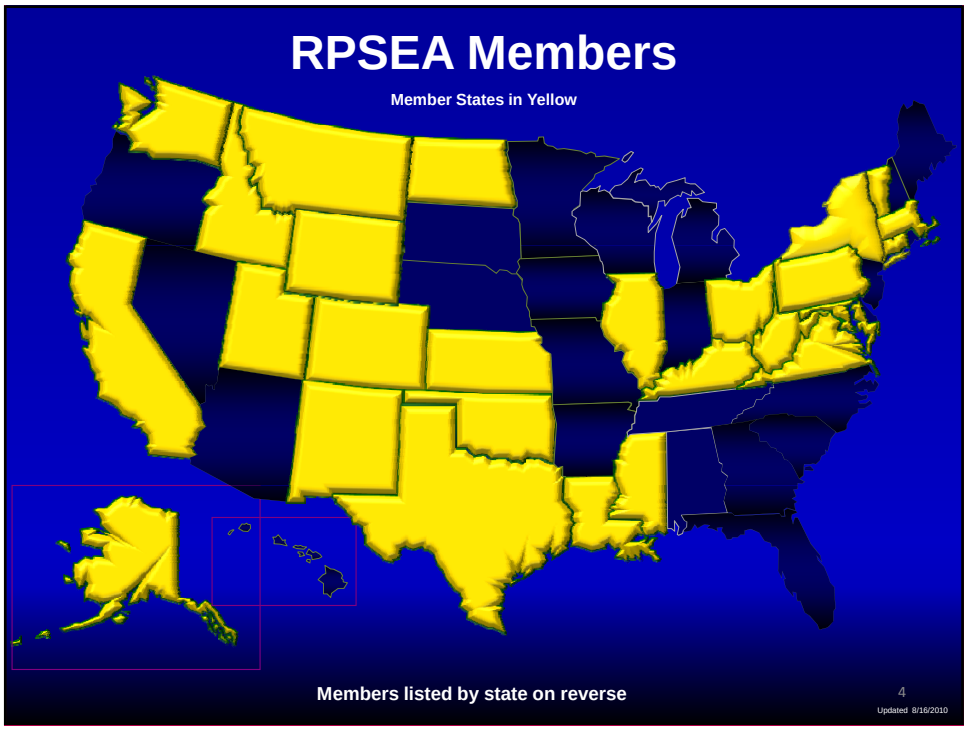
James M. Pappas
UDAC Meeting
Hilton Houston North
DaVinci Room
Houston, TX
January 19, 2012

Secure Energy for America

Contents

- RPSEA Organization
- Current Project Status


Current Program Structure/Funding
Program Funding From Federal Oil and Gas Royalties
Total Program: $50 M/yr
Department of Energy
$37.5 M
$12.5 M
Fossil Energy Office
Program Consortium
NETL
In-House R&D Program
Unconventional $16.25 M
Ultra-deepwater $17.5 M
Small Producer Program $3.75 M
Designed to be ~~10~~ 8 year, ~~$500M~~ $400M directed spending.
Secure Energy for America


RPSEA Members
Member States in Yellow
Members listed by state on reverse
4
Updated 8/16/2010

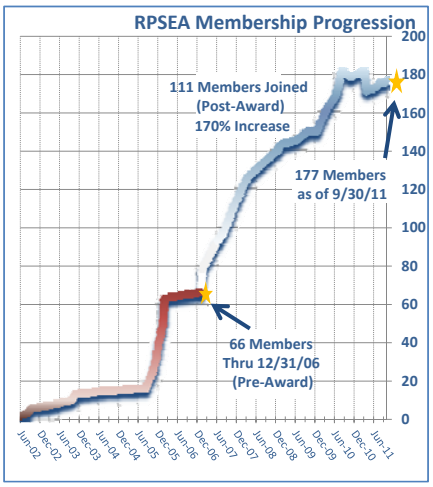
Alaska
University of Alaska Fairbanks
California
AeroVironment , Inc.
Campbell Applied Physics
Chevron Corporation
Conservation Committee of California Oil & Gas Producers
Drilling & Production Company
Jacobs Engineering Group Inc.
Lawrence Berkeley National Laboratory
Lawrence Livermore National Laboratory
Natural Carbon, LLC
Paulsson, Inc.
Stanford University
University of Southern California
Watt Mineral Holdings, LLC
Colorado
Altira Group LLC
Bill Barrett Corporation
Brownstein Hyatt Farber Schreck, LLP
Colorado Oil & Gas Association
Colorado School of Mines
DCP Midstream, LLC
EnCana Corporation
Energy Corporation of America
Foro Energy
Gunnison Energy Corporation
HW Process Technologies, Inc.
Leede Operating Company
NiCo Resources
Noble Energy, Inc.
Robert L. Bayless, Producer LLC
Spatial Energy
The Discovery Group, Inc.
University of Colorado at Boulder
Western Energy Alliance
Connecticut
APS Technology, Inc.
Idaho
Idaho National Laboratory
U.S. Geothermal Inc.
Illinoisas Technology Institute
Kansas
The University of Kansas
Kentucky
Greensburg Oil, LLC
NGAS Resources, Inc.
Louisiana
Louisiana State University
Maryland
Lockheed Martin Corporation
Massachusetts
Entropy Limited
Massachusetts Institute of Technology
Woods Hole Oceanographic Institution
Mississippi
Jackson State University
Mississippi State University
Montana
Nance Resources
New Mexico
Correlations Company
Harvard Petroleum Corporation
Independent Petroleum Association of New Mexico
Los Alamos National Laboratory
New Mexico Institute of Mining and Technology
Sandia National Laboratories
Strata Production Company
New York
Hess Corporation
North Dakota
Laserlith Corporation
Western Standard Energy Corporation
Ohio
MesoCoat, Ltd.
NGO Development Corporation
The Ohio State University
Wright State University
Oklahoma
Chesapeake Energy Corporation
Devon Energy Corporation
Interstate Oil and Gas Compact Commission
Oklahoma Independent Petroleum Association
MAP Royalty, Inc.
Panther Energy Company, LLC.
Petroleum Technology Transfer Council
The Fleischaker Companies
The University of Oklahoma
The University of Tulsa
The Williams Companies, Inc.
Pennsylvania
The Pennsylvania State University
Vista Resources, Inc.
Texas
Acute Technological Services, Inc.
Advantek International Corp.
AGR Subsea, Inc.
Alcoa Oil and Gas
AMOG Consulting, Inc.
Anadarko Petroleum Corporation
Apache Corporation
At Balance Americas L.L.C.
Athens Group
Baker Hughes Incorporated
Blade Energy Partners, Ltd.
BJ Services Company
BP America, Inc.
BMT Scientific Marine Services Inc.
Cameron/Curtiss-Wright EMD
Capstone Turbine Corporation
CARBO Ceramics, Inc.ity of Sugar Land
ConocoPhillips Company
Consumer Energy Alliance
CSI Technologies,Inc.
Cubility
DeepFlex Inc.
Deepwater Structures, Inc.
Deepwater XLP Technology, LLP
Det Norske Veritas (USA)
Energy Valley, Inc.
ExxonMobil Corporation
GE Oil & Gas
General Marine Contractors, LLC
Granherne, Inc.
Greater Fort Bend Economic Development Council
GSI Environmental, Inc.
Halliburton
HIMA Americas, Inc
Houston Advanced Research Center
Houston Offshore Engineering, LLC
Houston Technology Center
Intelligent Agent Corporation
Knowledge Reservoir, LLC
Konsberg Oil & Gas Technologies Inc.
Letton-Hall Group
Marathon Oil Corporation
M&H Energy Services
Merrick Systems, Inc.
Nalco Company
NanoRidge Materials, Inc.
National Oilwell Varco, Inc.
Nautilus International, LLC
Neptec USA
Nexen Petroleum USA Inc.
Oceaneering International, Inc.
OTM Consulting Ltd.
Oxane Materials, Inc.
Peritus International Inc.
Petris Technology, Inc.
Petrobras America, Inc.
Pioneer Natural Resources Company
QO Inc.
Quanelle, LLC
Quest Offshore Resources
Rice University
Rock Solid Images
RTI Energy Systems
Schlumberger Limited
Shell International Exploration & Production
Simmons & Company International
SiteLark, LLC
Southern Methodist University
Southwest Research Institute
Statoil
Stress Engineering Services, Inc.
Subsea Riser Products
Technip
Technology International
Tejas Research & Engineering, LP
Tenaris
Texas A&M University
Texas Energy Center
Texas Independent Producers and Royalty Owners Association
Texas Tech University
The Research Valley Partnership, Inc.
The University of Texas at Austin
Titanium Engineers, Inc.
TOTAL E&P USA, Inc.
Tubel Energy LLC
University of Houston
VersaMarine Engineering, LLC
Weatherford International Ltd.
WFS Energy & Environment
Ziebel
2H Offshore Inc.
Utah
Novatek, LLC
The University of Utah
Vermont
New England Research, Inc.
Virginia
Advanced Resources International, Inc.
American Gas Association
Independent Petroleum Association of America
Integrated Ocean Drilling Program
Washington
BlueView Technologies, Inc.
Quest Integrated, Inc.
Washington D.C.
Consortium for Ocean Leadership
West Virginia
West Virginia University
Wyoming
Big Cat Energy Corporation
EnerCrest, Inc.
WellDog, Inc.

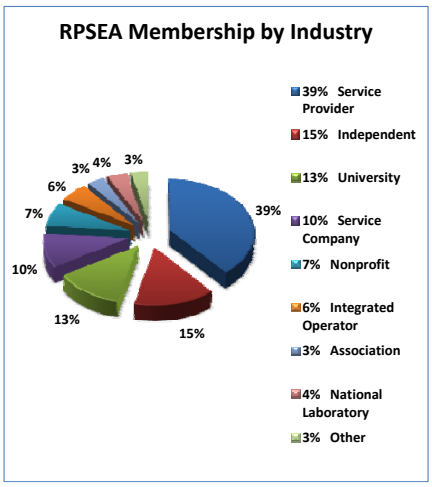
Newfoundland, Canada
Propel Inc.

Pending Member - company name in green

5

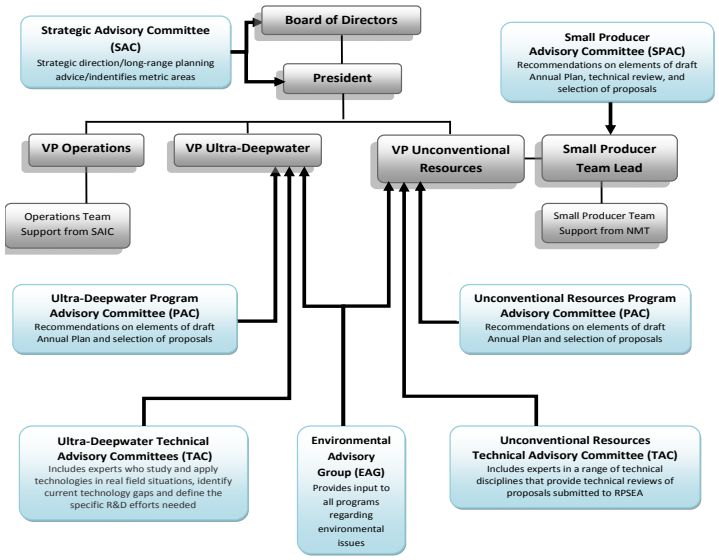
RPSEA Member Entities





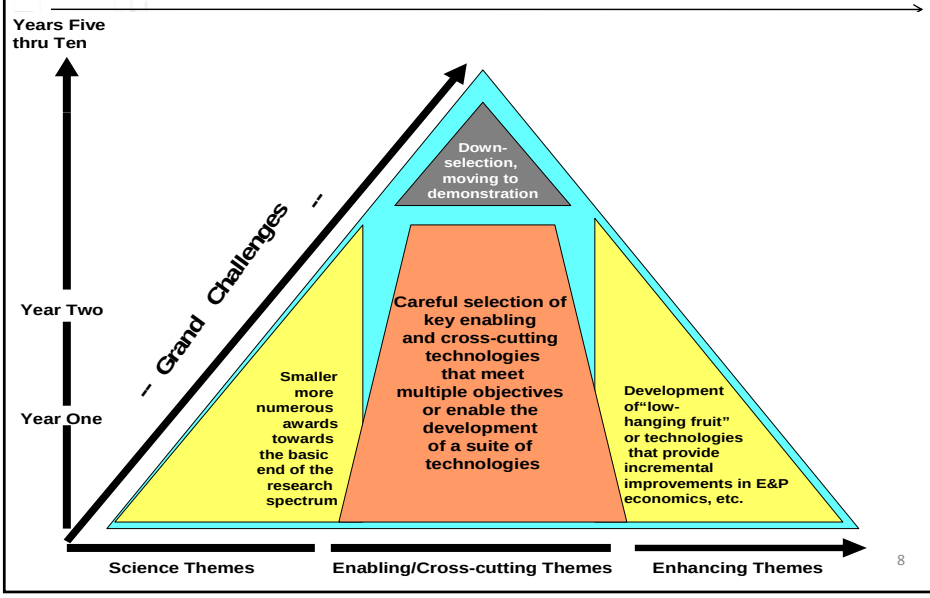
6

RPSEA Organization



7

Building a Relevant Portfolio

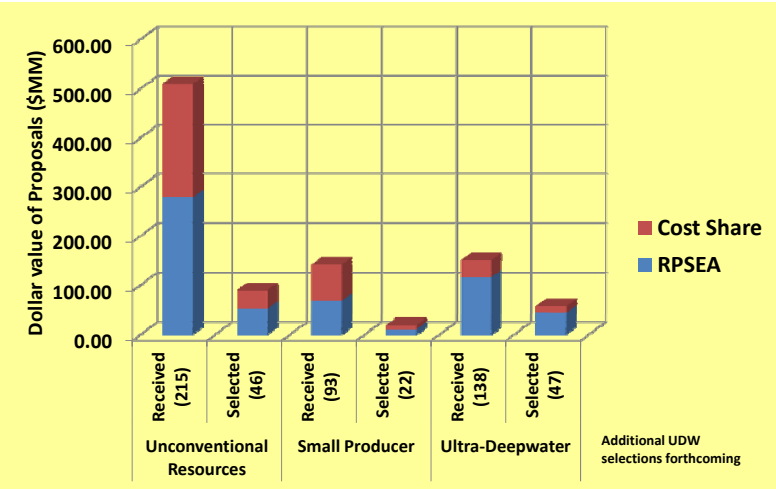


8

Contents

- RPSEA Organization
- Current Project Status

2007-2010 Proposals



Portfolio Overview

RPSEA Program Selections 2007-2010				
	Small Producer	Unconventional Resources	Ultra-Deepwater*	Total
Universities	15	30	10	55
For Profits	5	5	30	40
Non-Profits	1	5	6	12
National Labs	1	3	1	5
State Agencies	0	3	0	3
Total Selected	22	46	47	115

* Additional selections to be made

Secure Energy for America 11

RPSEA
Research Partnership to Secure Energy for America

UDW Results & Accomplishments

James M. Pappas
UDAC Meeting
Hilton Houston North
DaVinci Room
Houston, TX
January 19, 2012

Secure Energy for America

Contents

- UDW Program
- Results
- 2010 UDW Program
- 2011 UDW Program
- 2012 Draft Annual Plan

UDW Program

- The EPAct states the UDW *"shall focus on the development and demonstration of individual exploration and production technologies as well as integrated systems technologies including new architectures for production in ultra-deepwater."*
- The 2011 Annual Plan states that the Ultra-Deepwater Program Element shall concentrate on the following primary focus area: *"… to fill-in identified technology and/or knowledge gaps related specifically to ultra-deepwater safety, environmental impact assessment, and environmental impact mitigation which are not currently addressed by the portfolio of projects and outstanding solicitations resulting from past Annual Plans"*.

UDW Mission

To identify and develop technologies, architectures, and methods that ensure safe and environmentally responsible exploration and production of hydrocarbons from the ultra-deepwater (UDW) portion of the Outer Continental Shelf (OCS) in an economically viable (full life cycle) manner.

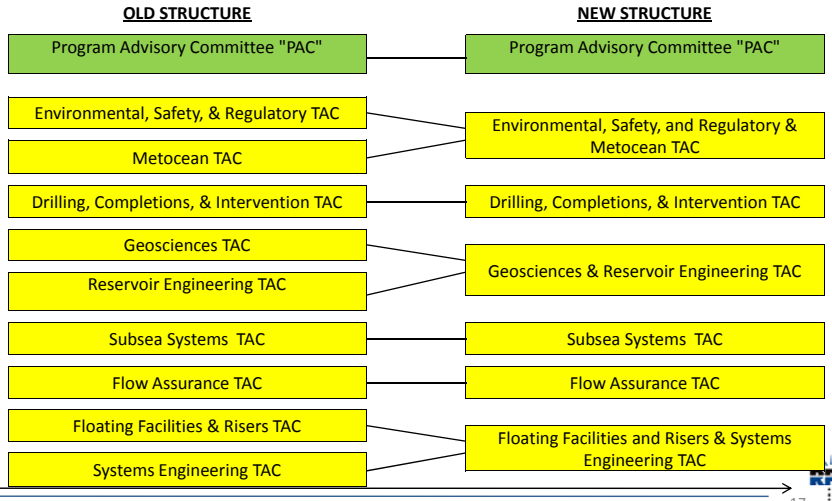
UDW Mission – How?

This mission of technology development encompasses:

- Extending basic scientific understanding of the various processes and phenomena directly impacting the design and reliable operation of a ultra-deepwater production system
- Developing “enabling” technologies
- Enhancing existing technologies to help lower overall cost and risks
- Pursuing new technologies which, if successfully developed, are capable of “leapfrogging” over conventional pathways
- Accomplishing these tasks in a safe and environmentally friendly manner.

UDW Structure

Resource of >950 SMEs from industry, academia and government!



Achieving the UDW Goals

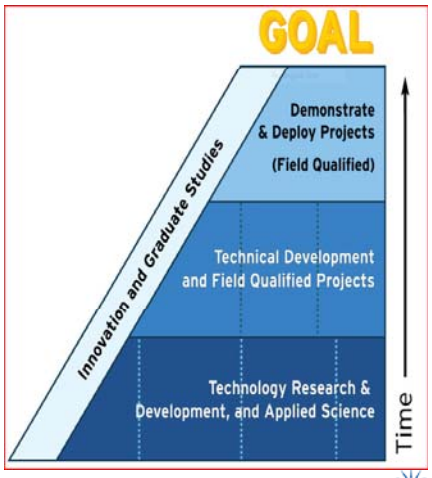
Maximize the Value of Domestic Resources:

- Increase production of ultra-deepwater oil and gas resources
- Reduce costs to find, develop, and produce such resources
- Increase efficiency of exploitation of such resources
- Increase production efficiency and ultimate recovery of such resources
- Increase safety and environmental awareness by addressing safety and environmental focus impacts associated with ultra-deepwater exploration and production, and technology development.

Early (Pre-2011) Objectives

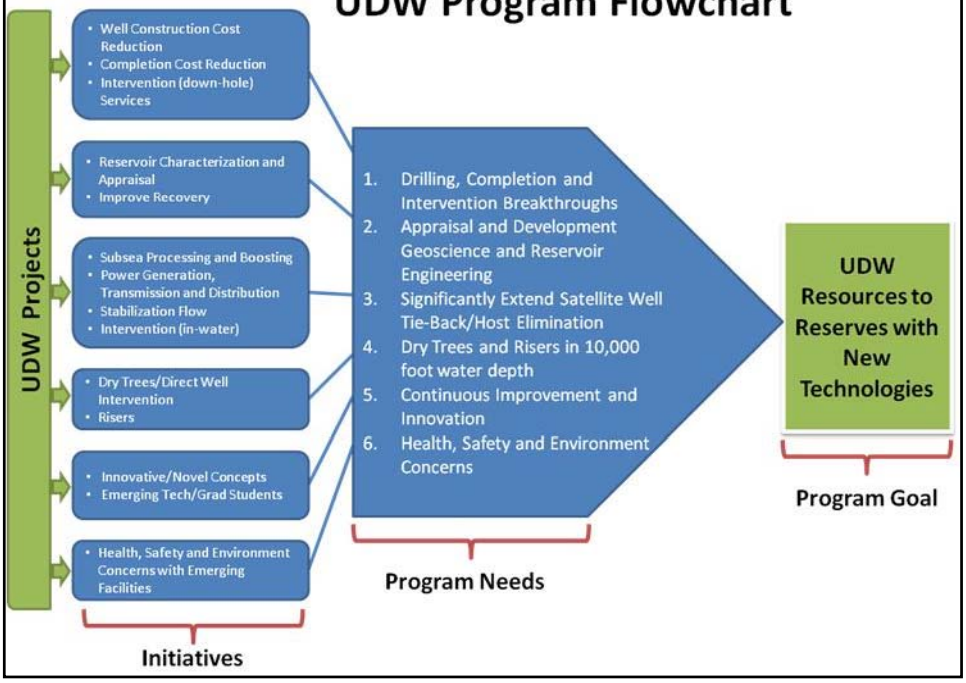
To meet the UDW Program goals, **6 objectives** were identified:

1. Technology Needs
2. Technology Research & Development, and Applied Science
3. Awareness and Cost-Share Development
4. Technical Development and Field Qualified
5. Environmental and Safety Technology Development and Deployment
6. Technology Demonstration



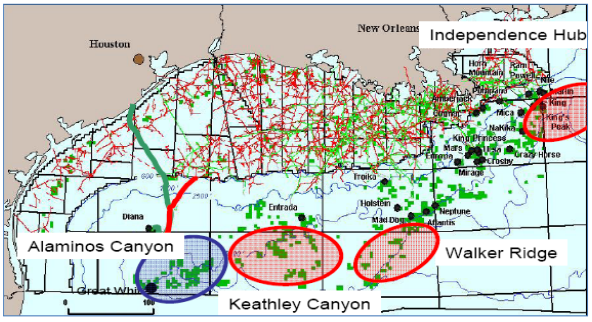
Secure Energy for America

UDW Program Flowchart



Technical Challenges for Identified Basins

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
- CO_2/H_2S

Overall
- higher drilling costs
- challenging economics

- UDW Program
- Results
- Technology Transfer
- 2010 UDW Program
- 2011 UDW Program
- 2012 Draft Annual Plan

Completed UDW Projects

Contract Number	Project Name	Company	Start Date	End Date	Total Project Cost	RPSEA Cost Budget	Cost Share Total	% Cost Share
07121-1201 COMPLETE	Wax Control in the Presence of Hydrates	University of Utah	09/02/08	08/31/11	$500,000	$400,000	$100,000	20.0%
07121-1302 COMPLETE	Ultra-High Conductivity Umbilicals	NanoRidge Materials, Inc.	12/05/08	05/30/10	$560,000	$448,000	$112,000	20.0%
07121-1402a COMPLETE	Ultra Deepwater Dry Tree System for Drilling and Production	Floatec	12/05/08	03/27/09	$394,515	$278,686	$115,829	29.4%
07121-1402b COMPLETE	Ultra Deepwater Dry Tree System for Drilling and Production	Houston Offshore Engineering	12/05/08	06/30/10	$1,047,898	$812,042	$235,856	22.5%
08121-1502-01 COMPLETE	Coil Tubing Drilling and Intervention System Using Cost Effective Vessel	Nautilus International, LLC	10/01/09	04/01/11	$1,025,000	$820,000	$205,000	20.0%
07121-1603a COMPLETE	Flow Phenomena in Jumpers-Relation to Hydrate Plugging Risk	University of Tulsa	09/22/08	01/21/10	$150,797	$120,000	$30,797	20.4%
07121-1603b COMPLETE	Hydrate Characterization & Dissociation Strategies	University of Tulsa	09/22/08	09/21/10	$181,719	$120,000	$61,719	34.0%
07121-1603c COMPLETE	Design investigation of extreme high pressure, high temperature, (XHPHT), subsurface safety valves (SSSV)	Williams Marsh Rice University	10/16/08	10/15/10	$150,000	$120,000	$30,000	20.0%
07121-1701 COMPLETE	Development of a Research Report and Characterization Database of Deepwater and Ultra-Deepwater Assets in the Gulf of Mexico, including Technical Focus Direction, Incentives, Needs Assessment Analysis and Concepts Identification for Improved Recovery Tech	Knowledge Reservoir, LLC	02/03/09	12/15/10	$1,999,712	$1,599,712	$400,000	20.0%
07121-1801 COMPLETE	Effect of Global Warming on Hurricane Activity	National Center for Atmospheric Research	02/23/09	04/01/11	$684,085	$544,085	$140,000	20.5%
07121-1901 COMPLETE	Subsea Systems Engineering Integration	GE Global Research Center (GE-GRC)	12/03/08	07/31/11	$1,511,448	$1,200,000	$311,448	20.6%
07121-1902 COMPLETE	Deep Sea Hybrid Power System	Houston Advanced Research Center	10/31/08	10/31/10	$600,000	$480,000	$120,000	20.0%
08121-2501-02 COMPLETE	Early Reservoir Appraisal Utilizing a Well Testing System	Nautilus International, LLC	10/20/09	03/31/11	$1,025,000	$820,000	$205,000	20.0%
08121-2502-01 COMPLETE	Modeling and Simulation of Managed Pressure Drilling for Improved Design, Risk Assessment, Training and Operations	Stratamagnetic Software, LLC	10/19/09	04/18/11	$460,000	$360,000	$100,000	21.7%
TOTAL	**14 Completed Projects**				**$10,290,174**	**$8,122,525**	**$2,167,649**	**21.1%**

08121-1502-01: Coiled Tubing Drilling and Intervention System Using Cost-Effective Vessel

Research Objectives

- Add engineering detail as the basis for an offshore demonstration for downhole work in deepwater Gulf of Mexico satellite wells without need for a mobile offshore drilling unit (MODU).
- Design & demo completion will improve S&E protection, facilitate improved resource recovery from existing satellite wells, and more practically evelop reservoirs that otherwise won't meet economic hurdles.

Accomplishments

- Conceptual design of the components needed for the subsea riser (SSR) system.
- Challenges addressed include: CT use from cost-effective vessel in UDW, size & weight of CT equipment in relation to vessel deck space/ deck load, WD & ocean current effects, need to have a riser for circulation.
- Detailed HAZID review concluded that hazards identified have been effectively managed and mitigated.

Significant Findings

- Work completed shows that the goals of the project can be met.
- Includes improved S&E protection, design suitable for central GOM UDW, & cost < ½ of using MODU for downhole intervention in deepwater satellite wells.

Future Plans

- Phase 2, subject to approval by RPSEA and DOE, to include staging of equipment, mobilization to a vessel, and safe demonstration of downhole work.

08121-2502-01: Early Reservoir Appraisal Utilizing a Well Testing System

Research Objectives

- Evaluate possibilities for new GOM DW testing methodology.
- Reservoir modeling of 3 major plays & simulations of a variety of well tests
- Summary of 8 DW well testing systems & their components for roadmap options.

Accomplishments

- SMEs addressed DW GOM well testing for early reservoir appraisal issues.
  - Part 1 - reservoir oriented to determine effectiveness of information gathering.
  - Part 2 - well test designs and operations efficiencies and S&E issues.
- Reservoir modeling led to design of 8 well testing systems for short-term, long-term, interference, and injection testing.
- Systems analyzed for operational feasibility: subsea & surface safety systems, vessel requirements, reducing risks to personnel & environment, equipment, & regulatory compliance

Significant Findings

- Numerous well test simulations - production rates 1000 - BPD provides necessary pressure vs time results for classical pressure transient analysis.
- DW testing can be done w/ < $, < time, < risk.
- Representative set of injection well test simulations (fluid injection and pressure fall-off) gave same results as the more common production and build-up tests.

Future Plans

- Proposed RPSEA GOM field test to demo the use of the self standing riser in well testing – rejected by PAC

07121-1302: Ultra-High Conductivity Umbilicals

Research Objectives

- Develop an ultra-high conductivity power cable suitable for use in undersea umbilicals.
- Design, build, & test a cable prototype that could in later stages be incorporated into an umbilical exceeding 100 miles in length and called upon to deliver up to 10 MW at up to 36 kV with operating temperatures up to 250°F and pressures up to 4500 psi.

Accomplishments

- Produced polymeric conductors with nanotube concentrations up to 90 wt%.
- Primary focus of the program was directed toward low concentration (10%) samples.
- Minimum resistivity (inverse of conductivity) value of 2x10-2 ohm-cm in the melt state, versus ideal goal of 1x10-6 ohm-cm in a solid wire.
- Workshop at Rice University on December 10, 2009.

Significant Findings

- Additional work to properly align the nanotube in the proper concentration will be required.
- Identified several new steps for lowering resistivity that should be evaluated.
- Note: Additional work achieved 10-4 ohm-cm resistivity.

Future Plans

- Proposed 2010 RPSEA project to take it to 10-6 or 10-7 resistivity. To include:
  - 1) Reduce/ eliminate host polymer; 2) Determine NT-NT node resistance; 3) Determine effect of contact angles & overlap distance between nanotubes on electrical resistance; 4) Determine ultimate electrical resistivity of metallic vs nonmetallic single-walled nanotubes; 5) Optimize processing methods to achieve best possible conductivity.

07121-1401: Composite Drilling Riser for Ultra-Deepwater High Pressure Wells

Research Objectives

- Basis of Design study & analysis to determine appropriate criteria for design & analysis.
- Fabrication & proof of concept testing of full-diameter, length-scaled riser joints.
- Create ready for trial/use riser system that satisfies S&E & regulatory concerns, industry performance standards, & high margins of safety to eliminate apprehension>
- Ultimately, to provide a UDW solution to enable access to oil reserves previously unreachable, yet with current top-side tension capabilities.

Accomplishments

- Tmax=180F, OD (with buoyancy) based on 60" rotary, 19.5" drift diameter riser design – best design.
- Global Riser Analysis completed Includes riser functional performance requirements, cost effective wrapping method/manufacturing process that addresses future manufacturability of large volume production, & comparative cost benefit analysis.
- Basis of Design Document & Preliminary and Comprehensive Design Reviews.
- Full-diameter prototypes demonstrated manufacturability & sufficient margins of safety with respect to burst strength, fatigue, and tolerance to impact damage.

Significant Findings

- Potential weight savings of 40 - 50%. Safety factors exceeded steel.

Future Plans

- Proposed 2011 RPSEA project to include:
  - Establish a TRL 6 - 7 in accordance with API 17N.
  - Address differences in composite vs conventional riser design philosophy
  - Risk mitigation plan according to DNV RP-A203 Qualification Procedures for New Technology.
  - Field trial.

- UDW Program
- Results
- 2010 UDW Program
- 2011 UDW Program
- 2012 Draft Annual Plan

2010 UDW Plan

- 7 Initiative-based RFPs prepared.
- UDW TACs have voted for individual projects.
- This input was evaluated by the PAC to decide appropriate balance for 2010 UDW program.
- UDW 2010 RFPs to consist of both specific projects and broader initiative-based requests.
- Released in March 2011.
- Bid out April – November 2011.
- 6 Projects awarded – contracting now.
- Seeking DOE approval on remainder – expected in January – February 2012.

2010 UDW Projects

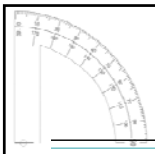
Contract Number	Project Name	Company	Total Project Cost	RPSEA Cost Budget	Cost Share Total	% Cost Share
10121-4304-01	More Improvements to Deepwater Subsea Measurement	Letton-Hall Group, LLC	$4,060,196	$3,248,156	$812,040	20.0%
10121-4306-02	All Electric Subsea Autonomous High Integrity Pressure Protection System (HIPPS) Architecture	Granherne, Inc.	$1,500,000	$1,200,000	$300,000	20.0%
10121-4502-01	Deepwater Reverse-Circulation Primary Cementing	CSI Technologies, LLC	$1,149,075	$881,075	$268,000	23.3%
10121-4505-01	Coil Tubing Drilling and Intervention System Using Cost Effective Vessel	Nautilus International LLC	$16,912,500	$1,250,000	$15,662,500	92.6%
10121-4802-01	Effect of Climate Variability and Change in Hurricane Activity in the North Atlantic	University Corporation for Atmospheric Research	$1,800,000	$1,440,000	$360,000	20.0%
10121-4502-01	Deepwater Reverse-Circulation Primary Cementing	CSI Technologies, LLC	$1,149,075	$881,075	$268,000	23.3%
10121-4903-02	Autonomous Underwater Inspection Using a 3D Laser	Lockheed Martin	$2,062,336	$1,649,868	$412,468	20.0%
TOTAL	6 Projects Awarded		$28,633,182	$10,550,174	$18,083,008	63.2%

Contract Number	Project Name	Company	Total Project Cost	RPSEA Cost Budget	Cost Share Total	% Cost Share
4501	Wellbore Integrity and Strengthening Methods		$ 3,750,000	$ 3,000,000	$ 750,000	20.0%
4503	Advanced Imaging for Tar Detection in Deepwater Wells		$ 3,500,000	$ 2,800,000	$ 700,000	20.0%
4504	Intelligent Casing		$ 500,000	$ 400,000	$ 100,000	20.0%
4901	EPS Front End Engineering Design (FEED) and Critical Component Prototype Design		$ 2,000,000	$ 1,600,000	$ 400,000	20.0%
4701	IOR in Deepwater Phase 2 - New Concepts		$ 1,500,000	$ 1,200,000	$ 300,000	20.0%
4201	Equation of State Development for Extreme High Pressure and High Temperature	NETL Project	$ -	$ -	$ -	0.0%
4202	Hydrate Modeling & Flow Loop Experiments for Water Continuous & Dispersed Systems		$ 850,000	$ 680,000	$ 170,000	20.0%
4203	Development of HPHT Viscosity Standards	NETL Project	$ -	$ -	$ -	0.0%
4204	Corrosion and Scale at Extreme Temperature and Pressure		$ 3,500,000	$ 2,800,000	$ 700,000	20.0%
4301	Subsea Electrical Penetrator Study		$ 350,000	$ 280,000	$ 70,000	20.0%
4303	Verification of Power System Modeling and Simulation Tools for Subsea Power Systems		$ 900,000	$ 720,000	$ 180,000	20.0%
4305	Subsea Water Quality Management Sensors		$ 450,000	$ 360,000	$ 90,000	20.0%
4401	Ultra-deepwater Riser Concepts for High Motion Vessels		$ 1,500,000	$ 1,200,000	$ 300,000	20.0%
4402	Qualification of Flexible Fiber Reinforced Pipe for 10,000' Water Depths [FIELD DEMO]		$ 11,300,000	$ 6,045,500	$ 5,254,500	46.5%
4403	Full Scale Testing of Threaded & Coupled Top Tension Riser Connectors in Air, Brine and H2S		$ 2,000,000	$ 1,600,000	$ 400,000	20.0%
4404	Low Cost Flexible Production System for Remote UDW Gulf of Mexico Field Development		$ 1,500,000	$ 1,200,000	$ 300,000	20.0%
4405	Ultra-deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico, Phase 2		$ 1,250,000	$ 1,000,000	$ 250,000	20.0%
4406	Effects of Fiber Rope - Seabed Contact on Subsequent Rope Integrity		$ 2,500,000	$ 2,000,000	$ 500,000	20.0%
4407	Deepwater Direct Offloading Systems, Phase 1		$ 850,000	$ 680,000	$ 170,000	20.0%
4801	Hurricane Risk to Gulf of Mexico Energy Infrastructure		$ 1,000,000	$ 800,000	$ 200,000	20.0%
4302	Ultra-High Conductivity Umbilicals (NEED 1)		$ 3,000,000	$ 2,400,000	$ 600,000	20.0%
TOTAL	21 Technical Areas of Interest Awaiting Review/Approval Projects Awarded		$42,200,000	$30,765,500	$11,434,500	27.1%

- UDW Program
- Results
- 2010 UDW Program
- 2011 UDW Program
- 2012 Draft Annual Plan

2011 UDW Plan Strategy

- Additional Focus on Safety and Environmental Impact – Follows ***2011 Annual Plan***.
- Recommending 4 Large (>$3MM) Projects and 8 Smaller (<$3MM) Projects.
  - Likely to be 2-year project durations or less
- Issues – September 30, 2014 Sunset Date.
  - Award projects in stage-gated phases
  - Utilize funds wisely
  - Account for hard Project End Dates
- Currently developing Statements of Work.



Human Factors Evaluation of Deepwater Drilling, including Literature Review	$ 2,020,000	$ 1,368,500	$ 651,500	32.3%
Obstruction Remediation without the Ballistic Plug Effect	$ 1,145,000	$ 916,000	$ 229,000	20.0%
High Power Local Generation and Local Storage	$ 2,100,000	$ 1,680,000	$ 420,000	20.0%
Construction and Testing of Deepwater Permanent Subsea Pressure Compensated Chemical Reservoir	$ 1,000,000	$ 800,000	$ 200,000	20.0%
Carbon-fiber Reinforced Riser for Dry Tree Drilling of High-Pressure Wells (contd 1401)	$ 16,000,000	$ 10,100,000	$ 5,900,000	36.9%
Riser Lifecycle Monitoring System for Integrity Management	$ 2,000,000	$ 1,300,000	$ 700,000	35.0%
VIM Study for Deep Draft Column Stabilized Floaters	$ 1,200,000	$ 750,000	$ 450,000	37.5%
Layered Measurement System in Drilling Mud for Early Kick Detection	$ 3,000,000	$ 2,400,000	$ 600,000	20.0%
Instrumented BOP Ram: Drill Collar/ Tool Joint Locator	$ 2,400,000	$ 1,920,000	$ 480,000	20.0%
IOR to Reduce Dependence on New Fields and Foreign Oil: Phases 3 & 4- Prototype Testing & Field Test	$ 8,200,000	$ 3,736,288	$ 4,463,713	54.4%
Advanced Borehole Seismic Technology for Deepwater Drilling	$ 3,865,000	$ 2,624,600	$ 1,240,400	32.1%
Quantifying Key Environmental Forces in Ultradeep Water	$ 1,650,000	$ 825,000	$ 825,000	50.0%
12 Technical Areas of Interest Awaiting Review/Approval Projects Awarded	**$44,580,000**	**$28,420,388**	**$16,159,613**	**36.2%**

Secure Energy for America

		2007		2008		2009		2010		2011	
NEED	INITIATIVE	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description
NEED 1: Drilling Completion and Intervention Breakthroughs	Drilling			08121-2502-01	DW2502, Modeling and Simulation of Managed Pressure Drilling for Improved Design, Risk Assessment, Training and Operations	09121-3500-10	DW3502: Gyroscope Guidance Sensor for Ultra-Deepwater Applications	10121-4501-01	Wellbore Integrity Improvement & Strengthening Methods: Smart Cementing Materials and Drilling Muds for Real Time Monitoring of Deepwater Wellbore Enhancement	5502	Layered Measurement System in Drilling Mud for Early Kick Detection
						09121-3500-02	DW3401: Fatigue Testing of Shrink-fit Riser Connection for High Pressure Ultra Deepwater Risers	10121-4502-01	Deepwater Reverse-Circulation Primary Cementing	5503	Instrumented BOP Ram: Drill Collar/ Tool Joint Locator
								10121-4503-01	Low Frequency Imaging for Tar Detection While Drilling Salt in Deepwater Wells		
	Completions					09121-3500-01	DW3501: Intelligent Production System for Ultra Deepwater with Short Hop Wireless Power and Wireless Data Transfer for Lateral Production Control and Optimization	10121-4504-01	Intelligent Casing-Intelligent Formation Telemetry (ICIFT) System		
	Intervention (Downhole Services)										
	Intervention (In-Water IMR)			08121-1502-01	DW1502, Coil Tubing Drilling and Intervention System Using Cost Effective Vessel	09121-3500-07	DW3301: Deepwater Subsea Test Tree and Intervention Riser System	10121-4505-01	Coil Tubing Drilling and Intervention System Using Cost Effective Vessel		
	Extended Well Testing										

NEED	INITIATIVE	2007 Project #	2007 Title / Description	2008 Project #	2008 Title / Description	2009 Project #	2009 Title / Description	2010 Project #	2010 Title / Description	2011 Project #	2011 Title / Description
NEED 2: Appraisal & Development Geoscience and Reservoir Engineering	Reservoir Appraisal & Surveillance	07121-2001	DW2001, Geophysical Modeling Methods			09121-3700-02	DW3001: A 1,000 level Drill Pipe Deployed Fiber Optic 3C Receiver Array for Deep Boreholes			5706	Advanced Borehole Seismic Technology for Deepwater Drilling
				08121-2501-02	DW2501, Early Reservoir Appraisal Utilizing a Well Testing System						
				08121-2701-03	DW2701, Ultra-Deepwater Resources to Reserves Development and Acceleration Through Appraisal						
	Enhanced Recovery	07121-1701	DW1701, Development of a Research Report and Characterization Database of Deepwater and Ultra-Deepwater Assets in the Gulf of Mexico, including Technical Focus Direction, Incentives, Needs Assessment Analysis and Concepts Identification for Improved Recovery Tech					10121-4701-02	Improved Sweep Using Gels and Polymers in High-Temperature, Low Permeability Reservoirs	5701	IOR to Reduce Dependence on New Fields and Foreign Oil: Phases 3 & 4- Prototype Testing & Field Test
								10121-4701-10	Development of Water Treatment Hubs for Improved Oil Recovery in Deepwater and Ultra-Deepwater in the Gulf of Mexico		
								10121-4701-09	Proving the Novel Concepts of Wettability-Enhanced, Gravity-Assisted Single-Well Improved Recovery Processes for Deepwater Gulf of Mexico Oil Reservoirs		
								10121-4701-06	Catalytic In-Situ CO2 Generation and Development of New Hybrid EOR Process for Deepwater Applications		

NEED	INITIATIVE	2007 Project #	2007 Title / Description	2008 Project #	2008 Title / Description	2009 Project #	2009 Title / Description	2010 Project #	2010 Title / Description	2011 Project #	2011 Title / Description
NEED 3: Significantly extend subsea tieback distances / surface host elimination	Stabilized Flow	07121-1201	DW1201, Wax Control in the Presence of Hydrates			09121-3300-02	DW3201: Displacement & Mixing in Subsea Jumpers - Experimental Data and CFD Simulations	*4201-NETL*	*Equation of State Development for Extreme High Pressure and High Temperature*		
		1202-NETL	*PVT Measurements at Extreme Conditions*					10121-4202-01	Hydrate Modeling & Flow Loop Experiments for Water Continuous & Dispersed Systems		
								4203-NETL	*Development of HPHT Viscosity Standards*		
	Subsea Power	07121-1302	DW1302, Ultra-High Conductivity Umbilicals	08121-2901-01	DW2901, Ultra-Reliable Deepwater Electrical Power Distribution System and Power Components	09121-3300-10	DW3302: Development of Carbon Nanotube Composite Cables for Ultra-Deepwater Oil and Gas Fields	10121-4301-01	Subsea Electrical Penetrator Study: Phase 1 - Connectors Technology Workshop to identify needs, gaps and strategies Phase 2 - Connector Qualification Testing and Development		
		07121-1902	DW1902, Deep Sea Hybrid Power System					10121-4302-01	Ultra-High Conductivity Umbilicals: Polymer Nanotube Umbilicals (PNUs)	5301	High Power Local Generation and Local Storage
								10121-4303-01	Verification and Validation of Power System Modeling and Simulation Tools for Subsea Power Systems		
	Subsea Processing, Pressure Boosting, Instrumentation and Controls	07121-1301	DW1301, Improvements to Deepwater Subsea Measurements			09121-3300-04	DW3304: High Resolution 3D Laser Imaging for Inspection, Maintenance, Repair, and Operations	10121-4304-01	More Improvements to Deepwater Subsea Measurement	5302	Construction and Testing of Deepwater Permanent Subsea Pressure Compensated Chemical Reservoir
		07121-1901	DW1901, Subsea Systems Engineering Integration			09121-3300-05	DW3303: Autonomous Inspection Of Subsea Facilities	10121-4903-02	Autonomous Underwater Inspection Using a 3D Laser		
						09121-3300-08	DW3305: 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	10121-4306-02	All Electric Subsea Autonomous High Integrity Pressure Protection System (HIPPS) Architecture		
								4305	Subsea Water Quality Management Sensors		

		2007		2008		2009		2010		2011	
NEED	INITIATIVE	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description
NEED 4: Dry Trees / Direct Well Intervention and Risers in 10,000' WD	Riser Systems	07121-1401	DW1401, Composite Riser for Ultra Deepwater High Pressure Wells	08121-2301-03	DW2301, Deepwater Riserless Intervention System (RIS)			10121-4401-02	Ultra-Deepwater Riser Concepts for High Motion Vessels	5401	Carbon-fiber Reinforced Riser for Dry Tree Drilling of High-Pressure Wells (contd 1401)
		07121-1403	DW1403, Fatigue Performance of High Strength Riser Materials in Sour Environments					10121-4402-01	Qualification of Flexible Fiber-Reinforced Pipe for 10,000-Foot Water Depths	5402	Riser Lifecycle Monitoring System for Integrity Management
								10121-4402-02	Qualification of Flexible Fiber-Reinforced Pipe for 10,000-Foot Water Depths		
								10121-4403-01	Full Scale Testing of Threaded & Coupled Top Tension Riser Connectors in Air, Brine and H2S		
	Dry Tree Structures	07121-1402a	DW1402, 07121-1402a, Ultra Deepwater Dry Tree System for Drilling and Production					4901	Early Production system (EPS) Front End Engineering Design (FEED) and Critical Component Prototype Design	5404	VIM Study for Deep Draft Column Stabilized Floaters
		07121-1402b	DW1402,Ultra Deepwater Dry Tree System for Drilling and Production					10121-4404-03	Low Cost Flexible Production System for Remote Ultra-Deepwater Gulf of Mexico Field Development		
								4405 #1	Ultra-deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico, Phase 2		
								4405 #2	Ultra-deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico, Phase 2		
								10121-4406-01	Effects of Fiber Rope - Seabed Contact on Subsequent Rope Integrity		
								10121-4407-01	Deepwater Direct Offloading Systems, Phase 1		

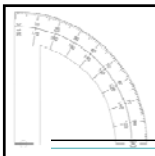
37

		2007		2008		2009		2010		2011	
NEED	INITIATIVE	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description
NEED 5: Continuous Improvement / Optimize Field Development	Long Term Research and Development and Graduate Student Program	07121-1603a	DW1603, Flow Phenomena in Jumpers-Relation to Hydrate Plugging Risk	08121-2902-02	DW2902, Technologies of the Future for Pipeline Monitoring and Inspection						
		07121-1603b	DW1603, Hydrate Characterization & Dissociation Strategies	08121-2902-07	DW2902, Fiber Containing Sweep Fluids for Ultra Deepwater Drilling Applications						
		07121-1603c	DW1603, Design investigation of extreme high pressure, high temperature, (XHPHT), subsurface safety valves (SSSV)								
	Sensors, tools and Inspection Processes	07121-1603d	DW1603, Robotic MFL Sensor for Monitoring and Inspection of Deepwater Risers	08121-2201-02	DW2201, Heavy Viscous Oil PVT						
				08121-2902-03	DW2902, Wireless Subsea Communications						
	Bridging and Contingency			08121-2902-04	DW2902, Replacing Chemical Biocides with Targeted Bacteriophages in Deepwater Pipelines and Reservoirs						
				08121-2902-06	DW2902, Enumerating Bacteria in Deepwater Pipelines in Real-Time at a Negligible Marginal Cost Per Analysis: A Proof of Concept Study						

38

		2007		2008		2009		2010		2011	
NEED	INITIATIVE	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description	Project #	Title / Description
NEED 6: Associated Safety and Environmental Concerns	Environmental Issues			08121-2801-02	DW2801, GOMEX 3-D Operational Ocean Forecast System Pilot Project	09121-3100-01	DW3101: Ultra Deep Water Seabed Discharge of Produced Water and/or Solids			5103	Autonomous Environmental Monitoring and Disaster Response for Deepwater Fields
										5201	Obstruction Remediation without the Ballistic Plug Effect
										5104	Oil spill response (non-chemical) biotechnologies in subsea dispersion
	Metocean	07121-1801	DW1801, Effect of Global Warming on North Atlantic Hurricane Activity					10121-4801-01	Hurricane Risk to Gulf of Mexico Energy Infrastructure	5801	Quantifying Key Environmental Forces in Ultradeep Water
								1-121-4802-01	Future hurricanes (contd 1801 Phase 2)		
	Safety Issues			08121-2101-02	DW2101, New Safety Barrier Testing Methods			10121-4204-01	Corrosion and Scale at Extreme Temperature and Pressure	5101	Human Factors Evaluation of Deepwater Drilling, including Literature Review
										5102	Evaluating potential for biological impacts of sub-sea dispersant injection
										5901	Best Practice frame work for analyzing, documenting, and managing compliance of pressure relief systems for offshore facility

39



Contents

- UDW Program
- Results
- Technology Transfer
- 2010 UDW Program
- 2011 UDW Program
- 2012 Draft Annual Plan

2012 Solicitations: Recommended 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.***
9. ***Continued research and technology development and demonstration of certain previously identified concepts and needs.***

Secure Energy for America

Mission Needs – Goal Topics Matrix

GOAL TOPICS	1 Improved intervention techniques to regain well control in ultra-deepwater	2 Improved casing and cementing design 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 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 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 and recovery methods which results in lower dependence on new field developments and new wells ...	9 Continued research and technology development of certain previously identified concepts and needs.
MISSION NEEDS									
1 Drilling, Completion, and Intervention Breakthroughs	■	■				■			■
2 Appraisal and Development Geoscience and Reservoir Engineering						■		■	■
3 Significantly Extend Subsea Tieback Distances / Surface Host Elimination			■	■	■	■	■		■
4 Dry Trees / Direct Well Intervention in 10,000' Water Depths	■					■			■
5 Continuous Improvement / Innovation	■	■	■	■	■	■	■	■	■
6 Associated Safety and Environmental Concerns	■	■	■	■	■	■	■	■	■

Secure Energy for America

Mission Needs – Goal Topics Matrix 2007 – 2010

	GOAL TOPICS	Improved intervention techniques to regain well control in ultra-deepwater.	Improved casing and cementing design for ultra-deepwater wells.	Improved subsea ultra-deepwater measurement and monitoring instrumentation.	Improvement of flow assurance, expediting the completion of well control efforts, and reducing the risk of environmental impacts from hydrate plugging related ruptures during producing operations.	Increased 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 drilling and production activity, to include modeling and evaluation of industry systems, based on newly developed technologies.	Research on sensors, instrumentation, command electronics, and advanced data interpretation technologies.	Improved reservoir characterization & recovery methods to results in lower dependence on new field developments & new wells, reducing the physical & environmental footprint, & dependency on foreign sources of oil.	Continued research and technology development of certain previously identified concepts and needs.
	MISSION NEEDS									
1	Drilling, Completion, and Intervention Breakthroughs	1	4					2		1
2	Appraisal and Development Geoscience and Reservoir Engineering								6	1
3	Significantly Extend Subsea Tieback Distances / Surface Host Elimination	2		3	2			6		1
4	Dry Trees / Direct Well Intervention in 10,000' Water Depths	1	3				4			1
5	Continuous Improvement / Innovation		1	2	2	2	2	1		
6	Associated Safety and Environmental Concerns	1	4	2	1	1	8	2		6

Secure Energy for America

Mission Needs – Goal Topics Matrix 2007 – 2011

	GOAL TOPICS	1 Improved intervention techniques to regain well control in ultra-deepwater.	2 Improved casing and cementing design 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 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 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 & recovery methods to results in lower dependence on new field developments & new wells, reducing the physical & environmental footprint, & dependency on foreign sources of oil.	9 Continued research and technology development of certain previously identified concepts and needs.
	MISSION NEEDS									
1	Drilling, Completion, and Intervention Breakthroughs	1	4				0 -> 1	2 -> 3		1
2	Appraisal and Development Geoscience and Reservoir Engineering							0 -> 1	6	1 -> 2
3	Significantly Extend Subsea Tieback Distances / Surface Host Elimination	2		3	2 -> 3			6		1 -> 2
4	Dry Trees / Direct Well Intervention in 10,000' Water Depths	1	3				4	1		1 -> 3
5	Continuous Improvement / Innovation		1	2	2	2	2	1		
6	Associated Safety and Environmental Concerns	1 -> 2	4	2	1 -> 2	1	8	2		6 -> 7

Secure Energy for America

Anticipated 2012 Awards

- Between $0 and $45 million available.
  - Depends on 2010, 2011 Selection approvals & contracting success
  - Depends on Phase 2+ approvals for 2009 – 2011 projects
- Expected project count = 3 - 5 multi-project awards & 2 - 4 continuation projects.
  - $1 – 5 million each
- Project duration = 1 – 1.5 years.
- Stage-gate approach to funding.
  - Decision points for additional funding not likely
  - Program close-out date of fiscal year 2014
  - Schedule additional phases in case Program is extended

Ongoing Activities

- Technical Transfer
  - TAC Meetings, OTC, Booth presentations, Website, Journals & Magazines
- Administration of current contracts
- Solicitation of new proposals
  - To solicit with other organizations
- Planning for the following year(s)
- Specifics:
  - Develop and release RFPs
  - Select, negotiate, and award subcontracts
  - Perform project management functions for current contracts and for future award

UDW Results & Accomplishments

James M. Pappas
jpappas@rpsea.org
(281) 690-5511

UDAC Meeting
Hilton Houston North
DaVinci Room
Houston, TX
January 19, 2012

Secure Energy for America