U.S. Department of
ENERGY

2011 Annual Plan

Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program

Report to Congress
August 2011

United States Department of Energy
Washington, DC 20585

Message from the Secretary

As we take steps to create the clean energy economy of the future, prudent development of domestic oil and natural gas resources will continue to be part of our Nation's overall strategy for energy security for decades to come. These operations have to be conducted responsibly, ensuring that communities are safe and that the environment is protected.

As industry tackles the challenge of developing an increasingly difficult reserve base – in ultra-deepwater offshore and unconventional plays onshore – we must ensure through scientific assessment of the risks, potential impacts, and adequacy of current response and mitigation technologies that the ability to quantify the risks of new technologies keeps pace.

This report addresses the requirements of the Energy Policy Act of 2005 (Public Law 109-58) (EPACT) to implement a research program pursuant to an annual plan that is focused on ultra-deepwater, unconventional natural gas, and the technology challenges faced by small producers. In this Annual Plan, I am refocusing the program on quantifying potential safety and environmental risks, and on developing the technologies to counter them.

Recommendations, analyses, and ongoing initiatives underpinning the *2011 Annual Plan* are:

- The *2011 Draft Annual Plan*, prepared by the Program Consortium, Research Partnership to Secure Energy for America (RPSEA), July 2010
- Final report of findings and recommendations prepared by the Department of Energy Unconventional Resources Technology Advisory Committee (URTAC), October 2010
- *Deepwater: The Gulf Oil Disaster and the Future of Offshore Drilling*, Report to the President, National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, January 2011
- *Blueprint for a Secure Energy Future*, The White House, Washington, March 30, 2011
- Final report of findings and recommendations prepared by the Department of Energy Ultra-Deepwater Advisory Committee, April 2011
- Department of the Interior Ocean Energy Safety Committee, Meeting Summary, April 2011
- Department of Energy *Strategic Plan*, May 2011

Pursuant to statutory requirements, this report is being provided to the following Members of Congress:

- **The Honorable John Boehner**
  Speaker, House of Representatives

- **The Honorable Joseph R. Biden, Jr.**
  President of the Senate

- **The Honorable Fred Upton**
  Chairman, Committee on Energy and Commerce

- **The Honorable Henry A. Waxman**
  Ranking Member, Committee on Energy and Commerce

- **The Honorable Jeff Bingaman**
  Chairman, Committee on Energy and Natural Resources

- **The Honorable Lisa Murkowski**
  Ranking Member, Committee on Energy and Natural Resources

If you need additional information, please contact me or Mr. Jeff Lane, Assistant Secretary, Office of Congressional and Intergovernmental Affairs, at (202) 586-5450.

Sincerely,

Steven Chu

Executive Summary

As the Nation transitions to the clean energy economy of the future, we must also ensure that we effectively mitigate the risks of our current energy portfolio.[1]

This *2011 Annual Plan*, the fifth such plan to be produced since the launch of the *Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research Program*, reflects an important shift in priorities towards safety and environmental sustainability. This shift is based on the recognition that a critical element in prudently developing our domestic resource base is a scientific assessment of the risks which exploration and production activities entail, and the development of appropriate technologies and processes to mitigate these risks.

Domestic deepwater and ultra-deepwater oil and gas resources, and domestic unconventional natural gas resources, are important contributors to our Nation's energy supply portfolio. Recent events, the *Macondo* well blowout and the *Deepwater Horizon* explosion in the Gulf of Mexico, and growing public opposition to the rapid pace of shale gas development onshore are stark reminders of the environmental risks of our current energy portfolio. The *2011 Annual Plan* proposes scientific research that will quantify and mitigate risks associated with oil and gas exploration and production onshore and offshore, thereby improving safety and minimizing environmental impacts.

The Department will ensure that the federal government's understanding of the risks associated with these operations keeps pace. This will be accomplished through scientific assessment of the risks, potential impacts, and adequacy of current response and mitigation technologies.[2]

The research discussed in this Annual Report will be administered by the Research Partnership to Secure Energy for America (RPSEA), which operates under the guidance of the Secretary of Energy. RPSEA is a consortium which includes representatives from industry, academia and research institutions. RPSEA's expertise in all areas of the exploration and production value chain ensure that the Department of Energy's research program has access to relevant emerging technologies and processes, and that projects are designed in a way that have a direct impact on practices in the field.

[1] U.S. Department of Energy, (2011). *Strategic plan* (DOE/CF-0067). Retrieved from http://energy.gov/media/DOE_StrategicPlan.pdf
[2] *Ibid*

2011 ANNUAL PLAN

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I. Legislative Language

This report responds to specific subsections of the legislative language set forth in **Title IX, Subtitle J, Section 999B and Section 999D of the Energy Policy Act of 2005 (EPAct)**, wherein it is stated:

SEC. 999B(e) ***ANNUAL PLAN***

(1) **IN GENERAL.--**The program under this section shall be carried out pursuant to an annual plan prepared by the Secretary in accordance with paragraph (2).

(2) **DEVELOPMENT.--**

(A) **SOLICITATION OF RECOMMENDATIONS.--**Before drafting an annual plan under this subsection, the Secretary shall solicit specific written recommendations from the program consortium for each element to be addressed in the plan, including those described in paragraph (4). The program consortium shall submit its recommendations in the form of a draft annual plan.

(B) **SUBMISSION OF RECOMMENDATIONS; OTHER COMMENT.--**The Secretary shall submit the recommendations of the program consortium under subparagraph (A) to the Ultra-Deepwater Advisory Committee established under section 999D(a) and to the Unconventional Resources Technology Advisory Committee established under section 999D(b), and such Advisory Committees shall provide to the Secretary written comments by a date determined by the Secretary. The Secretary may also solicit comments from any other experts.

(C) **CONSULTATION.--**The Secretary shall consult regularly with the program consortium throughout the preparation of the annual plan.

(3) **PUBLICATION.--**The Secretary shall transmit to Congress and publish in the Federal Register the annual plan, along with any written comments received under paragraph (2)(A) and (B).

(4) **CONTENTS.--**The annual plan shall describe the ongoing and prospective activities of the program under this section and shall include--

(A) a list of any solicitations for awards to carry out research, development, demonstration, or commercial application activities, including the topics for such work, who would be eligible to apply, selection criteria, and the duration of awards; and

(B) a description of the activities expected of the program consortium to carry out subsection (f)(3).

SEC. 999D. ADVISORY COMMITTEES

(a) *Ultra-Deepwater Advisory Committee*

(1) ESTABLISHMENT.--Not later than 270 days after the date of enactment of this Act, the Secretary shall establish an advisory committee to be known as the Ultra-Deepwater Advisory Committee.

(3) DUTIES.--The Advisory Committee under this subsection shall

(A) advise the Secretary on the development and implementation of programs under this subtitle related to ultra-deep water natural gas and other petroleum resources; and

(B) carry out section 999B(e)(2)(B).

(b) *Unconventional Resources Technology Advisory Committee*

(1) ESTABLISHMENT.--Not later than 270 days after the date of enactment of this Act, the Secretary shall establish an advisory committee to be known as the Unconventional Resources Technology Advisory Committee.

(3) DUTIES.--The Advisory Committee under this subsection shall

(A) advise the Secretary on the development and implementation of activities under this subtitle related to unconventional natural gas and other petroleum resources; and

(B) carry out section 999B(e)(2)(B).

II. Goals and Objectives

The Department of Energy is committed to taking bold steps to move our Nation towards a more environmentally sustainable energy supply portfolio. But even as we develop next generation energy technologies, we will continue to rely on oil and gas.[3] The Department of Energy will ensure that the Federal government understands the risks associated with ultra-deepwater operations offshore and unconventional gas onshore keeps pace.

Ultra-deepwater production is an increasingly important contributor to global oil production

The global oil and natural gas industry has responded to growth in international energy demand by developing new technologies for finding and producing oil and natural gas from deposits that are increasingly more technically challenging to develop, including those found in the deeper water areas along continental shelves. From 2006 to 2009, annual worldwide ultra-deepwater (defined as 1,500 meters or more water depth[4]) hydrocarbon discoveries accounted for roughly half of all discoveries—onshore and offshore (Figure 1.1).[5]

In the U.S., overall offshore Gulf of Mexico (GOM) production accounted for 30 percent of U.S. crude oil production in 2009.[6] Most of the production increase was due to new production from five fields (Tahiti, Dorado, King South, Thunder Hawk, and Atlantis North Flank). Offshore GOM natural gas production recorded a 3 percent increase in 2009 over 2008—the first increase after seven years of substantial declines—due to the start-up of the ultra-deepwater *Independence Hub* with its 1 billion cubic feet per day of capacity.

Figure 1.2 highlights the projected deepwater GOM production (total oil plus oil equivalent of natural gas) based on announced discoveries and expected discoveries.[7] This plot shows the contribution that the deepwater GOM is projected to make to domestic energy production over the next decade.

Growing demand combined with the continued decline of mature domestic onshore oilfields will mean that the deepwater GOM will remain a key contributor to America's supply of oil for the foreseeable future. Worldwide, ultra-deepwater oil and gas production is becoming an increasingly important element of the global energy portfolio.

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[3] The White House, (2011). *Blueprint for a Secure Energy Future* Washington, DC: Retrieved from http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf

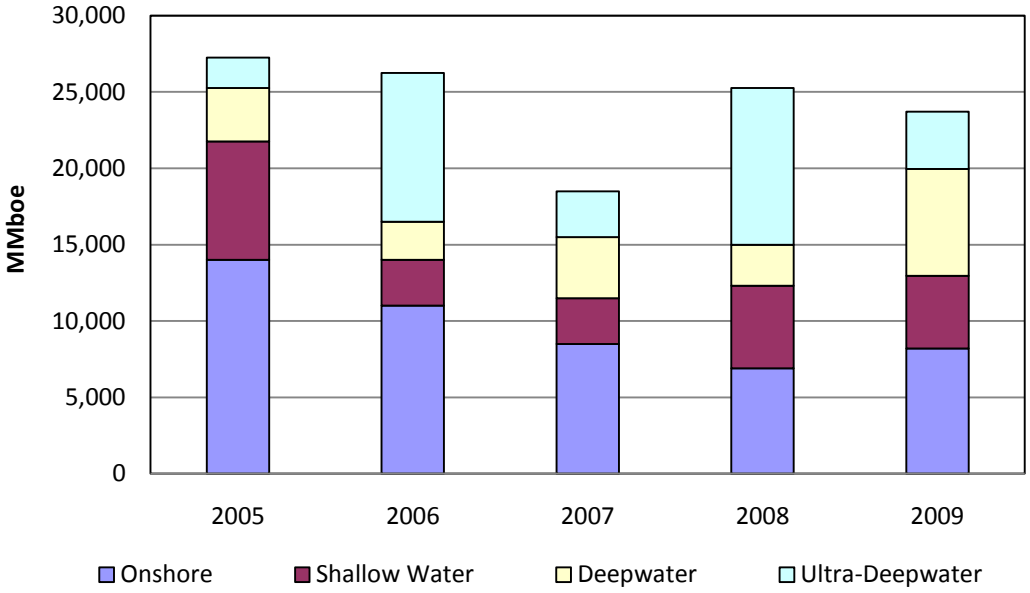
[4] Section 999G (8) of EPACT 2005.

[5] Chakhmakhchev, A. and P. Rushworth, 2010, "Global overview of offshore oil & gas operations for 2005-2009," *Offshore*, May 1.

[6] EIA, *Annual Energy Outlook 2011*

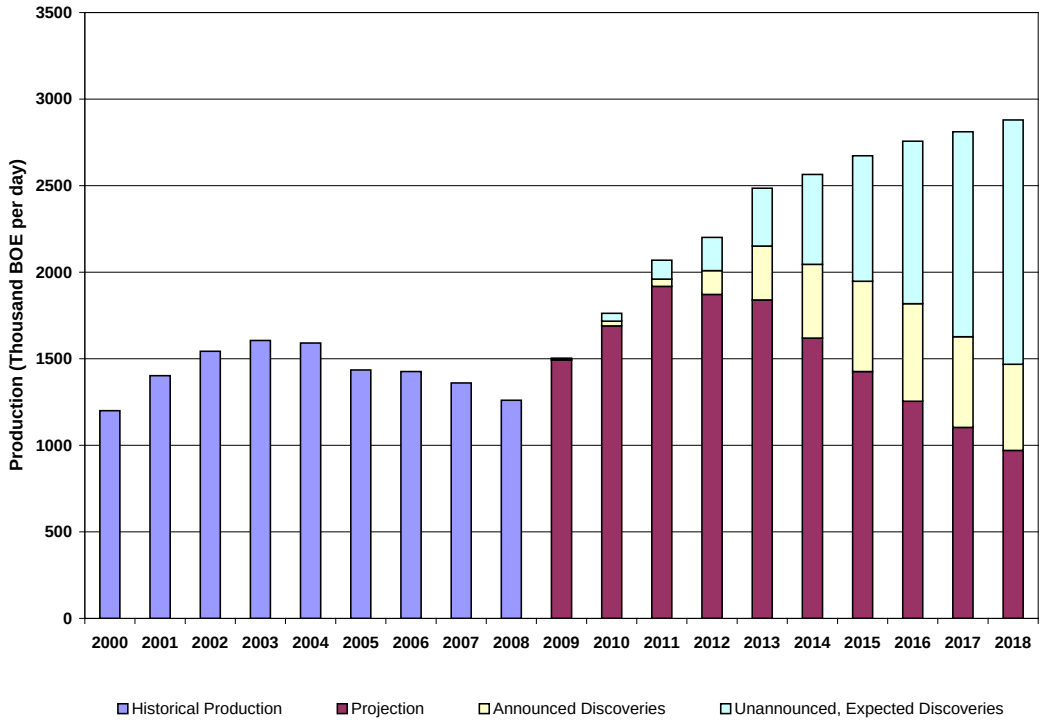
[7] MMS, 2009, Gulf of Mexico Oil and Gas Production Forecast: 2009 – 2018, MMS Report MMS 2009-012, May 2009, Tables 2 and 3.

Figure 1.1: Global oil and gas discovery volumes by terrain



Source: Chakhmakhchev & Rushworth, 2010

Figure 1.2: Projected deepwater production[8]



Source: MMS, 2009

[8] The MMS, 2009 report does not distinguish between deepwater and ultra-deepwater production.

Technological advances related to preventing and mitigating environmental impacts have lagged

The explosion of the *Deepwater Horizon* in the Gulf of Mexico is a stark reminder of the risks associated with operating in deeper water environments. Industry has had impressive success in innovating new technologies to find, develop and commercialize oil and gas in the ultra-deepwater, but additional work remains to be done to increase certainty and confidence that shoreline communities are protected, offshore workers are safe, and the integrity of the environment is maintained.

In May of 2010, President Obama created the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling to determine the root causes of the explosion and the subsequent spill. The Report to the President issued by the Commission highlighted the degree to which technological advances in the prevention and mitigation of environmental impacts have not kept pace with advances focused on commercializing oil and natural gas offshore. That report recommended that this research program be refocused on safety.[9]

Continued development of offshore resources will require the assessment of risks, the evaluation of technologies and processes to anticipate and mitigate accidents, and the ongoing evaluation of new innovations pursued by operators.

Given the growing importance of ultra-deepwater production worldwide, it is imperative that U.S. producers and technology developers maintain a focus on technologies that can help to minimize environmental impacts as companies move into deeper and deeper water around the globe. Domestic oil production will continue to play an important role in our Nation's energy security, but it must be done responsibly for the safety of our workers and our environment.

Natural gas from shale formations is an increasingly important part of U.S. energy supply

Over the past decade, it has become increasingly clear that natural gas produced from shale formations (shale gas) —has the potential to add hundreds of trillions of cubic feet (tcf) of gas resource previously considered technically unavailable to the domestic energy supply. Advances in horizontal drilling and hydraulic fracturing are largely responsible for this evolution.

The Energy Information Administration (EIA) projects that shale gas production will grow from just over 13 percent of total Lower 48 onshore dry gas production in 2009, to 28 percent by 2020 and 35 percent by 2035.[10] This growth in domestic natural gas supply will help to displace higher carbon oil and coal for heating and power generation, help support the growth of variable renewable sources like wind and solar, and reduce our Nation's reliance on energy imports.

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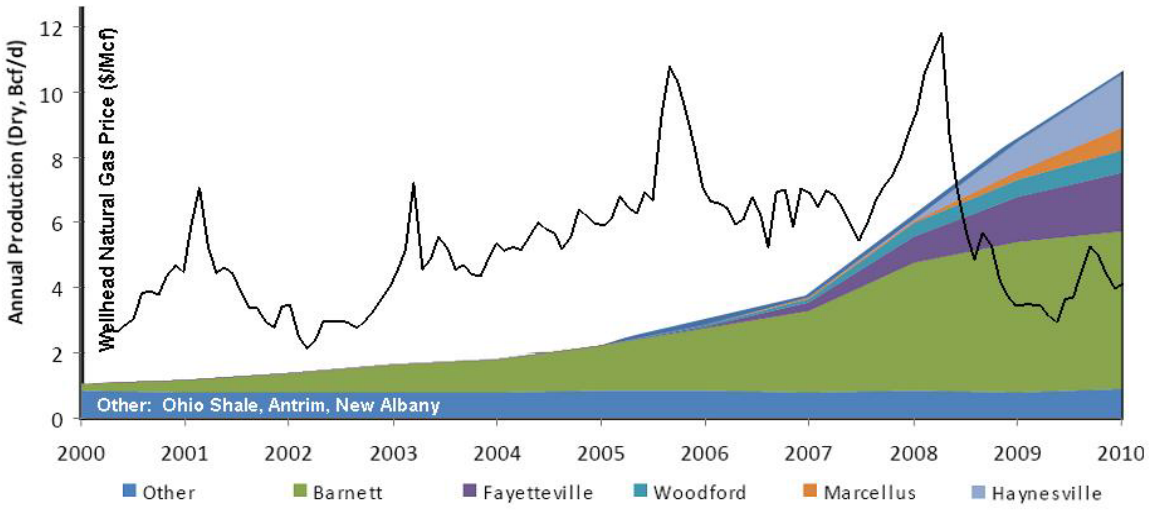
[9] National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, p. 254, (2010). *Commission Charter,* Retrieved from http://www.oilspillcommission.gov/sites/default/files/documents/osc_charter.pdf

[10] EIA, Annual Energy Outlook 2010, Reference Case, Table 14: Oil and Gas Supply, Retrieved from http://www.eia.doe.gov/oiaf/aeo/aeoref_tab.html

Figure 1.3 shows the increase in shale gas production over the past decade. This has started to have an impact on reducing the cost that American consumers pay for natural gas. The EIA has determined that natural gas prices would climb to more than $10 per million British Thermal Units (mmBtu) by 2035 should the development of shale gas resources be delayed or stopped (versus $7.62 per mmBtu in the high development case).[11] Also, a number of independent economic assessments have estimated the potentially significant positive regional impact on state revenues and employment as a result of shale gas development.[12]

Figure 1.3: Growth in U.S. shale gas production 2000-2010



Source: EIA, 2010

Growing community concerns related to the impacts of shale gas drilling should be addressed

The advent of shale gas play development also brings with it a host of safety and environmental issues. Among the issues that should be addressed are: demand for water for use in fracturing; protection of drinking water aquifers during hydraulic fracturing; evaluation of the safety of chemicals used in hydraulic fracturing; environmental impacts resulting from the treatment and/or disposal of produced or fracturing flowback water; air quality impacts resulting from increased drilling, natural gas production, and truck transportation activity; and community safety issues surrounding high pressure fracturing operations in populated areas.

[11] EIA, Annual Energy Outlook 2010, Sensitivity Case, available online at http://www.eia.doe.gov/neic/press/press340.html

[12] Considine, T. J., *et al*., 2020, *The Economic Impacts of the Pennsylvania Marcellus Shale Natural Gas Play: An Update*, The Pennsylvania State University, May 24.

These issues must be addressed in ways that build the confidence of the public. This will require the scientific assessment of risks, the evaluation of existing environmental impact mitigation methodologies and technologies, and the development and testing of novel concepts based on these assessments and the new data and insights that are being generated during the rapid development of multiple shale plays across the U.S.

The Department of Energy, along with the Environmental Protection Agency, is charged with conducting research on shale gas and with providing technical assistance to the States.[13] The research conducted in accordance with the 2011 Annual Plan will assist the Department in accomplishing this mission.

[13] The White House, (2011). *Blueprint for a Secure Energy Future* Washington, DC: Retrieved from http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf

III. Background

Offshore and onshore research activities are administered pursuant to an annual plan in compliance with Title IX, Subtitle J of EPACT, which directs that $50 million per year of federal royalties, rents and bonus payments be used to fund an oil and natural gas research and development (R&D) effort, the *Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research Program* (Program).

The Secretary of Energy approves all awards to research performers, and the planned R&D activities support the goals and objectives of the annual plan. The research activities are administered by a Program Consortium that has been selected by the Secretary, as detailed in the Program Consortium section below.

The National Energy Technology Laboratory (NETL) is responsible for implementation of the Program. Within NETL, the responsibility for overall program implementation, including oversight of the Program Consortium contract, has been assigned to the Strategic Center for Natural Gas and Oil.

Complementary research prescribed under Section 999A(d) is carried out by NETL's Office of Research and Development.

Program Consortium

In 2006, DOE selected the Research Partnership to Secure Energy for America (RPSEA) through a competitive solicitation to serve as the Program Consortium and administer the research activities pursuant to Section999B(c).

RPSEA has a broad membership base that includes representatives from all levels and sectors of both the oil and natural gas exploration and production (E&P) and oil and natural gas R&D communities. The breadth of membership helps to ensure that R&D funds leverage existing industry efforts in accomplishing the Program's objectives.

Administration funds provided to RPSEA cannot exceed 10 percent pursuant to Section 999G(3). The private companies, universities, and other organizations that are awarded contracts through this program provide cost-share contributions of at least 20 percent.

The Annual Plan Development Process

Pursuant to Section 999B(e)(2)(A), the Program Consortium prepared its *2011 Draft Annual Plan* (DAP) which it delivered to the Secretary July 2010. The Department of Energy prepared a *Draft 2011 Annual Plan*. Subsequently, the *Draft 2011 Annual Plan* and the DAP[14] were reviewed by the Unconventional Resources Technology Advisory Committee (URTAC) which presented its final report of findings and recommendations in October 2010.

[14] pursuant to Section 999B(e)(2)(B)

On February 2, 2011, the Secretary of Energy appointed new members to his Ultra-Deepwater Advisory Committee (UDAC), and met with the members on February 23, 2011 to discuss his goals for offshore research and development. Before presenting its final report of findings and recommendations to the Secretary in April 2011, the UDAC established a Subcommittee on Risk Assessment.

The Department of Energy will be continually informed by the UDAC based on the work of its Subcommittee on Risk. In addition, other Federal advisory bodies will help inform the Department. These include the SEAB which established a Subcommittee on Natural Gas, and the Department of the Interior's Ocean Energy Safety Committee (OESC) which has established four subcommittees including the Spill Prevention Subcommittee, and the Containment Subcommittee. The Department of Energy is a member of the OESC. The Department will take new information into account in the preparation of solicitations and the selection of research projects for the 2011 portfolio.

IV. Research Activities

Pursuant to Title IX, Subtitle J of EPACT, Sections 999A(a) and (b), the Secretary will direct a program of research, development, demonstration, and commercialization in an environmentally sustainable manner focused on:

- Ultra-deepwater architecture and technology, including drilling to formations in the Outer Continental Shelf at depths greater than 15,000 feet,
- Unconventional natural gas and other petroleum resource exploration and production technology, and
- The technology challenges of small producers.

Ultra-Deepwater Program

Program Goal

The goal of Ultra-Deepwater Program (UDW) is to ensure that the understanding of the risks associated with ultra-deepwater operations keeps pace with the technologies that industry has developed to tap reserves in increasingly challenging conditions.[15] UDW will assess and mitigate the risk in offshore production activities related to controls, safeguards, and environmental impact mitigation procedures in place during drilling and production operations.[16]

Research topics will be informed by the work of the UDAC Subcommittee on Risk Assessment and are expected to include: development of improved well control and wild well intervention techniques; evaluation of appropriate safeguards for BOPs, cementing and casing; evaluation of instrumentation and monitoring; improvement of flow assurance; expediting the completion of relief wells, and other topics associated with ultra-deepwater operations.

Implementation Plan

The Program Consortium will administer the UDW portfolio, and will work with its network of private sector experts to develop solicitations for additional R&D projects.

[15] *The Department will ensure that the federal government's understanding of the risks associated with these operations keeps pace. This will be accomplished through scientific assessment of the risks, potential impacts, and adequacy of current response and mitigation technologies.* Secretary Steven Chu, U.S. Department of Energy, Strategic Plan, May 2011

[16] *I continue to believe that domestic oil production is an important part of our overall strategy for energy security, but I've always said it must be done responsibly for the safety of our workers and our environment.* President Obama, April 30, 2010

2011 Solicitations

Upon transmittal of the *2011 Annual Plan* to Congress, the 2011 requests for proposals (RFPs) will be developed by the Program Consortium and submitted to the Secretary for approval.

For the 2011 portfolio, the process of informing stakeholders about pending solicitations will be expanded to increase the engagement of other groups such as Society of Petroleum Engineers, American Petroleum Institute, National Academies, other professional organizations, environmental groups, regulatory organizations, and marine well containment companies.[17] To broaden the solicitation audience, DOE will consider options for establishing a forum for environmental and safety analysis to capture lessons learned and best practices.

The list of planned solicitations for the 2011 UDW research portfolio is presented below. In its preparation of the actual 2011 UDW solicitations, the Department will be influenced and informed in large part by the UDAC stemming from the work of its Subcommittee on Risk Assessment, and advice to the Department of the Interior from its OESC stemming from its subcommittees on oil spill prevention and containment. Quantification and assessment of risk will be an integral part of the entire research program. Therefore, the actual 2011 research portfolio may be different.

The planned topics for the solicitations leading to the 2011 portfolio may include:

- *Improved intervention techniques for regaining loss of well control in ultra-deepwater*

Conduct research on techniques for regaining control of wells in ultra-deepwater [>5,000' water depth], to include: establishing the current technology baseline, establishing the range of conditions that can exist in ultra-deepwater reservoirs, quantifying the risks associated with the identified range of conditions, evaluation of the suitability of existing technology to address possible emergency conditions that could be encountered in the range of conditions in these reservoirs, evaluation of technologies developed or in the process of being developed by ongoing private sector well containment consortia under varying reservoir conditions at various depths of water greater than 5,000 feet, development of new techniques and technologies for regaining control of wells in various depths of water greater than 5,000 feet, and development of specific safety procedures and practices unique to the range of reservoir conditions in depths of water greater than 5,000 feet.

- *Improved casing and cementing design for ultra-deepwater wells*

Casing Characterize and describe the full range of sea and subsea conditions possible during the drilling of ultra-deepwater. Describe the current industry practices for casing and cementing designs and develop a comprehensive suite of failure scenarios. Quantify the risk of loss of well control for each scenario. Identify, characterize, and describe the technical specifications for the range of

[17] *The solicitation process should be expanded to increase the engagement of other groups not being addressed in the current program. For example: Society of Petroleum Engineers, American Petroleum Institute, National Academies and other professional organizations, regulatory forums, and marine well containment companies.* Ultra-Deepwater Advisory Committee, *Comments, Findings, and Recommendation*s, April 2010

improvements that will minimize the risk of loss of well control in each scenario. Articulate the qualities of novel alternatives that comprise competent cement barriers to flow (e.g., reverse circulation primary cementing).

Cementing Investigate, characterize, and describe the physical and chemical behavior of typical wellbore cements used in ultra-deepwater [>5000' water depth] completions. Describe how these cement formulations perform during setting and post-setting (including over the long-term), with a particular emphasis on identifying potential failure pathways (such as interfaces).

- *Improved measurement and monitoring instrumentation for subsea operations in ultra-deepwater*

Conduct research to identify, characterize, and quantify risks associated with drilling, completing, and operating in various ultra-deepwater environments leading to the development of improved measuring instruments in the well and/or at the wellhead (subsea or dry tree) to determine the nature of the well fluids, temperatures, pressures, and their flow status in real time, as well as status of blowout preventer (BOP) functions (valves or rams open or closed) accumulator pressure, and battery status. Identify and characterize the need for and role of remote sensing and surveillance equipment and vehicles under various operating scenarios including failure scenarios, including technology specifications leading to the development of autonomous underwater vehicles (AUVs) or other technology that can independently access seafloor information and transmit it to the surface uninterrupted, twenty-four hours per day, seven days a week whether the original surface equipment is present or not. Identify and characterize the optimum capabilities of high resolution imaging technologies that can be used to observe subsea installations via a Long Range/High Resolution 3-D Laser Detection and Ranging sensor leading to the development of devices that can be packaged onto an AUV.

- *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.*

Develop detailed descriptions and models of ultra-deepwater conditions that can result in hydrate formation and blockage phenomena during production operations. Significantly advance the ability to predict hydrate behavior based on advanced modeling of hydrate plug formation and dissociation in natural gas dominated systems. Modify and validate existing models, carry out flow loop and other experiments to support the model validation, and use the improved models to predict behavior of water+gas and water+gas+oil systems under a wide range of extreme ultra-deepwater pressure, temperature and equipment architecture conditions.

- *Increase understanding of complex fluid phase behaviors that occur under conditions of extreme pressure and temperature, and develop advanced models of hydrocarbon behavior under these conditions*

Develop an improved understanding of complex pressure-volume-temperature (PVT) relationships for mixtures of flowing fluids (water, gas and oil) under extreme temperatures and pressures (>19,000 psia bottomhole pressures and >250 degrees F). Study variations in behavior when these fluids include brine, hydrogen sulfide, and carbon dioxide. Conduct experimental and theoretical studies to predict the behavior of petroleum liquids under the high pressure and temperature conditions encountered at great water and formation depths. Hydrocarbon density and viscosity at temperatures ranging from 50 to 250°C, and pressures up to 280 MPa will be measured experimentally. Develop and validate advanced models for both of these important fluid properties.

- *Evaluation of the range of failure states under which BOPs must perform*

Characterize a robust set of failure modes under which BOPs may need to perform. Calculate the probability of each failure mode occurring in ultra-deepwater conditions (for example, at high flow rates indicative of an uncontrolled well in an ultra-deepwater environment). Identify, characterize, and articulate technical specifications leading to the development of BOP instrumentation that can be replaceable by remotely operated vehicles or AUVs as needed during use.

- *Research on sensors, instrumentation, command electronics, and advanced data interpretation technologies*

Develop design subsea water quality monitoring sensors that may be used to measure the quality of produced water separated at the seafloor. Develop improved failsafe systems, and controls, for subsea production equipment. Identify, characterize, and quantify risks associated with the installation and operations of long flowline tie-backs that stretch from subsea wells to host platform. Develop long flowline tie-backs that incorporate a high integrity pressure protection system with isolation valves that are hydraulically operated with a failsafe position and with multiple sensors that can be employed with the hardware to make shutdown decisions topsides.
Identify, characterize, and quantify the limits under which the above system can be maintained in optimum modes. Identify, characterize, and quantify the limits under which currently existing subsea electrical connection technologies can be maintained in optimum operating modes. Develop technologies that will improve both the failsafe integrity and reliability of electrical connectors and penetrators in ultra-deepwater architecture and technology. Investigate the integrity and reliability of current connectors and penetrators by quantifying the risk associated with the overall integrity of the well pressure barriers, and with the reliability of these wet connector systems in ultra-deepwater architecture and technology.

- *Improve understanding of the potential for environmental impacts in frontier ultra-deepwater areas where a well-established infrastructure for spill containment does not exist (e.g., the Alaskan Arctic offshore and the Eastern Gulf of Mexico (near Cuba).*

Identify, characterize, and quantify the risks of environmental impacts associated with ultra-deepwater drilling and production activity offshore Arctic Alaska and far eastern Gulf of Mexico. Identify the number and performance capabilities of response systems, and equipment. Characterize the technical capabilities in these areas, and quantify any deficiencies. Quantitatively evaluate key attributes of reservoirs in the ultra-deepwater Gulf of Mexico to estimate potential risks prior to development, and to conduct rapid predictions in the case of an emergency event. This effort includes capturing geospatial variability in key attributes such as changes in reservoir thicknesses, structural complexities (e.g. fractures, faults), pore fluid composition (including distribution of gas hydrate occurrences), temperature, pressure, permeability, porosity, well density/penetrations, and completion types.

- *Assess and quantify the risks of environmental impacts from ultra-deepwater oil and gas drilling and production activity, to include modeling and evaluation of industry containment systems to develop scenario estimates of time-to-regain-well control, based on newly developed technologies.*

Identify, characterize and quantify the risks associated with exploration and production of ultra-deepwater oil and gas resources in the Gulf of Mexico leading to the development of an integrated assessment model that couples reservoir behavior to the variety of engineered components in the system (e.g., wellbore, BOP, risers, etc.). Particular emphasis will be placed on the development of surrogate models that facilitate a thorough characterization of uncertainties associated with the reservoir properties affecting the flow rate and bottom-hole pressure dynamic within the reservoir. This includes characterization of a robust set of failure scenarios that combine this information with an assessment of variability in wellbore integrity characteristics to enable a comprehensive risk assessment of failure scenarios below the mudline as a function of various phases of operation (e.g., drilling and completion, production, and long-term post-production). Additionally, a comprehensive failure assessment of the above-mudline components will be completed.

A comprehensive risk assessment from a regional perspective to understand the impact on currently ongoing ultra-deepwater oil and gas operations resulting from sudden catastrophic naturally occurring events (for example submarine landslides and/or earthquakes) will be conducted to support the development of a logical framework for determining adequate spill clean-up and collection methods. Also included is the evaluation of applicability of Expert Systems or other decision making procedures during emergency conditions caused by these events.

Anticipated Awards for 2011

Approximately $15 million has been allocated for project awards. Cost-sharing beyond the required minimum of 20 percent will be sought. For the 2011 portfolio, a target to award three to five large projects with a value of $1 to $5 million per project has been set. Not all areas of solicitations may include actual awards. This is because proposals will be ranked and only the highest quality proposals received will be considered for award. Each project will have duration of one to three years. All awards are subject to the Secretary of Energy for final approval.

Administrative Activities

An important responsibility of the Program Consortium is the active management of all R&D projects in the UDW portfolio, as well as planning for the 2012 portfolio. The administrative milestones for the three 2011 portfolios are listed in Section V.

The first solicitations for the 2011 portfolio will be released after transmittal of the *2011 Annual Plan* to Congress, and approval by the Secretary of Energy. Each will remain open for a minimum of 60 days. The review and selection process will take about two months, and the award process will take approximately three months.

Shorter-term administrative activities conducted by the Program Consortium specific to UDW include the completion of annual milestones. As a minimum, short term administrative tasks to be completed include:

- Prepare and issue at least five RFPs for the 2011 portfolio
- Select and award three to five large projects for the 2011 portfolio
- Establish Fiscal Year (FY) 2012 R&D priorities based on results of 2007-2010 portfolios and inputs from the Program Consortium, and advice from the UDAC and other important Federal advisory bodies.
- Prepare the RPSEA *2012 Draft Annual Plan*

Summary of 2007- 2010 Activities

Appendix A is comprised of tables that list projects for all prior years. The projects are organized according to *Initiatives* that address specific needs identified in Appendix B.[18] Additional data included in the tables are: lead performer, project end date for active projects, project duration anticipated for projects pending award, project cost, and source year of funding. The solicitations for proposals for the 2010 portfolio were released March through May 2011.

Table 4.1 below summarizes the number of solicitations, selections, and awards for 2007 through 2010 made as of June 1, 2011.

Table 4.1: UDW Program Solicitations, Selections and Awards

Funding Year	Solicitations	Selections	Awards
2007	13	17	16
2008	11	14	13
2009	5	11	11
2010	6	Proposals under review	

Additional project and solicitation details are provided in Appendix B. Abstracts and project information for each of the projects can be found on the DOE website at www.netl.doe.gov/technologies/oil-gas/EPAct2005 and on the Program Consortium website at www.rpsea.org.

Unconventional Resources Program

Program Goal

The goal of Unconventional Resources Program (UCR) is to unlock the vast resources of natural gas trapped within shale deposits across the nation while recognizing that an important part of the challenge currently facing producers is public concern for safety and protection of the environment.[19] There is a need to demonstrate that the controls, safeguards, and environmental impact mitigation procedures put in place during drilling and production operations to protect America's communities and the environment are commensurate with the risks of potential environmental damage that oil and natural gas development entails.[20]

[18] In late 2010, the Program Consortium restructured its management of the UDW. The UDW program was managed by Chevron 2007 through late 2010, through a subcontract with RPSEA, utilizing the Chevron administered *DeepStar* consortium. In late 2010, this subcontract was ended.

[19] The White House, (2011). *Blueprint for a Secure Energy Future* Washington, DC: Retrieved from http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf

[20] *Ibid*

Research topics are expected to focus on: fugitive emissions management, groundwater protection, waste stream reduction and management, and produced water flowback treatment and recycling. Also, the Department will be informed by the work of the Secretary of Energy Advisory Board (SEAB) based on advice from its Subcommittee on Natural Gas.[21]

Implementation Plan

The Program Consortium will administer the UCR portfolio, and will work with its network of private sector experts[22] to develop solicitations for additional R&D projects.

2011 Solicitations

Upon transmittal of the *2011 Annual Plan* to Congress, the RFPs for the 2011 portfolio will be developed by the Program Consortium, and ultimately submitted to the Secretary of Energy for approval.[23]

For the 2011 portfolio, the process of informing stakeholders about pending solicitations will be expanded to increase the engagement of other groups such as Society of Petroleum Engineers, American Petroleum Institute, National Academies, other professional organizations, environmental groups, and regulatory organizations.[24] To broaden the solicitation audience, DOE will consider options for establishing a forum for environmental and safety analysis to capture lessons learned and best practices.

The list of planned solicitations for the 2011 portfolio is presented below. The Department will be influenced and informed in large part by the Secretary of Energy Advisory Board based on advice from its Subcommittee on Natural Gas.[25] Quantification and assessment of risk will be an integral part of the entire research program. Therefore, the actual 2011 solicitations may be different.

The planned topics for the solicitations leading to the 2011 portfolio may include:

- *Evaluate the effectiveness of current methods of protecting groundwater from contamination during shale drilling, casing and cementing and production operations*

Assess and quantify impacts on groundwater and drinking water during the drilling, casing and cementing of wells. Review current regulations and best practices, such as well control, casing, cementing, fluids, and spills associated with drilling, completion, stimulation and production operations. Develop new methods for quantifying and evaluating potential risks resulting from the

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[21] U.S. Department of Energy, Secretary of Energy Advisory Board (2010). *Advisory Board Charter,* Retrieved from http://www.energy.gov/media/SEABCharter_8-30-2010.pdf

[22] Research Partnership to Secure Energy for America (RPSEA), *2011 Draft Annual Plan*, July 2010, pg. 16-17

[23] SEC. 999B(c) (B) issue research project solicitations upon approval of the Secretary…

[24] U.S. Department of Energy, Unconventional Resources Technology Advisory Committee (2010). *Comments, Findings, and Recommendations*, retrieved from http://www.fossil.energy.gov/programs/oilgas/advisorycommittees/URTAC_2011_Recommendations.pdf

[25] U.S. Department of Energy, Secretary of Energy Advisory Board (2010). *Advisory Board Charter,* Retrieved from http://www.energy.gov/media/SEABCharter_8-30-2010.pdf

production and development of shale gas. Evaluate seal-integrity and wellbore-integrity characteristics required for protecting groundwater and the environment. Develop technologies and methodologies to mitigate these risks.

- *Improve best practices for handling and treating harmful constituents in waste streams, including naturally occurring radioactive material, and accelerate development and use of more environmentally benign additives for shale gas drilling, completion, stimulation, and production operations*

Assess and quantify contaminants in waste streams resulting from drilling and production operations and develop technologies to treat them. Accelerate the development of greener additives and enhanced best management practices for handling naturally occurring radioactive materials (NORM) and technologically enhanced NORM (NORM concentrated or exposed as a result of technological processes such as mining or waste water or sewage treatment). Characterize and quantify wastes created by processing produced water and drilling fluids and develop technologies and practices to treat them. Enhance the availability of green chemicals or additives used in shale gas development. Characterize shale gas waste water quality and compatibility with typical wastewater stream accepted by public owned waste treatment plant and develop technologies and practices to improve quality of waste water.

- *Evaluate and quantify the risks associated with propagation and communication of induced fractures with abandoned wells and/or naturally occurring fractures that may have the potential to contaminate drinking water sources*

Assess and quantify the potential impacts of hydraulic fracturing on drinking water sources by identifying and minimizing potential pathways for contamination through propagation and communication of induced fractures with abandoned wells or naturally occurring fractures. Characterize and quantify the communication pathways between induced hydraulic fractures and communication pathways to shallower depths and develop technologies and practices to address the issues.

- *Evaluate the risks and impacts of induced microseismic activity. Develop technologies and practices that decrease the frequency of micro-seismic activity in proximity to shale gas development*

Determine the nature and extent of small scale earthquakes and enhance understanding of associated impacts on communities in proximity to shale gas development. Define the main root causes and develop potential remediation technologies to reduce the occurrence of induced seismicity near populated areas.

- *Develop cost-effective water treatment technologies that reduce water usage by about 15 percent by maximizing hydraulic fracturing flowback water recycling*

Develop technologies and methodologies for handling and disposal of large volumes of flowback water, as well as water that is produced during the longer term production phase. Develop advanced technologies to improve fracturing water sourcing, handling, treatment, and disposal. Develop new technologies or refine existing technologies that will improve flowback water treatment and reuse by about 15 percent, including field experiments, pilot demonstrations of novel or pre-commercial technologies, and comprehensive operating cost assessments and comparisons. Make data from these research activities available for regulatory agencies in making informed decision on promulgating sound science-based regulations.

- *Quantification of fugitive methane emissions during shale gas development and development of technologies and best practices to reduce the emissions*

Quantify and characterize the volumes of gas vented and/or flared across the whole chain of operations during shale gas development. Characterize the practices and protocols currently followed and develop strategies for improvement. Devise testing procedures to accurately quantify volumes of methane emissions at various stages of the completion process. Determine estimates for possible methane emissions during the production process on a well, pad, or production facility basis.

- *Characterization of gas shales and associated shallow groundwater aquifer systems*

Improve understanding of the characteristics of gas shale and aquifer systems vertically (from the reservoir to the surface) and laterally (across reservoirs to the regional scale). Assess potential issues related to stress response during hydraulic fracturing, chemical composition of flowback and produced water, and other attributes of gas shales and shallow groundwater aquifer systems.

- *Field characterization of baseline environmental impact and those impacts resulting from development and production of shale gas resources*

Identify environmental impacts of shale gas and shale oil development that may be very different from that of conventional oil and gas. Conduct field studies and other measurements in order to arrive at an independent, science-based assessment of such risks, including establishment of baseline parameters.

- *Determination of fundamental interactions between hydraulic fracturing fluids and shale*

Determine how hydraulic fracturing fluids and additives interact with the shale matrix to improve the understanding of the fate and impact of injected hydraulic fracturing fluids as well as the safety of the operation. Conduct research to provide better accountability of the injected fluids and understanding of the underlying fundamental interaction of injected fluids with the shale matrix.

- *Integrated assessment of potential risks associated with the development and production of shale gas resources*

Conduct a rigorous science-based assessment to provide an unbiased basis for evaluation of potential risks associated with development and production of shale gas resources. Quantify the behavior of the natural system from the reservoir to potential receptors such as underground sources of drinking water by linking detailed predictions in an integrated assessment model that can accommodate the complexity, heterogeneity, and uncertainty of natural systems.

- *Improve transparent public disclosure of data of interest to the public, to include chemicals used in hydraulic fracturing*

Increase openness, transparency and disclosure of chemicals that are used in the hydraulic fracturing process. Address near-, mid-, and long-term strengths and weaknesses of these options and mechanisms, and develop an information roadmap.

Anticipated Awards for 2011

About $13.7 million has been allocated for project awards. Approximately four to eight awards are anticipated to be awarded as part of the 2011 portfolio. Not all areas of solicitations may include actual awards. This is because proposals will be ranked and only the highest quality proposals received will be considered for award. The typical project is expected to have duration of one to three years. All awards will be subject to the Secretary of Energy for final approval.

Administrative Activities

The Program Consortium will continue active management of the R&D portfolio, planning and development of future R&D, and holding program level technology transfer workshops. The administrative milestones for the three 2011 portfolios are listed in Section V.

The solicitation for the 2011 portfolio will be released after transmittal of the 2011 Annual Plan to Congress and approval by the Secretary of Energy. It will remain open for a minimum of 60 days. The review and selection process will take about two months, and the award process will take approximately three months.

Shorter-term administrative activities conducted by the Program Consortium specific to UCR include the completion of annual milestones that show progress towards meeting objectives. Short term administrative activities to be completed before the end of FY 2011 include:

- Issue and complete at least one solicitation.
- Engage technical advisory committees[26] to review the solicitation to ensure that it reflects sufficient breadth and depth of industry experience
- Select and award 4 - 8 projects for the 2011 portfolio

[26] Research Partnership to Secure Energy for America (RPSEA), *2011 Draft Annual Plan*, July 2010

- Establish FY 2012 R&D priorities based on results of 2007-2011 solicitations and other inputs from stakeholders, including the Program Consortiums advisory committees, advice from the Secretary of Energy's URTAC,[27] and from the SEAB.
- Prepare the RPSEA *2012 Draft Annual Plan*[28]

Summary of 2007- 2010 Activities

Appendix A is comprised of tables that list projects for all prior years. Additional data included in the tables are the lead performer, the project end date for active projects, and the project duration anticipated for projects pending award, project cost, and source year of funding. The 2010 solicitations for proposals were released in September 2010.

Table 4.2 below summarizes the number of solicitations, selections, and project awards for 2007 through 2010 as of June 1, 2011.

Table 4.2: UCR Program Solicitations, Selections and Awards

Funding Year	Solicitations	Selections	Awards
2007	1	19	19
2008	1	9	9
2009	1	11	9
2010	1	8	pending

Additional project and solicitation details are provided in Appendix B.[29] Abstracts and project information for each of the projects can be found on the DOE website at www.netl.doe.gov/technologies/oil-gas/EPAct2005 and on the Program Consortium website at www.rpsea.org.

[27] U.S. Department of Energy, Unconventional Resources Technology Advisory Committee (2010). *Comments, Findings, and Recommendations*, Retrieved from http://www.fossil.energy.gov/programs/oilgas/advisorycommittees/URTAC_2011_Recommendations.pdf

[28] SEC. 999B (e) (2) (A) SOLICITATION OF RECOMMENDATIONS.--Before drafting an annual plan under this subsection, the Secretary shall solicit specific written recommendations from the program consortium for each element to be addressed in the plan, including those described in paragraph (4). The program consortium shall submit its recommendations in the form of a draft annual plan.

[29] In late 2010, the Program Consortium restructured its management of UCR. The UCR program was managed by the Gas Technology Institute 2007 through late 2010 via a subcontract with RPSEA. In late 2010, this subcontract was ended.

Small Producer Program

Program Goal

Small Producer Programs (SP) contributes a significant percentage of the oil and gas that is used by our Nation's economy. However, because of their size they do not have access to the research and development that in some cases is necessary to ensure that they're producing at the highest levels of safety and environmental sustainability.

The goal of SP is to address the unique challenges of small producers. *Small producer* is defined in Section 999G of EPAct as *an entity organized under the laws of the United States with production levels of less than 1,000 barrels per day of oil equivalent.*[30]

The goal of this program is to carry out research, development, and demonstration efforts that will assist small producers in reducing the cost and increasing the efficiency of exploration and production while operating safely and in a manner which does not harm the environment.[31]

Specific goals of SP are:

- *Reduce Environmental Impacts from Small Producer Operations*– Carry out scientific and technical research that will help regulatory agencies create and enforce water management, safety and environmental regulations.
- *Mitigate Environmental Impacts in Mature Fields* – Develop and demonstrate technologies for mitigating environmental impacts from past or current operations in mature producing areas.
- *Extend Economic Life of Mature Fields Through Environmentally Safe Efficiency*

Improvements – Develop and demonstrate technologies to improve oil and gas recovery from mature fields while simultaneously creating positive environmental impacts.

Implementation Plan

SP is being implemented by developing and administering annual solicitations for R&D projects in areas that address the objectives outlined above. The following section outlines the major steps in the implementation plan.

[30] SEC. 999G(7) SMALL PRODUCER.--The term "small producer" means an entity organized under the laws of the United States with production levels of less than 1,000 barrels per day of oil equivalent.

[31] SEC. 999B(7) (C) SMALL PRODUCERS.--Awards from allocations under section 999H(d)(3) shall … focus on areas including complex geology involving rapid changes in the type and quality of the oil and gas reservoirs across the reservoir; low reservoir pressure; unconventional natural gas reservoirs in coalbeds, deep reservoirs, tight sands, or shales; and unconventional oil reservoirs in tar sands and oil shales.

Small Producer Consortium

All awards resulting from this solicitation *shall be made to consortia consisting of small producers or organized primarily for the benefit of small producers.*[32] For the purposes of the solicitation, a small producer consortium shall consist of two or more entities participating in a proposal through prime contractor-subcontractor or other formalized relationship that ensures joint participation in the execution of the scope of work associated with an award. The participation in the small producer consortium of the producer that operates the asset that is identified as the initial target for the proposed effort is highly encouraged.

2011 Solicitations

Upon transmittal of the *2011 Annual Plan* to Congress, the solicitations for proposals for the 2011 portfolio will be developed by the Program Consortium and submitted to the Secretary for approval.[33]

The solicitation outreach process will specifically engage state and national organizations representing independent producers.

The solicitation(s) will focus on the theme of promoting safety and environmentally responsible operations among small producers, including topics that focus on:

- *Analyses to support Federal regulatory agencies in the development of produced water management standards and other regulations. Specific topics include:*

Development of data for regulators to determine produced water management compliance standards, development of new or improved methods for water management, including produced water shutoff or minimization, treatment and disposal of produced water, and minimization of water use, and collection and organization of existing well and field data from multiple sources into a readily accessible and usable format that will inform the development of science-based regulations.

- *Assessment of environmental risks in mature fields and development of technologies that address that risk. Specific topics include:*

Development of cost-effective producing well monitoring methods and technologies that can reduce the likelihood of uncontrolled release of fluids and new or improved methods and technologies for well site or producing facility site remediation.

[32] SEC. 999B(7) (C) SMALL PRODUCERS.--Awards from allocations under section 999H(d)(3) shall be made to consortia consisting of small producers or organized primarily for the benefit of small producers

[33] SEC. 999B(c) (B) issue research project solicitations upon approval of the Secretary…

- *Novel methods and technologies that provide positive environmental benefits while extending the economic life of mature fields. Specific topics include:*

Creative capture and reuse of industrial waste products (produced water, excess heat) to reduce operating costs or improve recovery, methods and technologies that leverage existing wellbores and surface footprint to maximize recovery of additional hydrocarbons without additional environmental disruption, and development of methods and technologies for improving oil and gas recovery and/or extending the economic life of marginal wells in environmentally responsible ways.

Anticipated Awards for 2011

About $3.19 million[34] has been allocated for SP. Approximately four to seven awards are anticipated to be awarded in 2011.[35] The typical project is expected to have duration of one to three years. All awards are subject to the Secretary of Energy for final approval.

Administrative Activities

The Program Consortium will continue active management of the R&D portfolio, planning and development of the R&D Program for 2012, and holding program level technology transfer workshops. All administrative milestones for 2011 for SP are listed in Section V.

The 2011 Small Producer solicitation will be released after approval by the Secretary of Energy[36] and transmittal of the *2011 Annual Plan* to Congress, and will remain open for a minimum of 60 days. The review and selection process will take about two months, and the award process will take approximately three months. The Program Consortium will work closely with each awardee to develop a successful technology transfer plan.

Shorter-term administrative activities specific to SP include the completion of annual milestones. At a minimum, short-term administrative include:

- Issuance of at least one solicitation
- Integration of input from the technical advisory group[37] to ensure solicitation reflects sufficient breadth and depth of industry experience
- Selection and award of four to seven projects
- Establishment of FY 2012 R&D priorities based on results of 2007-2011 solicitations and other inputs from stakeholders, including the Program Consortium's advisory committees and advice from the Secretary of Energy's URTAC
- Prepare the *RPSEA 2012 Draft Annual Plan*[38]

[34] SEC. 999B(c) (B) issue research project solicitations upon approval of the Secretary…
[35] SEC. 999B (e) (3) PUBLICATION.--The Secretary shall transmit to Congress …the annual plan
[36] SEC. 999B(c) (B) issue research project solicitations upon approval of the Secretary…
[37] Research Partnership to Secure Energy for America (RPSEA), *2011 Draft Annual Plan*, July 2010
[38] SEC. 999B (e) (2) (A) SOLICITATION OF RECOMMENDATIONS.--Before drafting an annual plan under this subsection, the Secretary shall solicit specific written recommendations from the program consortium for each element to be addressed in the plan, including those described in paragraph (4). The program consortium shall submit its recommendations in the form of a draft annual plan.

Summary of 2007-2010 Activities

Appendix A is comprised of tables that list projects for all prior years. Additional data included in the tables are the lead performer, the project end date for active projects, and the project duration anticipated for projects pending award, project cost, and source year of funding. The solicitations of proposals for the 2010 portfolio were released in July 2010.

Table 4.3 below summarizes the number of solicitations, selections, and awards for 2007 through 2010 as of June 1, 2011.

Table 4.3: SP Program Solicitations, Selections and Awards

Funding Year	Solicitations	Selections	Awards
2007	1	7	7
2008	1	6	6
2009	1	6	6
2010	1	3	pending

Additional project and solicitation details are provided in Appendix B.[39] Abstracts and project information for each of the projects can be found on the DOE website at www.netl.doe.gov/technologies/oil-gas/EPAct2005 and on the Program Consortium website at www.rpsea.org.

[39] In late 2010, the Program Consortium restructured its management of SP. The SP program was managed by New Mexico Institute of Mining and Technology 2007 through late 2010 via a subcontract with RPSEA. In late 2010, this subcontract was ended.

V. Administrative Activities

Solicitation Process

Eligibility

Pursuant to Title IX, Subtitle J of EPAct,[40] in order to receive an award, an entity must either be:

1) a United States-owned entity organized under the laws of the United States; or
2) an entity organized under the laws of the United States that has a parent entity organized under the laws of a country that affords to United States-owned entities -
   a) Opportunities comparable to those afforded to any other entity, to participate in any cooperative research venture similar to those authorized under this subtitle;
   b) Local investment opportunities comparable to those afforded to any other entity; and
   c) Adequate and effective protection of intellectual property rights.

RPSEA is not eligible to apply for an award under this program.

Organizational/Personal Conflict of Interest

The approved RPSEA Organizational Conflict of Interest (OCI) Plan will govern all potential conflicts associated with the solicitation and award process.

In accordance with the conflict of interest requirements of Section 999B(c)(3) of EPAct,[41] RPSEA submitted an OCIPlan which addressed the procedures by which RPSEA will (1) ensure its board members, officers, and employees in a decision-making capacity disclose to DOE any financial interests in or financial relationships with applicants for or recipients of awards under the Program and (2) require board members, officers, and employees with disclosed financial relationships or interests to recuse themselves from any oversight of awards made under the Program. RPSEA's OCI Plan was reviewed by DOE. After DOE's comments and questions were addressed, a final OCI Plan was approved. It remains in force as "active."

[40] SEC. 999E. LIMITS ON PARTICIPATION. An entity shall be eligible to receive an award under this subtitle only if the Secretary finds-- (1) that the entity's participation in the program under this subtitle would be in the economic interest of the United States; and (2) that either-- (A) the entity is a United States-owned entity organized under the laws of the United States; or (B) the entity is organized under the laws of the United States and has a parent entity organized under the laws of a country that affords-- (i) to United States-owned entities opportunities, comparable to those afforded to any other entity, to participate in any cooperative research venture similar to those authorized under this subtitle; (ii) to United States-owned entities local investment opportunities comparable to those afforded to any other entity; and (iii) adequate and effective protection for the intellectual property rights of United States-owned entities.

[41] SEC. 999B(c) (3) CONFLICT OF INTEREST.-- (A) PROCEDURES.--The Secretary shall establish procedures--(i) to ensure that each board member, officer, or employee of the program consortium who is in a decision-making capacity under subsection (f)(3) shall disclose to the Secretary any financial interests in, or financial relationships with, applicants for or recipients of awards under this section, including those of his or her spouse or minor child, unless such relationships or interests would be considered to be remote or inconsequential; and(ii) to require any board member, officer, or employee with a financial relationship or interest disclosed under clause (i) to recuse himself or herself from any oversight under subsection (f)(4) with respect to such applicant or recipient.

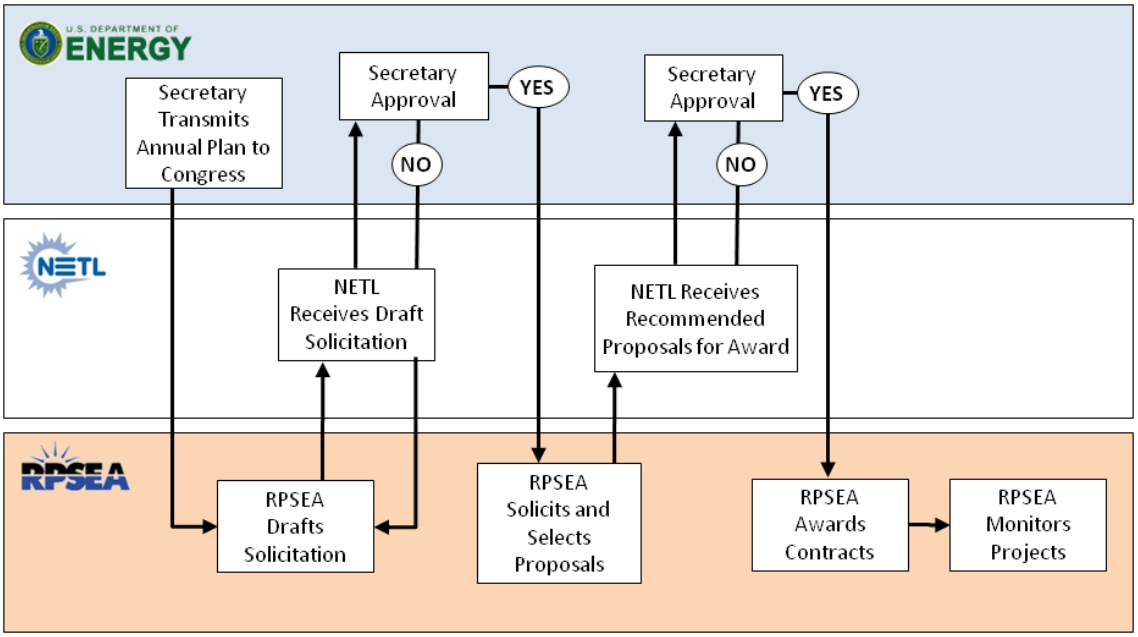
In addition, the Contract between DOE and RPSEA includes the following OCI clauses: H.22 Organizational Conflict of Interest (Nov 2005); H.23 Organizational Conflict of Interest (OCI) Annual Disclosure; and H.24 Limitation of Future Contracting and Employment.
These Contract clauses and the approved RPSEA OCI Plan govern potential conflicts associated with the solicitation and award process.

Solicitation Approval and Project Selection Process

The overall structure of the solicitation approval and project selection process is illustrated in Figure 5.1. Project selection will be through a fully open and competitive process. Beginning with the 2008 solicitation cycle, a two-step process was employed by the Program Consortium. This two-step process eliminates unnecessary detailed cost development for proposals that are not selected after step one. The two-step proposal process may be used where a technical volume and cost summary is submitted prior to submission of a full-cost proposal and other associated detailed information.

Within the Program Consortium's project proposal review and selection process, the RPSEA Technical Advisory Committees (TACs)[42] provide technical reviews of proposals, while the RPSEA Program Advisory Committees (PACs)[43] select projects for award. The Secretary of Energy is responsible for the final review and approval of recommended projects.[44]

Figure 5.1: Project Solicitation Approval Process



[42] Research Partnership to Secure Energy for America (RPSEA), *2011 Draft Annual Plan*, July 2010
[43] *Ibid*
[44] SEC. 999B(c) (C) make project awards to research performers upon approval of the Secretary…

Selection Criteria

The following general criteria are used to evaluate proposals. The detailed selection criteria and weighting factors vary depending on the specific technology area and will be clearly and specifically identified in each solicitation and the solicitation will direct applicants to respond to each, as appropriate:

- Technical merit and applicable production, reserve, and environmental impact (including an assessment of the impacts, both positive and negative, that would result from the application of a developed technology)
- Statement of Project Objectives
- Personnel qualifications, project management capabilities, facilities and equipment, and readiness
- Technology transfer approach
- Cost for the proposed work
- Cost share
- Health and Safety Quality Assurance/Quality Control
- Justification that R&D would not be done without government funding

In SP, the following criteria will be used to evaluate proposals in addition to those stated above:

- Approach to application of the results
- Involvement of small producers
- Overall strength of the small producer consortium

The proposer may be required to meet with the technical review committee to present their proposal and to answer any outstanding questions.

Schedule and Timing

The schedule for the solicitations leading to the 2011 portfolio will be determined in consultation with NETL after the *2011 Annual Plan* has been submitted to Congress and the Secretary has approved the solicitations. After release, solicitations will remain open for a minimum of 60 days. The administrative milestones for all three of the project portfolios are listed in Table 5.1.

Table 5.1: Program Elements Timeline

Cost Shared Program Process Timeline													
Month		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Plan Approved	♦												
Obtain DOE Approval of Solicitation			♦										
Solicitation Open Period													
Proposal Evaluation and Selection													
DOE Approval									♦				
Contract Negotiation and Award													
Manage 2011 Awards													
Manage 2007- 2010 Awards													
Report Program Deliverables													
Conduct Technology Transfer Workshops & Activities													
Establish 2012 R&D Priorities & Annual Plan													

Proposal Specifications

The structure and required elements of proposals submitted in response to each of the solicitations, as well as the specific details regarding format and delivery, will be developed in consultation with DOE and will be provided in each solicitation. The proposal must also comply with the *Department of Energy Acquisition Regulations* (DEAR) and *Federal Acquisition Regulations* (FAR) clauses listed in the solicitation. In addition, proposals will be required to assess whether industry would undertake the proposed R&D project in the near term (next two to three years) in the absence of public funding.[45]

Funding Estimates

It is anticipated that for FY 2011, $14.9 million will be available for UDW with approximately five to ten awards, and $13.8 million for UCR with approximately four to eight awards.[46]

The typical award is expected to have duration of one to three years, although shorter or longer awards may be considered if warranted by the nature of the proposed project. All projects will be fully funded to the completion of the appropriate decision point identified in each contract, which may include multiple stages. Once a decision is made to move to the next stage or decision point, additional funding will be provided from available funds.[47]

[45] United States Government Accountability Office, Research and Development. (2008). *DOE Could Enhance the Project Selection Process for Government Oil and Natural Gas Research* (GAO-09-186), page 13.

[46] SEC. 999H(d) *Allocation*.--Amounts obligated from the Fund under subsection (a)(1) in each fiscal year shall be allocated as follows: (1) 35 percent shall be for activities under section 999A(b)(1).
(2) 32.5 percent shall be for activities under section 999A(b)(2)…

[47] Research Partnership to Secure Energy for America (RPSEA), *2011 Draft Annual Plan*, July 2010

It is anticipated that $3.2 million will be available for SP in FY 2011.[48] Approximately four to seven awards are anticipated during FY 2011. The typical award is expected to have duration of two years, although shorter or longer awards may be considered if warranted by the nature of the proposed project.

Advertising of Solicitations

Each solicitation will be advertised in a manner that ensures wide distribution to the specific audience targeted by each solicitation.

The vehicles used will include but not be limited to:

- Publication on the NETL website, supported by DOE press releases and newsletters, e.g. *E&P Focus and other general public publications*
- Publication on the RPSEA website, supported by RPSEA press releases and newsletters
- Announcements distributed via e-mail to targeted lists (e.g., small producer, universities, Non-Government Organizations (NGOs), etc)
- Petroleum Technology Transfer Council (PTTC)[49]

Other vehicles that may be used include:

- Advertising in recognized industry publications (e.g., *Oil and Gas Journal, Hart's E&P, Offshore, American Oil and Gas Reporter*, *other appropriate journals*, etc.)
- Presentations at industry meetings by both RPSEA and NETL representatives, as appropriate given the timing of the solicitations
- Subscribing to funding-alert organizations that send e-mails once a week about funding opportunities to members in their specific areas of expertise
- Coordinating with the various professional, industry, state, and national organizations to utilize their established networks, such as Society of Petroleum Engineers, Independent Producers Association of America, Independent Petroleum Association of Mountain States, State regulatory groups, NGOs, etc.)
-

Additional Requirements for Awards

The following items are specified in Section 999C as requirements for awards. This information must be addressed in the solicitations and applications, if applicable.

- ***Demonstration Projects –*** An application for an award for a demonstration project must describe with specificity the intended commercial use of the technology to be demonstrated.[50]
- ***Flexibility in Locating Demonstration Projects –*** A demonstration project relating to an ultra-deepwater (≥1500 meters) technology or an ultra-deepwater architecture may be conducted in deepwater depths (>200 but <1500 meters).[51]

[48] SEC. 999H(d) (3) 7.5 percent shall be for activities under section 999A(b)(3).

[49] http://www.pttc.org

[50] SEC. 999C(a) *Demonstration Projects*.--An application for an award under this subtitle for a demonstration project shall describe with specificity the intended commercial use of the technology to be demonstrated.

[51] SEC. 999C(b) *Flexibility in Locating Demonstration Projects*.--Subject to the limitation in section 999A(c), a demonstration project under this subtitle relating to an ultra-deepwater technology or an ultra-deepwater architecture may be conducted in deepwater depths.

- ***Intellectual Property Agreements –*** If an award is made to a consortium, the consortium must provide a signed contract agreed to by all members of the consortium describing the rights of each member to intellectual property used or developed under the award.[52]
- ***Technology Transfer –*** 2.5 percent of the amount of each award must be designated for technology transfer and outreach activities.[53]
- ***Information Sharing –*** All results of the research administered by the Program consortium shall be made available to the public consistent with Department policy and practice on information sharing and intellectual property agreements.[54]

Project Management

The Program Consortium has developed and implemented formal policies/procedures for the management of selected R&D awards which are consistent with the core principles of DOE Order 413.3A, *Program and Project Management for the Acquisition of Capital Assets*, as applied to R&D. Their policies/procedures address:

- Environmental considerations (NEPA considerations)
- Project negotiations
- Project funding decisions/factors
- Project reporting
- Assessments of individual project performance
- Project performance periods
- Project continuations (stage/gate)
- Project change/modification
- Project closeout and termination
-

Technology Transfer[55]

The goal of the Technology Transfer Program is to engage participants all along the technology value chain, from conceptual development to commercial application. This will be accomplished through the coordinated effort between DOE/NETL and RPSEA outlined below.

NETL has developed and implements a Technology Transfer Program that provides the internal process for integrating information from the *Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research Program* and other DOE Oil & Gas Programs.[56]

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[52] *Ibid*

[53] SEC. 999C(d) *Technology Transfer*.--2.5 percent of the amount of each award made under this subtitle shall be designated for technology transfer and outreach activities under this subtitle.

[54] SEC. 999C(f) *Information Sharing*.--All results of the research administered by the program consortium shall be made available to the public consistent with Department policy and practice on information sharing and intellectual property agreements.

[55] SEC. 999C(d) *Technology Transfer*.--2.5 percent of the amount of each award made under this subtitle shall be designated for technology transfer and outreach activities under this subtitle.

[56] http://www.fossil.energy.gov/programs/oilgas/

The Technology Transfer Program has five primary elements and is based on distinct technology transfer mechanisms:

1. Engage project performers, through collaborative agreements[57], in actively disseminating the results of their research efforts through regular meetings (conferences, industry meetings, workshops, seminars, and forums).
2. Maintain the DOE website as a centralized repository[58] of all information related to the oil and gas program and undertake efforts to direct stakeholders to the website as the source of that information.
3. Publish research results on a routine basis via trade press articles, technical articles, and targeted in-house newsletters or journals.
4. Produce CD/DVD compilations of research reports and digital versions of specific information products related to individual projects.
5. Contract with industry technology transfer organizations to meet the needs of specific audiences.

Each of the four entities involved in the Program will utilize a combination of various technology transfer mechanisms. Table 5.2 is a matrix that illustrates this concept and highlights the DOE/NETL role.

The research products will be made available through Internet websites, presentations, and publications. Active websites that are already sources of information related to the Program include the RPSEA website, the NETL website, and several individual project websites. Both the RPSEA newsletter and the Strategic Center for Natural Gas and Oil quarterly newsletter, *E&P Focus*, have feature articles highlighting individual projects and overall Program activities. As work on individual projects accelerates, all of the various technology transfer mechanisms will be engaged to deliver results and data products identified in Table 5.2.

A cornerstone of the NETL Technology Transfer Program is the development and implementation of a Knowledge Management Database (KMD) which will bring archived project information to the forefront.[59] The KMD includes projects in the cost-shared program portfolio as well as information from DOE's traditional programs, both current and past. Opportunities to include additional data from other organizations are also being explored. For example, NETL is working with the Society of Petroleum Engineers to include a search in the KMD when members search their website for research papers/information. NETL and the Program Consortium will coordinate to ensure that all relevant non-confidential and non-privileged project information will be made available to the public in a timely manner. Reports, data, and results from the cost-shared program projects will be added as they become available. The KMD is accessible to the public via the Internet at www.netl.doe.gov/kmd.

[57] http://www.netl.doe.gov/tech-transfer/partnership.html
[58] http://www.netl.doe.gov/kmd
[59] http://www.netl.doe.gov/kmd

Table 5.2: Matrix Outlining Products and Delivery Vehicles for Section 999 Research Results

		RPSEA	NETL	Research Performers	DOE-HQ
Information to be Delivered	**Project Reports**		Complementary Program	Interim and final reports	
	Project Data Sets		Complementary Program	Spreadsheets, GIS data and other	
	Project Software			Models and online tools	
	Presentations/papers	Program and project level	Program and project level	Project level	High level Program
	Program Information	RFPs, deliverables, metrics, feedback	Program updates, benefits assessments		Program activity, FAC reports, mandated info.
Delivery Vehicle	**Project Websites**			Selected projects have websites	
	Program websites	RPSEA site with links	Portal on NETL site with links (KMD)		Pages on DOE site
	Publications	Newsletter, articles in trade press	Newsletter, Techlines, articles in trade press	Technical papers, articles	Press releases, Techlines
	Forums/workshops	RPSEA forums and workshops*	PTTC workshops		
	Public meetings	SPE papers, other technical meetings	SPE papers, other technical meetings	SPE papers, other technical meetings	SPE papers, other technical meetings

* RPSEA contracted PTTC as its Technology Transfer Agent in 2010. This will enhance coordination between NETL and the Consortium-Administered Program

The Program Consortium will engage in technology transfer at both the project and the Program level, and will coordinate with its subcontractors to develop an appropriate approach that fulfills both the project and program technology transfer requirements.[60] While only 2.5 percent of the amount of each contract is specifically set aside for funding technology transfer, the entire technology transfer program will be planned and executed with knowledge that for the desired impact to be achieved, significant technology transfer is needed.

At the project level, technology transfer activities include:

- Project reviews at quarterly UDW TAC meetings
- Press releases on significant project results
- Articles published in technical journals/publications
- Technical papers presented at conferences/workshops
- Specific project websites

[60] Research Partnership to Secure Energy for America (RPSEA), *2011 Draft Annual Plan*, July 2010

Program-level technology transfer activities (or planned activities) include:

- Posting of project information (abstracts, technical status assessments, results, accomplishments, reports, and key personnel contact information) on the Program Consortium's public website
- Coordination with the KMD to include publishing appropriate links to cost-shared and complementary program websites
- Periodic project reviews conducted as part of the Program management process
- Select, focused workshops, seminars and forums
- Website enhancements to support interactive technology transfer (planned)
- Leveraging via participation and coordination with existing conferences, forums, and workshops (planned)
- Resurrection of a print publication similar to *GasTips*[61] (planned)
- Program Consortium technical conferences held at a national or large regional scale (planned)
- Webcasts/Podcasts (planned)

The schedule for the Program Consortium technology transfer events is dynamic, driven by progress on individual projects and coordination with industry activities. A Calendar of Events on the RPSEA website[62] and announcment in the detailed project descriptions in the KMD, lists upcoming as well as past events. As new events are scheduled, they will be added to the Calendar of Events and included in the KMD notification.

[61] *GasTips*, no longer in publication, was a technical journal jointly published by Gas Technology Institute, NETL and Hart Publications between 2002 and 2007 that focused on new technology developments with application to natural gas resources.
[62] http://www.rpsea.org

VI. Conclusion

This report addresses the requirements of the Energy Policy Act of 2005 (Public Law 109-58) (EPACT) to implement a research program pursuant to an annual plan that is focused on ultra-deepwater, unconventional natural gas, and the technology challenges faced by small producers.

Appendix A: Current Projects

UDW Project Portfolio

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
Need 1: Drilling, Completion, and Intervention Breakthroughs				
Initiative 1: Well Construction Cost Reduction				
DW2501: Early Reservoir Appraisal, Utilizing a Well Testing System	Nautilus International, LLC	March 2011	$820,000	2008
DW2502: Modeling and Simulation of Managed Pressure Drilling for Improved Design, Risk Assessment, Training and Operations	Stratamagnetic Software, LLC	April 2011	$360,000	2008
DW3500-10: Gyroscope Guidance Sensor for Ultra-Deepwater Applications	Laserlith Corporation	January 2013	$489,346	2009
		Subtotal:	**$1,669,346**	
Initiative 2: Completion Cost Reduction				
		Subtotal:		
Initiative 3: Intervention (Downhole Services)				
DW1502: Coil Tubing Drilling and Intervention System Using Cost Effective Vessels	Nautilus International, LLC	April 2011	$820,000	2008
DW2301: Deepwater Riserless Intervention System (RIS)	DTC International, LLC	April 2012	$3,382,017	2008
DW3500-07: Deepwater Subsea Test Tree and Intervention Riser System	DTC International, Inc.	July 2012	$1,551,239	2009
		Subtotal:	**$5,753,256**	
		Need 1 Total:	***$7,422,602***	
Need 2: Appraisal and Development Geoscience and Reservoir Engineering				
Initiative 1: Reservoir Characterization and Appraisal				
DW2001: Synthetic Benchmark Models of Complex Salt	SEAM	March 2012	$2,633,364	2007
DW2701: Resources to Reserves Development and Acceleration through Appraisal	University of Texas at Austin	June 2011	$200,331	2008
		Subtotal:	**$2,833,695**	
Initiative 2: Improved Recovery				
DW1701: Improved Recovery	Knowledge Reservoir	Completed	$1,599,712	2007

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
DW3500-01: Intelligent Production System for UDW with Short Hop Wireless Power & Wireless Data Transfer for Lateral Production Control & Optimization	Tubel LLC	January 2013	$1,103,000	2009
DW3700-02: A 1,000 Level Drill Pipe Deployed Fiber Optic 3C Receiver Array for Deep Boreholes	Paulsson, Inc.	February 2013	$1,994,329	2009
		Subtotal:	**$4,697,041**	
		Need 2 Total:	***$7,530,736***	
Need 3: Significantly Extend Satellite Well Tieback /Surface Host Elimination				
Initiative 1: Subsea Processing & Boosting				
DW1301: Improvements to Deepwater Subsea Measurements	Letton-Hall Group	April 2011	$3,600,126	2007
DW1901: Subsea Processing System Integration Engineering	GE Global Research	June 2011	$1,200,000	2007
		Subtotal:	**$4,800,126**	
Initiative 2: Power Generation, Transmission & Distribution				
DW1902: Deep Sea Hybrid Power System	Houston Advanced Research Center	Completed	$480,000	2007
DW1302: Ultra-High Conductivity Umbilicals	NanoRidge Materials	Completed	$448,000	2007
DW2901: Ultra-Reliable Deepwater Electrical Power Distribution System and Power Components	GE Global Research	November 2012	$4,999,967	2008
DW3300-10: Development of Carbon Nanotube Composite Cable for Ultra Deepwater Oil and Gas Fields	Los Alamos National Laboratory	January 2013	$2,000,000	2009
		Subtotal:	**$7,927,967**	
Initiative 3: Stabilized Flow				
DW1201: Wax Control	University of Utah	August 2011	$400,000	2007
DW1202: Equation of State Improvement for Extreme High Pressure and High Temperature Conditions (xHPHT)	NETL Complementary Program			
DW2201: Heavy Viscous Oil PVT	Schlumberger	24 Months	$460,000	2008
DW3300-02: Displacement & Mixing in Subsea Jumpers Experimental Data and CFD Simulations	The University of Tulsa	December 2012	$254,952	2009
		Subtotal:	**$1,114,952**	
		Need 3 Total:	***$13,843,045***	
Need 4: Dry Trees and Risers in 10,000 Feet Water Depth				

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
Initiative 1: Dry Trees/Direct Well Intervention				
DW1402A: Ultra-Deepwater Dry Tree System for Drilling and Production (Stage 1 & 2)	FloaTec	Completed	$278,686	2007
DW1402B: Ultra-Deepwater Dry Tree System for Drilling and Production (Stage 1)	Houston Offshore Engineering	Completed	$812,042	2007
		Subtotal:	**$1,090,728**	
Initiative 2: Risers				
DW1401: Carbon Fiber Wrapped High Pressure Drilling and Production Riser Qualification Program	Lincoln Composites	April 2011	$1,678,411	2007
DW1403: Fatigue Performance of High Strength Riser Materials	Southwest Research Institute	June 2011	$800,000	2007
DW3500-02: Fatigue Testing Of Shrink-Fit Riser Connection For High Pressure Ultra Deepwater Risers	Subsea Riser Products	November 2011	$349,806	2009
		Subtotal:	**$2,828,217**	
		Need 4 Total:	***$3,918,945***	
Need 5: Continuous Improvement and Innovation				
Initiative 1: Improve Operating and Inspection Processes				
DW2101: New Safety Barrier Testing Methods	Southwest Research Institute	May 2011	$128,000	2008
DW3300-06: High Resolution 3D Laser Imaging for Inspection, Maintenance, Repair, and Operations	3D at Depth, LLC	May 2012	$498,898	2009
DW3300-08: Sensors & Processing for Pipe, Riser, Structure, & Equipment Inspection to Provide Detailed Measurements, Corrosion Detection, Leak	Blueview Technologies, Inc.	June 2012	$468,463	2009
		Subtotal:	**$1,095,361**	
Initiative 2: Graduate Student and Innovative Game-Changing Technologies				
DW1603-A: Graduate Student Design Project. Flow Phenomena in Jumpers	Tulsa University	Completed	$120,000	2007
DW1603-B: Graduate Student Design Project. Hydrate Plug Characterization and Dissociation Strategies	Tulsa University	Completed	$120,000	2007
DW1603-C: Graduate Student Design Project. Design of Extreme High Pressure and High Temperature Subsurface Safety Valve	Rice University	Completed	$120,000	2007

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
DW1603-D: Graduate Student Design Project. Robotic MFL Sensor for Monitoring and Inspection of Deepwater Risers	Rice University	October 2011	$120,000	2007
DW2902-02: Technologies of the Future for Pipeline Monitoring and Inspection	The University of Tulsa	December 2011	$120,000	2008
DW2902-03:Wireless Subsea Communications Systems	GE Global Research	July 2011	$120,000	2008
DW2902-04: Replacing Chemical Biocides with Targeted Bacteriophages in Deepwater Pipelines and Reservoirs	Phage Biocontrol, LLC	February 2012	$120,000	2008
DW2902-06: Enumerating Bacteria in Deepwater Pcipelines in Real-Time and at a Negligible Marginal Cost Per Analysis: A Proof of Concept Study	Livermore Instruments Inc.	July 2011	$119,716	2008
DW2902-07: Fiber Containing Sweep Fluids for Ultra Deepwater Drilling Applications	The University of Oklahoma	January 2012	$119,972	2008
		Subtotal:	**$1,079,688**	
		Need 5 Total:	***$2,175,049***	
Need 6: HS&E Concerns (Safety and Environmental)				
Initiative 1: Met-ocean Needs That Impact Operations and Facility Design				
DW1801: Effect of Global Warming on Hurricane Activity	National Center for Atmospheric Research (NCAR)	April 2011	$544,085	2007
DW2801: Gulf 3-D Operational Current Model Pilot Project	Portland State University	September 2012	$1,248,000	2008
		Subtotal:	**$1,792,085**	
Initiative 2: HS&E Concerns with Emerging New Technologies				
DW3300-05: Autonomous Inspection of Subsea Facilities	Lockheed Martin	September 2012	$994,020	2009
DW3100-01: UDW Seabed Discharge of Produced Water and/or Solids	Fluor Enterprises, Inc.	December 2011	$448,9560	2009
		Subtotal:	**$1,442,976**	
		Need 6 Total:	***$3,235,061***	
	Total for 2007 - 2009		***$38,125,438***	

UCR Project Portfolio

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
2007 Funding Year				
A Self-Teaching Expert System for the Analysis, Design and Prediction of Gas Production from Shales	Lawrence Berkeley National Laboratory	$1,774,840 Apr 2011	User friendly software package for gas shale production prediction	Texas A&M University; University of Houston; University of California Berkeley; Anadarko; Southwestern Energy
Advanced Hydraulic Fracturing Technology for Unconventional Tight Gas Reservoirs	Texas A&M University	$1,045,551 Sep 2011	Design methodology for hydraulic fracturing considering new conductivity model	Carbo Ceramics; Schlumberger; Halliburton Energy Services; BJ Services
An Integrated Framework for the Treatment and Management of Produced Water	Colorado School of Mines	$1,560,393 Completed	Best practices protocol for handling and processing produced water in the Rocky Mountains	Kennedy/Jenks Consultants; Argonne National Laboratory; Stratus Consulting; Eltron Research and Development; Chevron; Pioneer Natural Gas; Marathon; Triangle Petroleum; Anadarko; Awwa Research Foundation; Stewart Environmental; Southern Nevada Water Authority; Veolia Water; Hydration Technology; Petroglyph Operating
Application of Natural Gas Composition to Modeling Communication Within and Filling of Large Tight-Gas-Sand Reservoirs, Rocky Mountains	Colorado School of Mines	$670,417 Aug 2011	Fundamental understanding of gas composition as vs. migration pathways	U.S. Geological Survey; University of Oklahoma; University of Manchester; Fluid Inclusion Technology Permedia Research Group; Williams Exploration and Production; ConocoPhillips; ExxonMobil; Newfield Exploration; BP; Anadarko; EnCana Oil & Gas; Bill Barrett Corporation

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
Comprehensive Investigation of the Biogeochemical Factors Enhancing Microbially Generated Methane in Coal Beds	Colorado School of Mines	$864,333 Dec 2011	Identification of critical factors for generating gas microbially in coal formations	University of Wyoming; U.S. Geological Survey; Pioneer Natural Resources; Pinnacle Gas Resources; Coleman Oil and Gas; Ciris Energy
Enhancing Appalachian Coalbed Methane Extraction by Microwave-Induced Fractures	The Pennsylvania State University	$79,409 Completed	Fundamentals of efficacy of using microwaves as a CBM stimulation technique	Nottingham University
Gas Condensate Productivity in Tight Gas Sands	Stanford University	$518,227 Dec 2011	Production protocols to minimize formation damage due to liquids precipitation near the wellbore	
Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures	The University of Utah	$1,068,863 Sep 2011	Best Practices for development of Utah gas shales integrating natural and hydraulic fracture interaction	Utah Geological Survey; Golder Associates; Utah State University; HCItasca; Anadarko; Wind River Resources Corp
Geological Foundation for Production of Natural Gas from Diverse Shale Formations	Geologic Survey of Alabama	$497,459 Jul 2011	Geologic characterization of diverse shales in Alabama	
Improved Reservoir Access through Refracture Treatments in Tight Gas Sands and Gas Shales	The University of Texas at Austin	$949,318 Aug 2011	Strategy for refracture of tight gas and gas shale wells. Define window of refracture opportunity	Noble Energy; BJ Services; Anadarko; Jones Energy; Pinnacle Technologies
Improvement of Fracturing for Gas Shales	The University of Texas at Austin	$691,821 Apr 2012	Design and field test of lightweight proppant materials in the Barnett shale	Daneshy Consultants; BJ Services

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
New Albany Shale Gas	Gas Technology Institute	$3,445,159 Completed	Well completion strategy for New Albany Shale wells focusing on well stimulation	Amherst College; University of Massachusetts; ResTech; Texas A&M University; Pinnacle Technologies; West Virginia University; Texas Bureau of Economic Geology; Aurora Oil and Gas; CNX Gas; Diversified Operating Corporation; Noble Energy; Trendwell Energy Corporation; BreitBurn Energy
Novel Concepts for Unconventional Gas Development in Shales, Tight Sands and Coalbeds	Carter Technologies	$91,680 Completed	Feasibility study for the utilization of cables for cutting rock formations in a wellbore for stimulation purposes	University of Oklahoma; University of Houston; M-I L.L.C.
Novel Fluids for Gas Productivity Enhancement in Tight Formations	The University of Tulsa	$219,920 Sep 2011	Model for the mitigation of gel damage due to hydraulic fracturing in the near wellbore region	Williams Exploration & Production
Optimization of Infill Well Locations in Wamsutter Field	The University of Tulsa	$443,563 Apr 2011	Simulation technique for high-grading downsized spacing locations in a tight gas reservoir	Texas A&M University; Devon Energy
Optimizing Development Strategies to Increase Reserves in Unconventional Gas Reservoirs	Texas A&M University	$314,606 Aug 2011	Reservoir and decision model incorporating uncertainties	Unconventional Gas Resources Canada Operating Inc.; Pioneer Natural Resources
Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities	Utah Geologic Survey	$428,491 Aug 2011	Characterization of Paleozoic shales, identification of highest potential areas, best practices for drilling and completion	Bereskin and Associates; GeoX Consulting; Halliburton Energy Services; Shell; Sinclair O&G; EnCana Oil & Gas; Bill Barrett Corporation; CrownCrest Operation LLC
Petrophysical Studies of Unconventional Gas Reservoirs Using High-Resolution Rock Imaging	Lawrence Berkeley National Laboratory	$1,071,105 Oct 2011	Development of recovery strategies mitigating condensate precipitation based on high resolution rock imaging	Schlumberger; BP; Chevron

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
Reservoir Connectivity and Stimulated Gas Flow in Tight Sands	Colorado School of Mines	$2,894,256 May 2011	Mamm creek field characterization and productivity criteria for application to similar environments	University of Colorado; Mesa State University; iReservoir; Bill Barrett Corporation; Noble Energy; Whiting Petroleum Corporation; ConocoPhillips
2008 Funding Year				
Barnett and Appalachian Shale Water Management and Reuse Technologies	Gas Technology Institute	$2,500,000 Aug 2011	Water management methods and technologies that reduce demands for freshwater, reduce environmental impact of brine disposal, and ensure supplies of water for well drilling and completion for shale gas development	The Bureau of Economic Geology/The University of Texas at Austin; Texerra; Geopure Water Technologies/Texas A&M University; Texas Oil and Gas Association; Chesapeake Energy Corporation; ConocoPhillips; Devon Energy Corporation; EnCana; EOG; Pittls Oil Company; Quicksilver; Range Resources; XTO; Barnett Shale Water Conservation and Management Committee; Appalachian Shale Water Conservation and Management Committee
Novel Gas Isotope Interpretation Tools to Optimize Gas Shale Production	California Institute of Technology	$1,190,000 Aug 2012	Novel diagnostic tools for predicting, monitoring and optimizing shale gas production	Devon Energy Corporation; BJ Services Company; GeoIsoChem Inc.

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
The Environmentally Friendly Drilling Systems Program	Houston Advanced Research Center	$2,199,895 Jul 2012	Identification and evaluation of critical technologies for low-impact drilling, transfer of technology to industry, and tools for selecting low-impact technologies appropriate for a given site	BP; CSI Technologies; Devon Energy Corporation; Gulf Coast Green Energy; Halliburton; Huisman; Jacarilla Apache Nation; KatchKan U.S.A.; M-I SWACO; Newpark Mats & Integrated Services; Weatherford; TerraPlatforms, LLC; Texas A&M University; Sam Houston State University; University of Arkansas; University of Colorado; Utah State University; University of Wyoming; West Virginia University; Argonne National Laboratory; Los Alamos National Laboratory; TerraPlatforms, LLC; Environmentally Friendly Drilling Joint Industry Partnership; The Nature Conservancy; Natural Resources Defense Council; New York State Energy Research and Development Authority
Pretreatment and Water Management for Frac Water Reuse and Salt Production	GE Global Research	$1,105,000 Aug 2011	Technology that enables recycle of fracturing flowback water, and production of a salable salt by-product	STW Resources, Inc.
Stratigraphic Controls on Higher-Than-Average Permeability Zones in Tight-Gas Sands in the Piceance Basin	Colorado School of Mines	$111,216 Jul 2011	Evaluation of the stratigraphic controls on the distribution and quality of tight-gas reservoirs in the Piceance Basin	
Coupled Flow-Geomechanical-Geophysical-Geochemical (F3G) Analysis of Tight Gas Production	Lawrence Berkeley National Laboratory	$2,900,000 Apr 2013	Knowledge regarding long-term behavior of fractured tight gas reservoirs	Texas A&M University; Stanford University; Baker Hughes Inc.; Unconventional Gas Resources, Inc.

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
Sustaining Fracture Area and Conductivity of Gas Shale Reservoirs for Enhancing Long-Term Production and Recovery	Texas A & M University	$1,615,000 Sep 2012	A methodology for reservoir typing and selection of fracture stimulations for preventing loss of productive fracture area and loss of fracture conductivity	TerraTek a Schlumberger Company; Devon Energy Corporation; EnCana Oil & Gas USA; Pennsylvania General Energy Co.
Multiazimuth Seismic Diffraction Imaging for Fracture Characterization in Low-Permeability Gas Formations	Bureau of Economic Geology, The University of Texas at Austin	$1,105,000 Oct 2012	Techniques for predicting fractures and attributes by combining seismic tools, fracture modeling and characterization based on wireline sampling techniques	The University of Texas at Austin; Bill Barrett Corporation
Evaluation of Fracture Systems and Stress Fields Within the Marcellus Shale and Utica Shale and Characterization of Associated Water-Disposal Reservoirs: Appalachian Basin	Bureau of Economic Geology, The University of Texas at Austin	$1,020,000 Sep 2012	Demonstration of multicomponent seismic data to evaluate fracture systems that control production of shale gas systems, quantify stress fields and elastic moduli that influence frac performance in shale reservoirs, and measure the capacity of porous sandstone units to accept flow-back water produced during frac operations.	University of Pittsburgh; Chesapeake Energy Corporation; Jeter Field Service; RARE Technology; AscendGeo; AOA Geophysics, Inc.; Austin Powder Company; Seismic Source
2009 Funding Year				
Gas Well Pressure Drop Prediction under Foam Flow Conditions	The University of Tulsa	$573,493 Dec 2013	Correlation to calculate pressure drop under foam flow in deep gas wells with low water production	Marathon; Chevron
Characterizing Stimulation Domains, for Improved Well Completions in Gas Shales	Higgs-Palmer Technologies	$385,861 Mar 2013	Method and a prototype screening software tool to characterize how flow properties change during and after well stimulation. Permeability-based stimulation diagnostics as related to fracture treatment parameters. Improved well stimulation demo prototype tool.	Aetman Engineering; PCM Technical; Southwestern Energy Company

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
Marcellus Gas Shale Project	Gas Technology Institute	$3,215,157 May 2012	Technologies to overcome challenges preventing the expansion of Marcellus production through a field-based project.	Pennsylvania State University; West Virginia University; Bureau of Economic Geology; Pinnacle Technologies; Restech
Prediction of Fault Reactivation in Hydraulic Fracturing of Horizontal Wells in Shale Gas Reservoirs	West Virginia University Research Corporation	$853,378 Jan 2014	Advanced method to predict fault reactivation and improve effectiveness of fracturing stimulation of horizontal gas shale wells.	Range Resources; Appalachian, LLC
Cretaceous Mancos Shale Uinta Basin, Utah: Resource Potential and Best Practices for an Emerging Shale Gas Play	Utah Geological Survey	$1,084,029 Oct 2013	GIS-based integrated geologic characterization of the Mancos Shale along with drilling, completion, and stimulation method recommendations.	University of Utah; Halliburton Energy Services
Simulation of Shale Gas Reservoirs Incorporating Appropriate Pore Geometry and the Correct Physics of Capillarity and Fluid Transport	Board of Regents of the University of Oklahoma	$1,053,779 Nov 2013	Production of a reservoir simulator that provides for the appropriate pore geometry complexity, and models the processes with valid physical assumptions.	BP; Chesapeake Energy Corporation; Exco; Newfield; Total; Computer Modeling Group, Inc.
Integrated Experimental and Modeling Approaches to Studying the Fracture-Matrix Interaction in Gas Recovery from Barnett Shale	The University of Texas at Arlington	$457,891 Oct 2012	The outcomes of this proposal will bridge the knowledge gaps in the pore connectivity effect on diffusive gas transport and gas recovery in fractured shale system.	Carrizo Oil and Gas, Inc.
Using Single-molecule Imaging System Combined with Nano-fluidic Chips to Understand Fluid Flow in Tight and Shale Gas Formation	Missouri University of Science and Technology	$1,211,083 Feb 2014	Improved understanding of the flow behavior of natural gas and introduced fluids in nano-darcy tight gas and shale formations sing advanced single-molecule imaging system combined with nano-fluidic chips and pore-scale numerical simulation techniques.	Colorado School of Mines; BJ Services; HESS Corporation

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
Improving Reservoir Contact for Increased Production and Recovery of Gas Shale Reservoirs (Achieving Management of Fracture Complexity)	TerraTek, A Schlumberger Company	$830,000 25 months	Improved understanding of the operational drivers of fracture complexity (pumping rate, fluid viscosity, and proppant) and provide guidance for maximizing this opportunity.	New Ventures; Encana Oil and Gas; Unconventional Gas Completion Research; Shell; William Duncan; Cimarex Energy Company; Devon Energy
A Geomechanical Model for Gas Shales Based on the Integration of Stress Measurements and Petrophysical Data from the greater Marcellus Gas System	The Pennsylvania State University	$3,140,000 36 months	Development of an integrated, predictive geomechanical model that integrates rock stress and petrophysical properties for the Marcellus gas system. The model can be generalized for application in other shale plays.	Chesapeake Energy Corporation; Schlumberger; Range Resources
Improved Drilling and Fracturing Fluids for Shale Gas Reservoirs	The University of Texas at Austin	$600,000 Nov 2013	Develop nano-particle based water-based drilling fluids that are compatible with reactive gas shales and cost a lot less than the oil-based fluids being used today.	Conoco Phillips; Chevron Energy Technology Company; Mi SWACO

** Note that duration and award amounts on some 2009 projects have not been finalized*
***All awards made to consortia with prime listed as awardee and other members listed as participants*

SP Project Portfolio

Projects	Awardee	RPSEA Funding/ Completion Date	Deliverable	Other Participants
2007 Funding Year				
Cost-Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers	New Mexico Institute of Mining and Technology	$420,543 Aug 2011	A process to purify produced water at the wellhead	Robert L. Bayless, Producer LLC; Harvard Petroleum Company
Enhancing Oil Recovery from Mature Reservoirs Using Radial-Jetted Laterals and High-Volume Progressive Cavity Pumps	The University of Kansas	$248,385 Aug 2011	Application of available technology to increase oil recovery while effectively disposing of water	Kansas Geological Survey; American Energies Corporation
Field Site Testing of Low Impact Oil Field Access Roads: Reducing the Footprint in Desert Ecosystems	Texas A&M University	$284,839 Sep 2011	Identify materials and processes that will lessen the environmental impact of oilfield operations	Rio Vista Bluff Ranch; Halliburton
Near Miscible CO2 Application to Improved Oil Recovery for Small Producers	The University of Kansas	$274,171 Completed	Define the potential for CO2 recovery or sequestration in near-miscible reservoirs	Carmen Schmitt
Preformed Particle Gel for Conformance Control	Missouri University of Science and Technology	$520,212 Completed	Assessing gel performance in mitigating water production in fractured systems	ChemEOR Company; BJ Services
Reducing Impacts of New Pit Rules on Small Producers	New Mexico Institute of Mining and Technology	$509,185 Aug 2011	Access to online compliance data and automating permitting process	Independent Petroleum Association of New Mexico; New Mexico Oil Conservation Division
Seismic Stimulation to Enhance Oil Recovery	Lawrence Berkeley National Laboratory	$723,373 Aug 2011	Methodology to predict if a reservoir is amenable to seismic stimulation	U.S. Oil & Gas Corporation; Berkeley GeoImaging Resources

Projects	Awardee	RPSEA Funding/ Completion Date	Deliverable	Other Participants
2008 Funding Year				
Commercial Exploitation and the Origin of Residual Oil Zones: Developing a Case History in the Permian Basin of New Mexico and West Texas	The University of Texas of the Permian Basin	$630,934 July 2011	Examination of regional data to clarify extents, locations, and origins of residual oil zones in Permian Basin	Chevron Corporation; Legado Resources; Yates Petroleum; Petroleum Technology Transfer Council; Midland College; Applied Petroleum Technology Academy
Evaluation and Modeling of Stratigraphic Control on the Distribution of Hydrothermal Dolomite Reservoir Away from Major Fault Planes	Western Michigan University	$393,369 Oct 2011	Study of lateral variability of reservoir quality hydrothermal dolomites to improve prediction of laterally persistent reservoir zones in the Albion-Scipio trend of southern Michigan.	Polaris Energy Company
Development Strategies for Maximizing East Texas Oil Field Production	Bureau of Economic Geology, The University of Texas at Austin,	$700,000 Oct 2011	Exploration of short to midterm strategies for maximizing recovery from East Texas Oil Field.	Danmark Energy LP; John Linder Operating Co. LLC
Mini-Waterflood: A New Cost Effective Approach to Extend the Economic Life of Small, Mature Oil Reservoirs	New Mexico Institute of Mining and Technology	$313,751 Aug 2011	Demonstrate the feasibility of waterflooding small oil reservoirs that are not conducive to a fully-developed, patterned waterflood.	Armstrong Energy Corporation; Keltic Wall Services
Field Demonstration of Alkaline Surfactant Polymer Floods in Mature Oil Reservoirs Brookshire Dome, Texas	Layline Petroleum 1, LLC	$597,834 Dec 2011	Conduct a pilot study in Brookshire Dome field to demonstrate applicability of alkaline surfactant polymer flooding to improve incremental oil production.	Tiorco LLC; The University of Texas at Austin

Projects	Awardee	RPSEA Funding/ Completion Date	Deliverable	Other Participants
Electrical Power Generation from Produced Water: Field Demonstration of Ways to Reduce Operating Costs of Small Producers	Gulf Coast Green Energy	$229, 796 May 2011	Demonstrate a relatively small low cost heat exchange device that converts heat from produced water to electricity.	Denbury Resources; ElectraTherm Inc.; Dry Coolers Inc.; Southern Methodist University; Texas A&M University
2009 Funding Year				
Field Testing and Diagnostics of Radial-Jet Well-Stimulation for Enhanced Oil Recovery from Marginal Reserves Enhanced Oil	New Mexico Institute of Mining and Technology	$656,537 Mar 2013	Field evaluation of radial jet technology for production enhancement to determine effectiveness, directional control and placement of jets	Well Enhancement Services LLC; Harvard Petroleum Company LLC
Recovery from the Bakken Shale Using Surfactant Imbibition Coupled with Gravity Drainage	University of North Dakota	$500,000 Mar 2014	Investigate the ability of certain surfactant solutions to alter the wettability of the Bakken formation, without causing formation damage	North Dakota Industrial Commission; Tiorco – Stepan; Champion Technologies; Hess Corporation
Treatment and Beneficial Reuse of Produced Waters Using A Novel Pervaporation-Based Irrigation Technology	University of Wyoming	$413,230 Mar 2014	Evaluate the application of a novel pervaporation (PV) based irrigation technology for treating and reusing oil and natural gas produced water	Imperial College London; WyoTex Ventures LLC; DTI Group
Green Oil™ CO_2-Enhanced Oil Recovery For America's Small Oil Producers	Pioneer Astronautics, Inc.	$564,606 Feb 2013	Development and testing of truck-portable equipment for generating CO2 on-site at small producer fields	J & L Allen Inc.; American Pioneer Ventures; New Mexico Institute of Mining and Technology
Characterization of Potential Sites for Near Miscible CO2 Applications to Improve Oil Recovery in Arbuckle Reservoirs	University of Kansas Center for Research, Inc.	$605,360 Feb 2013	Collection of field data needed to help model Arbuckle reservoirs to predict recovery in a future near-miscible CO2 flood	Tertiary Oil Recovery Project; University of Kansas; Kansas Geological Survey; Carmen Schmitt, Inc.

Projects	Awardee	RPSEA Funding/ Completion Date	Deliverable	Other Participants
Creating Fractures Past Damage More Effectively With Less Environmental Damage	DaniMer Scientific, LLC	$350,000 Mar 2012	Development of a more environmentally-friendly fracture fluid and technique for mature reservoirs	CSI Technologies LLC; Texas A&M University

***** *All awards made to consortia with prime listed*

Appendix B: RPSEA 2011 Draft Annual Plan

RPSEA 2011 Draft Annual Plan

July 2010

www.rpsea.org

1650 Highway 6, Suite 300
Sugar Land, TX 77478

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Executive Summary

This document is the Research Partnership to Secure Energy for America (RPSEA) 2011 Draft Annual Plan (DAP) for the Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program (Program) established pursuant to Title IX, Subtitle J, Section 999 (Section 999), of the Energy Policy Act of 2005 (EPAct). RPSEA administers three of the four program elements identified in EPAct, pursuant to an annual plan, which include: ultra-deepwater architecture and technology, unconventional natural gas and other petroleum resources exploration and production technology, and technology challenges of small producers. The Department of Energy (DOE), through its National Energy Technology Laboratory (NETL), implements a complementary research and development (R&D) program of Section 999. Previously, RPSEA submitted DAPs for 2007 through 2010, and in their development gathered extensive input through industry workshops, road mapping sessions, and expert opinion, including input from two Federal Advisory Committees (FACA).

The 2011 DAP is an evolutionary document building upon the foundation of the 2007 through 2010 approved Annual Plans, all of which DOE has submitted to Congress and all of which incorporated RPSEA's earlier DAPs. The vision and plan laid out in these previous DAPs remains solidly in place as the program begins to produce results that will positively impact the nation's energy security, job development, and economy. While safety and environmental sensitivity have always been key components of the technologies developed under the program, the recent Deepwater Horizon incident in the Gulf of Mexico and ongoing concerns regarding the safety and environmental aspects of shale gas development has resulted in an increased emphasis on the evaluation of potential safety and environmental risks associated with the development of ultra-deepwater and unconventional resources, and approaches to reduce and mitigate those risks. While the original intent of the Section 999 was to "maximize the value of natural gas and other petroleum resources of the United States" none of that value will be realized if the targeted resources cannot be developed in a safe and environmentally sensitive manner. The Deepwater Horizon incident has caused the industry to reevaluate its approach to risk management as applied to all exploration and development operations. An important component of this plan is conducting the research necessary to ensure that the risks associated with the development of ultra-deepwater and unconventional resources are fully understood, and the means are available to fully mitigate those risks with respect to both prevention and recovery.

RPSEA's Mission is to provide a stewardship role in ensuring the focused research, development and deployment of safe and environmentally sensitive technology that can effectively deliver hydrocarbons from domestic resources to the citizens of the United States.

At this stage of the Program, RPSEA's objectives are: the continued aggressive engagement of the private sector and research communities to enhance the value of the public/private partnership; a focus on building, maintaining, and managing the optimal portfolio contemplated by the original DAPs; and the transition from planning to project execution and technology transfer. Focus is the operative word regarding portfolio composition, and RPSEA remains keenly focused on the objectives more fully described in the following chapters. The program chapters each include examples of projects that are having an impact on the operations of the participants and developing technology and information to transfer to the industry as a whole. Each of the three RPSEA program portfolios, ultra-deepwater, unconventional resources, and small producer, have developed according to plan. The 2011 DAP continues that evolution to build the foundation required for optimal portfolio composition.

RPSEA Model

The RPSEA model for technology development involves the active engagement of stakeholders across the entire community of energy producers, researchers, technology providers, regulators, and environmental groups. The best efforts of the research community will be required to develop the technology necessary to safely deliver hydrocarbons from the targeted resources; however, the knowledge residing with producers and service companies is crucial in providing effective direction for the needed research. Further, the rapid application of new ideas and results will be facilitated by the continuing involvement of producers and service companies in the planning and execution of the research program. The increased emphasis on safety and environmental sensitivity reflected in this plan will require more direct involvement and communication with the regulatory agencies and the environmental community, as represented by the Environmental Advisory Group (EAG). The chapters for the individual program elements describe the ways in which stakeholder groups are effectively engaged for each portion of the program.

The safe and environmentally sensitive delivery of secure domestic hydrocarbon resources to the citizens of the United States is not the only outcome of the research conducted under this program. While the United States is currently a leader in terms of the development of Ultra-deepwater and Unconventional Resources, other nations around the world are beginning to see these resources as an important component of a plan to move toward a lower-carbon, sustainable energy mix. While development of these resources in the U.S. directly yields thousands of high-paying domestic jobs, the research efforts funded by this program are helping to keep U.S. companies in the forefront of energy technology worldwide.

The portion of the Section 999 program covered by this plan includes an authorized expenditure of $100 million, subject to appropriation, in excess of the $50 million directed spending associated with the RPSEA administered program and the NETL Complementary program. During the first three years of the program, the RPSEA solicitation process has been able to generate qualified proposals for several times the amount of funding available. The model and process used for the program could thus readily support additional appropriated funds, with the associated increased impact on the

energy supply in the U.S. and the global competitiveness of the U.S. energy technology industry. With significant opportunities well in excess of available funds, RPSEA will continue to high-grade and prioritize funding needs and coordinate with the NETL complementary program.

2010 and 2011 Planning

The Ultra-deepwater Program for 2007 and 2008 was divided into theme areas based on four generic field types that represent the most challenging field development scenarios facing ultra-deepwater operators in the Gulf of Mexico: low permeability reservoirs, flow assurance, small field development, and high pressure/high temperature. RPSEA solicited R&D projects to develop technologies that will facilitate development of these field types. For the 2009 solicitations, six need areas further defined the four field development scenarios:

- Drilling, completion, and intervention breakthroughs
- Appraisal and development geoscience and reservoir engineering
- Significantly extend subsea tieback distances/surface host elimination
- Dry trees/direct well intervention and risers in 10,000 foot water depth
- Continuous improvement/optimization of field development
- Associated safety and environmental concerns

The focus for UDW in 2010 continued to address the themes articulated for the four generic field types by addressing the six heretofore described needs areas.

In 2011 the UDW Program will prioritize technology needs and continue to develop and mature selected projects. In addressing the higher-level goal of accelerating the development of resources into reserves, the program will strategically begin combining previously developed technologies into cohesive and comprehensive systems that address the overall needs and lead toward field demonstrations, and ultimately to commercialization. As such, the UDW program will move generally to fewer and larger projects, emphasizing cross cutting projects where possible.

While the general focus remains the same, the UDW Program 2011 solicitations will center around the following themes:

- Emergency prevention, preparedness, response and recovery
- Next phase projects based on completed projects from the 2007 and 2008 program
- Specific project ideas to fill-in identified technical gaps
- Graduate Student and Innovative/Novel projects

An added emphasis on environmental and safety issues will be addressed through needs identified as a result of analysis of the Deepwater Horizon incident. These are likely to include analyses of systems integrity in ultra-deepwater environments, environmental

studies regarding the potential impact of ultra-deepwater operations, as well as specific technology developments aimed at increasing the safety of offshore operations.

The **Unconventional Resources Program** for 2007 through 2010 focused on three theme areas that target gas shales, water management for both coalbed methane and gas shales, and tight sands, emphasizing unconventional natural gas rather than "other petroleum resources" (e.g., shale oil, oil sands, deep gas). The 2010 program will see the continued population of the portfolio set forth in the early foundational years. For 2011, the focus on unconventional natural gas remains essentially unchanged, with integration and application of project results as a particular priority. While safety and environmental impact have been key elements of the program since its inception, the 2011 plan includes specific efforts to more fully define the risks associated with unconventional gas development and ensure that appropriate technologies are available to mitigate those risks. As with the UDW program, evaluating and ensuring systems integrity will be a key issue for the Unconventional Resources program. In addition, the 2011 DAP contemplates an emphasis on specific geographic areas to broadly incorporate the components of the existing portfolio and begin the transition to field scale demonstration projects.

The **Small Producer Program** for 2007 through 2010 targeted advancing technologies for mature fields, which primarily covers the technology challenges of managing water production, improving recovery, and reducing costs. Mature fields are the domain of small producers, and they face these three challenges on a daily basis. Accordingly, the initial solicitations under this program were aimed toward developing and proving the application of technologies that will increase the value of mature fields by reducing operating costs, decreasing the cost and environmental impact of additional development, and improving oil and gas recovery. The 2010 solicitation will continue this building process. For 2011, the focus will remain on the theme of advancing technology for mature fields; however, opportunities will be sought to complement the project selections in the 2007 through 2010 programs by funding research that builds upon earlier results and expands their geographic application.

Chapter 1 Strategic Overview

RPSEA Mission, Goals and Objectives

The primary mission of RPSEA as applied to Section 999 of EPAct is to administer a program of *"research, development, demonstration, and commercial application of technologies for ultra-deepwater and unconventional natural gas and other petroleum resource exploration and production, including addressing the technology challenges for small producers, safe operations, and environmental mitigation (including reduction of greenhouse gas emissions and sequestration of carbon)."*

All RPSEA activities contemplated in this DAP are focused on achieving this mission. This fifth year plan is RPSEA's continuing effort toward meeting the more specific goal in EPAct of *"[maximizing] the value of natural gas and other petroleum resources of the United States, by increasing the supply of such resources, through reducing the cost and increasing the efficiency of exploration for and production of such resources, while improving safety and minimizing environmental impacts."* As the Section 999 program has a sunset date of September 30, 2014, this plan will include provisions for managing the program in a way that will ensure that the funds allocated in the program's final years are effectively deployed to meet the specific goal above.

RPSEA, as the program consortium selected by DOE, is directed by statute to administer a program of research, development, demonstration, and commercialization in two of the nation's most promising, but technically challenged, natural gas and petroleum resource areas:

- Ultra-deepwater integrated system technologies and architectures for water depths in excess of 1,500 meters or drilled depths greater than 15,000 feet in the Outer Continental Shelf (OCS)

- Unconventional natural gas and other petroleum resource E&P technology, with unconventional being defined as economically inaccessible. This resource-based, prioritized, research program focuses on converting technically recoverable tight gas sands, coalbed methane, and gas shales resources to economic gas production.

Further, RPSEA is required to specifically address the unique technology challenges of small producers through a consortia approach. This research component is focused on advancing technologies for mature oil and gas fields. Small producers are defined as those with production of less than 1,000 barrels oil equivalent per day (BOEPD).

Safety and Environmental Stewardship

The resources targeted by the Section 999 program have the potential to increase America's energy security and provide a stable and abundant supply of low-carbon natural gas that opens the possibility of significant near-term reductions in carbon emissions associated with transportation and power generation. This potential cannot be

realized unless these resources can be developed safely and with minimal risk to the environment. The Deepwater Horizon incident has called into question the risk management capability of the oil and gas development industry. It is essential that research be conducted to ensure that the risks associated with the development of ultra-deepwater and unconventional resources are fully understood and that reliable processes and procedures are in place to prevent incidents and mitigate the impact of any incidents that do occur. It is not enough that industry experts feel that operations can be conducted safely and with minimal environmental risk. In order to assure timely development of these important resources, the public and the regulatory bodies must be fully convinced of the capabilities of the oil and gas industry for safe development of these challenging resources.

Proactively embedded in the DAP and cross-cutting all elements of the Program is a focus on the environment, including projects that minimize or mitigate environmental impact or risk, mitigate water usage, reduce the "footprint," and lower emissions. This plan includes elements that focus specifically on understanding the risks associated with oil and gas development operations and developing technologies to mitigate those risks. In addition, all projects in the Program will be evaluated for potential and ongoing environmental impacts as applicable, both positive and negative, to ensure that these impacts are fully understood during project selection and management.

There are currently a number of efforts under way to understand and evaluate the risks associated with ultra-deepwater operations and the development of shale gas through hydraulic fracturing. The sections of this DAP describing each program element include a commitment to research specifically directed toward relevant safety and environmental topics, and include sufficient flexibility to ensure coordination with other efforts that may be ongoing when this plan is executed.

Research Program Development Principles

In the United States, energy demand is growing at the same time the domestic natural gas and oil industry is transitioning from "harder to find and easier to produce conventional reservoirs, to easier to find and harder to produce unconventional reservoirs." The United States, however, is not resource poor, but rather resource long and technology short. This technology dearth, in turn, places substantial new demand on the nation's research infrastructure to meet the challenge of developing the portion of the resource base addressed in this DAP.

It is the obligation of RPSEA and the goal of this DAP to appropriately balance the critical research needs of the Program with the capabilities of the research community and, in so doing, meet its responsibility to the American public - developing technologies to enhance domestic energy supplies in environmentally responsible ways.

As recommended in the 1999 NPC Natural Gas Supply study, *"the government should continue investing in research and development through collaborations with industry, state organizations, national laboratories and universities."* The research collaboration envisioned in this Program is critical; integrating these diverse but capable sectors in the energy research value chain represents one of the largest challenges for the Program, as well as one of its greatest potential rewards.

It is important that a fundamental point be understood prior to discussing other guiding principles for RPSEA's portfolio development: the Program mission cannot be achieved without a vibrant and diverse technical workforce of scientists and engineers. This entails a strong organizational commitment to the academic and research community, and a Program structure that specifically enables their unique problem-solving and innovation capabilities. The active engagement of the research community ensures that the program is able to look-ahead toward future challenges as well as respond effectively to current needs. This robust R&D emphasis also supports the nation's intellectual capital, helping to maintain America's global technological leadership position, as the universities are the training ground and consequently the source for this skilled workforce.

RPSEA will be instrumental in advocating the advanced technology aspects of the natural gas and oil E&P industries sufficient to attract the best minds in the energy technology industry.

RPSEA works to educate both the professionals in the oil and gas industry and the general public on the issues surrounding technology development and deployment and the corresponding public benefits. RPSEA:

- Works with industry to enhance technology transfer and deployment, demonstrating technology utilization as technologies are developed
- Encourages public appreciation of the natural gas and oil industry as both an innovator and consumer of technology solutions through its communications efforts

It is critical, also, to acknowledge the importance of a collaborative partnership with industry to the success of the mission; academic research, while absolutely necessary, is clearly not sufficient. Along with other research institutions, industry, as the ultimate enduser investing in the application of the technologies developed in this Program, must play a key, and in many instances, the lead role in technology development. This is particularly true as projects move to the development and demonstration phase.

A key goal for RPSEA is "improving safety and minimizing environmental impacts". The benefits of access to additional energy resources cannot be realized unless those resources can be reliably produced with minimal risk to the public, oil and gas development personnel, and the environment. Additionally, the risks associated with oil and gas development in the targeted resources must be transparent and understood not just by industry, but by the public and the regulatory bodies charged with ensuring the

safety of the public and the environment. Additional effort in the 2011 plan will be directed toward evaluating the risks associated with oil and gas development in ultra-deepwater and in unconventional gas resources and technology development to mitigate those risks. These efforts may include environmental studies to fully understand how technologies can preserve, protect, or restore natural resources. In addition to participation by industry and research organizations, active engagement with regulatory bodies, environmental organizations, and the public will be critical to the successful application of technologies that will enable the development of these resources. The status of RPSEA as a public-benefit organization with active engagement of industry and other stakeholders provides a unique opportunity for a significant near-term impact on the safety and potential environmental impact of oil and gas development operations.

RPSEA's research portfolio includes projects that focus on near-term and longer-term time scales. It will seek to mitigate research investment risks by building upon early successes and providing stringent mechanisms for interim continuation or termination decisions on individual projects. RPSEA's portfolio of projects specifically seeks to:

- Create leverage wherever possible on funding, personnel, equipment, operations, and other resources
- Create synergies through integration or investments in cross-cutting and enabling technologies, allowing the whole to be greater than the sum of its parts
- Allow for investment in high-risk, high-reward activities and ensure that good project management derives maximum learning benefit from failures that are expected from a portfolio with an appropriate risk profile
- Avoid the funding of many disparate small and/or one time, single-use projects, which generally minimize the potential for high-impact results
- Conversely, focus on a relatively fewer number of larger and/or higher potential projects, which create legacy opportunities with appropriate provisions for follow on funding and resources
- Provide for coordination with the complementary program administered by NETL to maximize the federal investment in the Section 999 program
- Identify technologies outside of the natural gas and oil industry that may have application to help achieve the mission of the Program
- In concert with the DOE/NETL, strongly emphasize technology transfer to effectively disseminate the results of the R&D

Reliable and reasonably priced natural gas and oil supplies will be a critical component of a future energy mix that combines near-term use of traditional sources and long-term development of alternatives with conservation and energy efficiency. In order to achieve this mix, the Program must balance incremental technology developments with breakthrough technologies, such as grand challenges that will have fundamental and lasting impact for energy consumers. This necessarily entails multiple perspectives to identify problems, as well as solutions. This DAP must encourage and make provisions

for "out-of-the-box" approaches and applications to enable powerful entrepreneurial enterprise and innovation. Further, RPSEA must provide safeguards against "development by committee" and promote a commitment to technology transfer, as well as commercialization.

Fostering research that is commercially viable that enables faster-than-average adoption will enhance the industry's role as both a "high-tech" developer, as well as a consumer, and will help attract the best minds to the energy industry.

These attributes of portfolio construction are graphically depicted below in Figure 1.1. This strategic triangle developed by the Strategic Advisory Committee (SAC) conveys Program timeframes against the spectrum of technology development levels from basic to applied. It also depicts a broad foundation of projects in early years migrating to fewer, more focused, field demonstration projects, which are outgrowths of the early foundation projects. Not all early projects will develop. Finally, grand challenges are superimposed, as they can leapfrog the conventional development cycle.

For 2011, the RPSEA program has moved upward in the triangle depicted in Figure 1.1. As will be described in the individual program element chapters, there will likely be fewer projects selected in the 2011 program. In some cases, early feasibility studies have laid the groundwork for larger demonstration projects. In other areas, the results of successful projects from previous years will be integrated into larger efforts and applied in field tests or other activities that address the challenges associated with the development of the targeted resources. In addition, it is likely that some longer-term projects will be planned to be funded with 2012-2014 program year funds. Clear decision points will be established, beyond which funding will depend not only on successful preliminary results, but also the availability of funds in future program years. By the time the draft Annual Plans for the 2013 and 2014 program years are developed, it is likely that the bulk of those years' funds will be committed to existing projects. Planning now for the effective use of 2012-2014 program year funds will allow the program to maximize its impact through the 2014 end date, as well as provide the means to plan and manage the larger scale projects that will be necessary as the program moves toward the integration and application of earlier results.

Finally, it should be noted that the program has been able to consistently attract high-quality proposals significantly in excess of the available funding. For example, the 2008 and 2009 Unconventional Resource solicitations resulted in the submission of proposals requesting over $167 million in funding. The technical reviewers and the PAC felt that approximately $85 million of requested funding represented relevant, well conceived proposals backed by strong research teams that could be expected to yield solid dividends in term of enabling additional reserves and production; however, only $27 million in funding was available for the two program years. The roughly $58 million in qualifying projects that were not funded represents a resource of work that could be initiated rapidly to have a near-term impact on the nation's energy supply should additional funding become available.

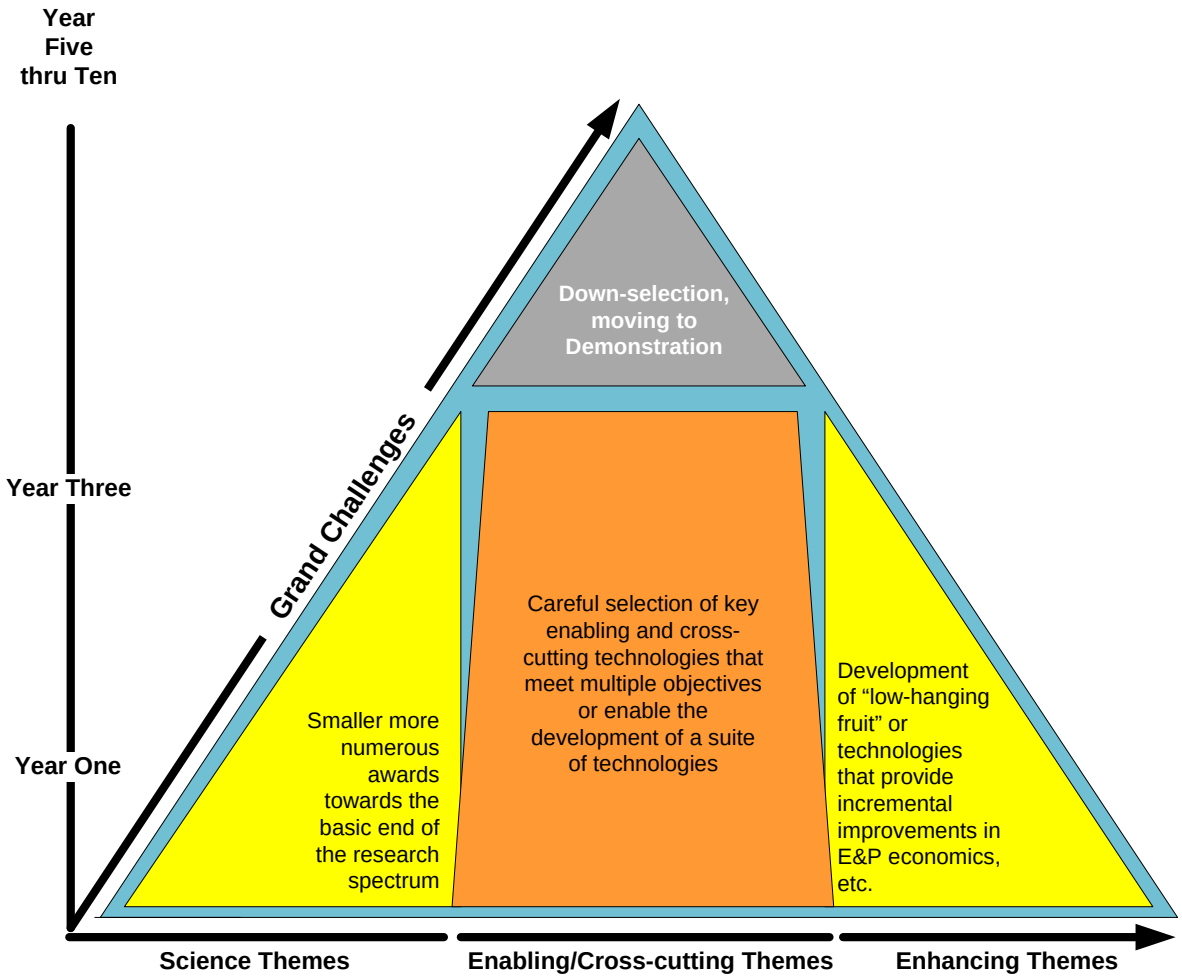


Figure 1.1: SAC Research Portfolio Guidance

Draft Annual Plan Organization

Following the structure of the strategic triangle in Figure 1.1, this fifth-year DAP builds upon the foundation laid by the 2007 through 2010 Annual Plans and incorporates lessons learned and evolving technology and resource needs. It seeks to transition the early-term research portfolio into a more specific later-term portfolio. It retains the fundamental components of the years 2007 through 2010 Annual Plans as follows:

- Four ultra-deepwater field types have evolved to six industry needs
- Three unconventional resource types
- One small producer technology challenge

While RPSEA has established a generic process to identify resource targets, opportunities, barriers, research themes, and thrusts for the research plan, there are process differences across the Program. Table 1.1 details these variations in industry structure and the ramifications for RPSEA management in the development of the DAP.

	Industry Structure	Research Management Implications
Ultra-Deepwater Program	• Relatively small number of industry players • Significant capital requirements • Consistent but evolving national regulatory environment • Some internal research capability • Very high-cost, high-risk working environment • Industry players operating in major UDW basins worldwide	• Focus on infrastructure/harsh environnemental conditions • Setting priorities with industry input critical to success • Potential to provide significant cash matching funds • Demonstration is very expensive. High value on risk avoidance forces limited number of focus areas • Formal collaborative research model exists • Opportunity for synergy with other UDW research programs (DEMO, PROCAP etc) • Need to engage regulators, environmental organizations and other stakeholders in setting research priorities that address risk, response and clean-up technologies
Unconventional Resources Program	• Large number of players, some very small in size • Somewhat limited access to capital • Multiple regulatory jurisdictions • Limited internal research capability • Ability to adopt new technology varies • Technology issues vary considerably with geographic/geologic area	• Focus on production/geology/environmental issues • Need to identify and pursue specific resource targets • Less potential for cash matching funds, but history of in-kind contributions • Formal tech transfer mechanisms exist, but are challenging due to the high diversity of the users • Historical, but no current formal collaborative research model • Research programs need to be designed with geographic area and technology user in mind
Small Producer Program	The number of small producers is more than 10,000 in diverse regions and resources with: • Limited access to capital • Multiple regulatory jurisdictions • No internal research capability • Limited or no capability to internalize new technology • Threats from technical, environmental, and market challenges	• Focus on geology, environmental, regulatory compliance, cost reduction • Must work with small producers to identify issues that impact small producers across and within regions • Little potential for cash matching funds but history of in-kind contributions • Formal tech transfer mechanisms exist, but are challenging due to the high diversity of the users • Some successful examples of collaborative research exist • Small producers may lack the staff to internalize complicated technology, so tech transfer must involve appropriate service providers

Table 1.1: Variations by Programs

This DAP has been written by RPSEA in consultation with its BOD. In addition, input has been provided by NETL throughout the process. Each of these three programs is individually outlined in the chapters that follow.

Chapter 2 Background

Energy Policy Act of 2005: Section 999

The Energy Policy Act of 2005 (EPAct), Title IX, Subtitle J, Section 999 (Section 999) supports oil and gas research and development (R&D) through a program of research, development, demonstration, and commercial application of technologies for ultra-deepwater and unconventional natural gas and other petroleum resource exploration and production to maximize the value of natural gas and other petroleum resources of the United States.

Section 999 sets the funding for the Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program (Program) at a level of $50-million-per-year provided from federal lease royalties, rents, and bonuses paid by oil and gas companies. The funds are to be directed towards research specifically targeting four areas: ultra-deepwater resources, unconventional natural gas and other petroleum resources, technology challenges of small producers, and research complementary to these areas. The complementary research is being performed by the National Energy Technology Laboratory (NETL), while all other research is administered by the Research Partnership to Secure Energy for America (RPSEA). See Table 2.1 for a breakdown of funding as directed by Section 999.

The investment in research provides the public with a two-for-one benefit. New federal revenues are created because much of the technology investment impacts natural gas and oil production from federal lands, and the projects enhance the nation's intellectual capital through the process of new technology development. The technology also applies to nonfederal lands, which although not directly providing federal royalties do make a significant contribution to gross national product and domestic energy security. Technically challenging resources cannot be fully exploited to their full public economic and security benefit potential without the necessary technology.

One example of such a needed technology is the 2008 Unconventional Resources Program selection on ***Coupled Flow-Geomechanical-Geophysical-Geochemical Analysis of Tight Gas Production***, led by Lawrence Berkeley National Laboratory. The emergence of extraordinary unconventional natural gas resources has in a very short time frame completely changed the domestic energy outlook. However, the flow mechanism for these huge resources is still not well understood: this critically important project seeks to advance the understanding of how all the factors are coupled to characterize and optimize gas flow from these relatively impermeable formations. While industry has done a remarkable job of iteratively advancing its operational processes to enable economic production, efficiency still needs to improve to reduce the overall costs and much still remains to be learned to further advance production with reduced environmental footprint. Overlaying the science from this work onto existing field operations is not something that market forces would normally incentivize and is the appropriate application for advancement through a public/private partnership.

To enable high-payoff activities and attain longer-term national goals, especially national security and increased energy independence, there must be extensive collaboration of researchers and service providers, both supported by industry. This extensive collaboration is not easily achieved with current industry constraints and market incentives; it can only happen with effective public policy and leadership. Therefore, a fundamental objective of the Program is to generate collaborative projects that are not well suited or practical for industry to perform without an incentive. The Program will achieve this goal by combining the unique and valuable contributions of industry, academia, and the research community leveraged by significant public investment. This is especially crucial for independent producers who drill 90 percent of the wells in the United States and produce 82 percent of the nation's natural gas and 68 percent of our nation's oil, yet in general have little or no internal technology development capability. (www.ipaa.org/issues/testimony/IPAATestimony-HouseOversiteGovtReform10-31-2007.pdf).

Each program has specific examples of such collaboration. An example in the 2008 Unconventional Resources Program is the project selection of **the *Environmentally Friendly Drilling Systems Program***. While the potential for unconventional natural gas is now clearly demonstrated by investment and production increases, it still requires drilling wells to access the resource. This project seeks to optimize the drilling process to assess trade-offs and establish balance among various interests using the land. This is especially relevant to urban areas and to public lands in the West. This project has over 15 diverse participants bringing a variety of perspectives and expertise to address this critical issue. Another example is the 2008 UDW selection on ***Coil Tubing Drilling and Intervention System Using Cost Effective Vessels*** project. Recovery factors in the ultra-deepwater of the Gulf of Mexico (GOM) are directly related to intervention costs, and federal royalties are a function of recovery factors. By lowering the cost of intervention, producing fields can produce more hydrocarbons at lower costs from existing environmenal footprints, thereby increasing federal royalties and enhancing domestic energy security. Yet another example is the 2008 Small Producer selection on ***Electrical Power Generation from Produced Water*** project. This project advances the technology to capture thermal energy from existing waste streams and converting it to generate electricity, thereby lowering operating costs, which in turn prolongs well life and increases recovery. An added benefit lies in the fact that since the electrical energy is geothermally generated, it produces no greenhouse gas emissions.

A. Consortium Selection

NETL contracted with RPSEA, a 501(c)(3) nonprofit corporation, to administer the distribution of approximately $32 million per year in R&D contracts (Table 2.1). The federal government will maintain management oversight of the Program, and RPSEA's administration funds are limited to no more than 10 percent of the funds.

Area	Allocation	Area Funds	NETL Review & Oversight 5%	RPSEA Administration 10%	R&D Funds for Distribution
Ultra-Deepwater	35%	17,500,000	875,000	1,750,000	14,875,000
Unconventional Resources	32.5%	16,250,000	812,500	1,625,000	13,812,500
Small Producer	7.5%	3,750,000	187,500	375,000	3,187,500
Consortium Total		37,500,000	1,875,000	3,750,000	**31,875,000**
Complementary	25%	12,500,000	0	0	12,500,000
Section 999 Total	100%	50,000,000	1,875,000	3,750,000	44,375,000

Table 2.1: Distribution of Section 999 Funds ($)

RPSEA is organized as a consortium and has a broad membership base that includes representatives from all levels and sectors of both the oil and gas exploration and production (E&P) and oil and gas R&D communities. RPSEA is currently comprised of over 160 member firms. For a complete list of RPSEA members, see Appendix A. RPSEA members represent virtually all critical elements of the natural gas and oil supply technology value chain. This breadth of membership helps ensure that consortium-administered R&D funds are directed towards key problems in ways that leverage existing industry efforts. A variety of advisory committees and meetings drawn from this membership are incorporated into RPSEA's planning process, as well as in the recommendation of R&D projects to be awarded and the review of project results. Collectively, this network has accounted for approximately 21,600 hours of volunteer participation, the value of which cannot be over-emphasized and could not otherwise be easily procured at any cost. This voluntary participation has occurred because industry recognizes the value to economically and efficiently find and produce natural gas and oil, which ultimately benefits American consumers and supports a program of wide-ranging methods to increase energy supply.

The companies, universities, and other organizations that receive funds through this Program will provide cost-share contributions of at least 20 percent of total project costs. The involvement of industry partners in all phases of the oil and gas R&D process increases the likelihood that technologies developed by the Program will move into the marketplace.

RPSEA is a new model for public/private partnership that has never existed at this scale in the natural gas and oil industry and resembles the model recommended by the 1999 National Petroleum Council (NPC) study. Using a collaborative approach with industry, academia, and government to advance technology, RPSEA's membership includes E&P corporations, service companies, research organizations, universities, national labs, financial entities, nonprofits, and consumer and civic organizations. In addition, through

the Environmental Advisory Group, RPSEA has established a collaboration with prominent environmental organizations. This "network of networks" avoids reinventing the wheel by utilizing and leveraging the robust individual capabilities of the network components. Moreover, member company volunteers are subject matter experts in their lines of work who routinely collaborate to solve problems and fill the most important technology needs. The model, uniquely developed for the natural gas and oil sector, seeks to replicate the success of other models developed for other public and private sectors such as the National Aeronautical Space Administration and the Defense Advanced Research Projects Agency, which employed flexible, innovative, and relevant methods to achieve their objectives by matching capabilities with needs and goals.

B. RPSEA Structure

Key features of RPSEA's organization are illustrated in Figure 2.1. RPSEA is the consortium competitively selected by the Department of Energy (DOE) to administer three programs of Section 999. Information on RPSEA and its members can be found at this link, RPSEA Members, and membership is depicted in Appendix A.

The key features of RPSEA's organization are illustrated below showing the broad process of engagement both internally and externally.

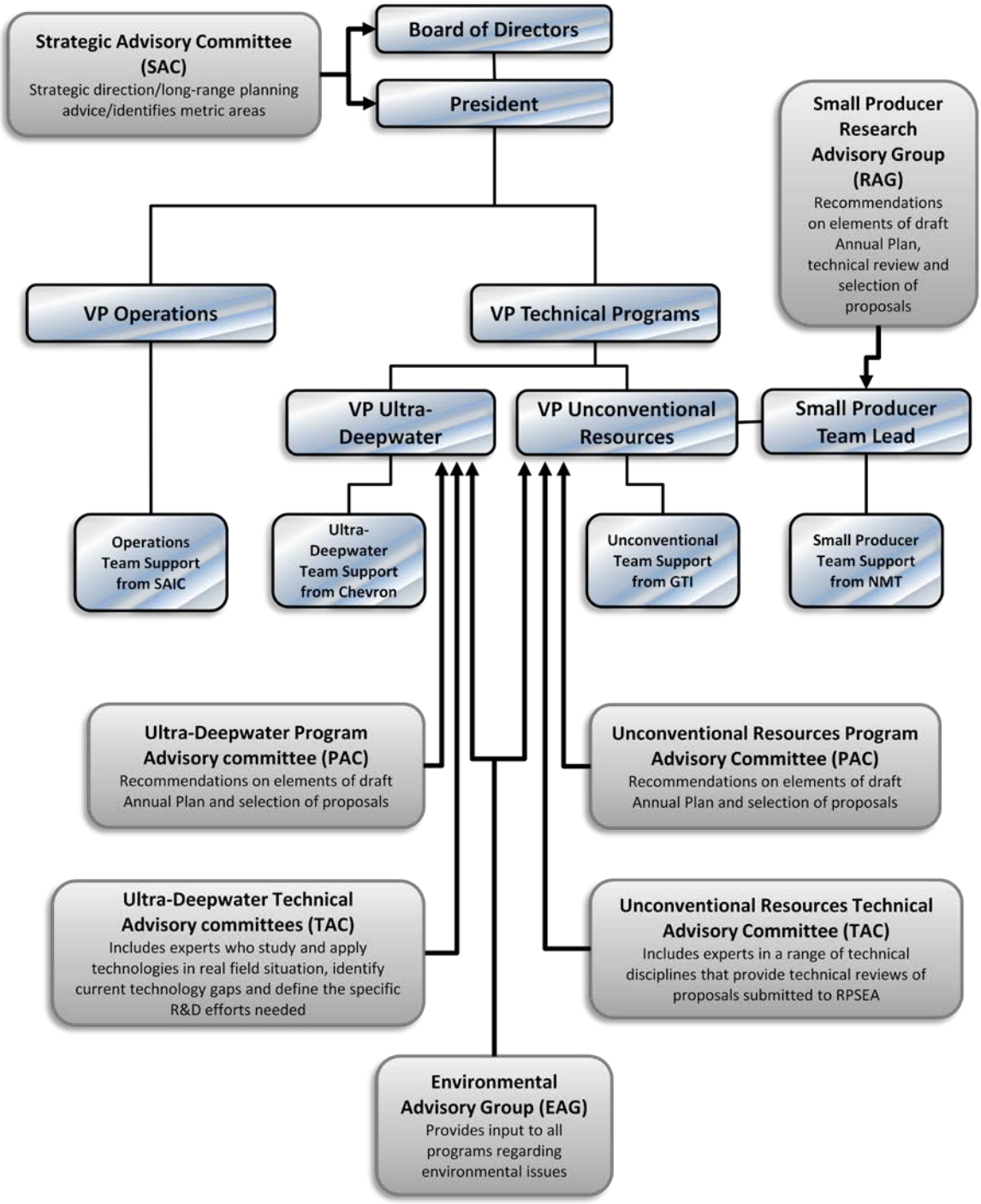


Figure 2.1: Organization of RPSEA and Advisory Committee Relationships

The makeup of the Board of Directors and the external advisory committees and groups are provided in Appendix A, and their respective roles are described below.

Board of Directors (BOD) - In addition to operational oversight, the BOD provides significant input and direction to the preparation of the RPSEA Draft Annual Plan (DAP).

RPSEA has a diverse BOD, whose members are each renowned for their expertise and give RPSEA valuable guidance. RPSEA bylaws require a two-thirds, super majority vote for approval of the DAP.

Strategic Advisory Committee (SAC) - RPSEA established the SAC to provide strategic direction, advice on the shape of the research portfolio, long-range planning recommendations, and metrics determination to the BOD and to the president. The SAC is comprised of a group of industry leaders in the energy field, including both RPSEA members and nonmembers. The SAC provides guidance regarding the process used to develop the RPSEA DAP, the proposed R&D portfolio, and the metrics to be used to track progress toward Program goals.

Environmental Advisory Group (EAG) - Environmental stewardship is at the core of all RPSEA activities. The EAG is designed to provide input to the Program regarding environmental issues. It organizes and brings together key experts and policy leaders from academia, regulatory entities, nongovernmental organizations, and industry for road mapping exercises to identify key regulatory barriers/issues. As requested, the EAG reviews programs, projects, and plans to ensure that environmental issues are appropriately addressed. The EAG also serves in a liaison capacity with various environmental programs and organizations across the United States. The role of the EAG will be expanded in the 2011 program to ensure that appropriate priorities are placed on relevant and needed environmental studies to fully understand how technologies can preserve, protect, or restore natural resources. In addition, operational safety will be a key element of the 2011 program, and advice will be sought through the EAG or other appropriate resources.

Program Advisory (PAC) and Technical Advisory (TAC) Committees - The roles of the PACs and TACs within each program are further defined in Chapters 5 through 7, as they are specific to each program. Generally, the PACs provide recommendations on elements of the proposed plan, but primarily make project selection recommendations from the pool of reviewed proposals into an integrated R&D portfolio. The TACs provide subject specific technical advice on the development of the proposed plan and conduct the quantitative proposal reviews at the direction of the PACs.

Small Producer Research Advisory Group (RAG) - The Small Producer Program receives guidance from the RAG consisting of industry and academic representatives that are closely tied to the national small producer community. The RAG reviews proposals, makes project selection recommendations, and follows each selected project's progress, plans, results, and especially, technology transfer. All projects are reviewed by the RAG annually. While the RAG is responsible for directing the Small Producer Program, the Unconventional Resources Program PAC remains responsible for oversight of the entire onshore program, which includes the Small Producer Program.

In addition to the BOD and the advisory committees described above, RPSEA has contracted with four organizations: Chevron, through the Chevron-administered DeepStar Consortium (DeepStar); Gas Technology Institute (GTI); Science Applications

International Corporation (SAIC); and New Mexico Institute of Mining and Technology (NMT), as part of its management team.

RPSEA's Management Approach
RPSEA's approach to the administration of this critical and innovative Program is intended to provide substantial benefits to American consumers by meeting significant public policy objectives. Key features of this approach include:

- **Broad and deep stakeholder engagement** to accurately identify and expertly execute high-impact research
- **A rigorous technology portfolio management structure** to align programs, projects, technologies, and technology transfer with the high-level strategic objectives of the statute
- **Integration of diverse programs** into a cohesive and coherent program that maximizes programmatic impacts
- **Aggressive, informed, and effective technology transfer** focused on each step of the technology maturation process to ensure maximum technology penetration and diffusion in the marketplace

C. Planning Process

In late 2006, NETL contracted with RPSEA to begin its work with an effective date of January 4, 2007. RPSEA submitted its first DAP to the DOE on April 3, 2007. In November 2007, RPSEA provided recommendations for the 2008 Annual Plan. In August 2008, RPSEA provided recommendations for the 2009 Annual Plan, and in July 2009 it did the same for the 2010 Annual Plan. RPSEA will continue to provide Annual Plan input each July on a regular cycle.

Each year, the Annual Plan for the Program must be published by the Secretary of Energy (Secretary) before the solicitation of R&D project proposals can begin. Prior to submitting the Annual Plan to the Secretary, the legislation calls for the DOE to gather input on the Annual Plan from Federal Advisory Committees (FACA), as well as from other industry experts. These two committees are the Ultra-Deepwater Advisory Committee (UDAC) and the Unconventional Resources Technology Advisory Committee (URTAC). The DOE's Office of Fossil Energy is responsible for organizing both of these committees. This approach is designed to bring together a broad range of ideas to ensure that the Program returns the maximum benefit to the nation.

Upon publication, the Secretary must transmit the Annual Plan to Congress, along with the recommendations of RPSEA's DAP, the advisory committees, and any other experts from whom comments have been received. Each Annual Plan must include details of: ongoing activities; a list of solicitations for awards to carry out research, development, demonstration, or commercial application activities, including topics for such work; that would be eligible to apply; selection criteria; duration of awards; and, a description of the activities expected of RPSEA to fulfill its administrative responsibility.

Timely approval and implementation of each Annual Plan is critical to effective results. Achieving these results within the finite time specified by Section 999 requires that each year's plan build upon previous years as an integrated and evolving Program. Subsequent year solicitations and project selection are a function of proposals received in a given year, and gaps are identified and addressed as quickly as possible. Groundwork is laid within the research and producer community to assemble the teams to propose. Commitments are made to secure human and capital resources well in advance. Delays in plan approval and/or transmittal, research solicitations, or in project selection and award complicate and discourage participation. Unrelated schedule disruptions significantly impair Program effectiveness and undermine the efforts of all those involved. It also pertains to universities who seek to recruit, incentivize, and schedule students to participate in projects.

RPSEA has received broad and diverse input from its member organizations, as well as from additional experts. Input was solicited and/or developed from:

- Twenty-seven RPSEA member forums held in various regions of the country. Universities have served as hosts of the majority of the RPSEA member forums. While RPSEA members hosted the forums, participation was not limited to RPSEA members. Member forums included 1457 individual participants representing multiple organizations with interests in technologies to enhance domestic natural gas and oil production. Most of these forums have been oriented to the Unconventional Resources Program and the Small Producer Program. While a few of the forums have been oriented to UDW, the primary inputs for UDW are the TAC meetings and an annual TAC Conference. Additional forums and meetings are continually planned in order to secure input to future plans and R&D solicitations.
- Multiple individual meetings and contacts with individual RPSEA members, who cover a broad spectrum of knowledge and expertise and provide the backbone of the program strengths
- RPSEA's PACs and the RAG for general guidance and project selection, the various TACs and the RAG for technical gap identification, and the SAC for high level direction
- Federal and state government agencies; non-oil and gas stakeholder groups including for example, the Nature Conservancy, the Groundwater Protection Council, and the National Resources Defense Council (NRDC) among others; state, regional, and national hydrocarbons organizations, and national and international technical societies
- Managers and vice presidents of all RPSEA Programs, to focus on cross-cutting technologies, opportunities to further integrate the knowledge base, and identifying key elements for further collaboration and study
- Key representatives from NETL in events and planning exercises to enhance complementary efforts, eliminate the likelihood of competing evaluations, ensure open lines of communication, and identify knowledge-based opportunities

- Multiple road-mapping exercises conducted by the DOE, RPSEA, and others prior to 2007

The process of integrating these inputs is illustrated in the schematic shown in Figure 2.2, which describes detailed steps leading to the development of the DAP. It should be noted that this is an iterative process, both initially and over time, that is not precisely linear. The process itself lends strong transparency to how the DAP is developed, ensuring that no one interest can dominate. This holds true for project selection and portfolio development, where the open and robust process with multiple inputs overrides possible individual biases and provides invaluable credibility. This process is ongoing.

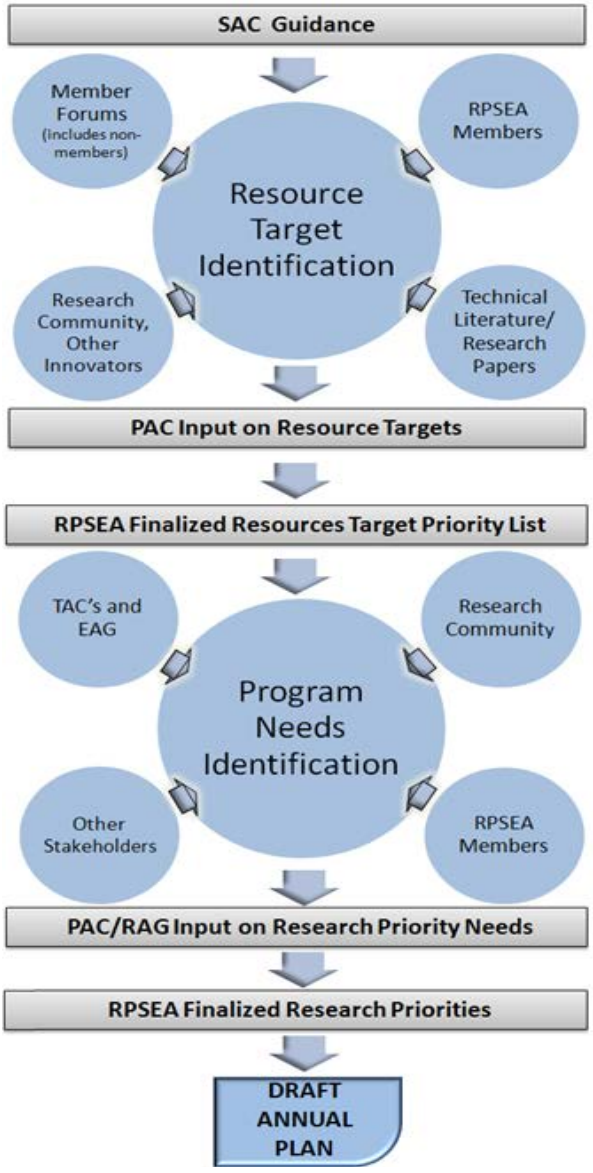


Figure 2.2: RPSEA DAP Development Process

Chapter 3 RPSEA Accomplishments

The primary accomplishment of the RPSEA program is the engagement of technical experts across the spectrum of disciplines and stakeholder organizations to form an active research program developing new technology to meet the program goals for each of the program elements. Information on the 72 projects that have been awarded and the 28 projects that have been recently selected is provided in the Chapters for each program element. RPSEA has also made significant organizational progress towards the overall, high-level goals of the Program. These accomplishments are listed below.

- Commenced a new, fully-functional management structure and developed compliant policies and procedures specifically for administering Section 999 for the Program
- Developed a federally compliant set of policies and procedures for a new revolutionary Program, including management and operating plans
- Obtained federal certification of RPSEA's Procurement System, thereby expediting the approval process for research awards
- Successfully completed independent third party and federal accounting system audits with no material weaknesses
- Launched a new, content-rich website to support strategic communications, technology transfer, and the solicitation process
- Established a comprehensive advisory committee network
- Built support among oil and gas research and industry constituencies
- Increased membership within the different oil and gas community stakeholder groups. RPSEA currently has 168 members.
- Promoted links to other associations and members and has utilized the RPSEA website as a "network of networks"
- Initiated discussions and continued a series of meetings on technology collaboration with Norway's Demo 2000, United Kingdom's Industry Technology Facilitator (ITF) and Canada's Petroleum Research Atlantic Canada (PRAC). The objective of this collaboration is the identification and commencement of joint leveraged research opportunities.
- Developed the 2007 through 2010 Draft Annual Plans, which were the bases for the approved Program Annual Plans transmitted to Congress.
- Developed and issued research solicitations for the 2007 Program
    - Received and reviewed 99 research proposals and made 43 project selections
    - Successfully negotiated and awarded 42 of the 43 project selections in 2007
- Developed and issued research solicitations for the 2008 Program
    - Received and reviewed 116 research proposals and made 29 project selections

  - Successfully negotiated and awarded all 29 project selections in 2008
- Developed and issued research solicitations for the 2009 Program
  - Received and reviewed 97 research proposals and made 28 project selections
- Established a Fellowship/Scholarship Program with private funding of $255,000 for eight member universities, providing much needed support for 16 students per year over three years
- Established a RPSEA summer internship
- Hosted multiple membership meetings
- Held the RPSEA Small Producer Project Review meeting for the Small Producer Program in February 2009 and the Unconventional Gas Project Review meeting for the Unconventional Resources Program in April 2009
- Hosted the Unconventional Gas Resource Conference 2010
- Hosted the Small Producer Program Technology Showcase 2010
- Held 27 nationwide member technology input forums
- Established RPSEA Lunch and Learn talks at member organizations
- Participated/exhibited and/or sponsored/supported multiple industry functions
- Chosen as the 2009 Offshore Technology Conference (OTC) Invited Organization
  - This recognition was based on RPSEA's outstanding contributions to the offshore industry and included a full afternoon panel of RPSEA members and researchers and provided a highlighted booth space to showcase research projects underway.
- Chosen as a 2010 Offshore Technology Conference (OTC) Supporting Organization
- Sponsored the Young Professionals in Energy (YPE) website
- Sponsored the development of the Oil & Gas Innovation Center
- Sponsored Oil & Gas Innovation Center Showcase
- Sponsored an award at the senior level for the Science Engineering Fair of Houston
- Sponsored an award for the Best Energy Business Plan at the Rice Alliance competition for 2008 and 2009

In order for RPSEA to effectively meet the overall, high-level goals of this Program as described in EPAct and ensure that Program funds are used efficiently, RPSEA also set and met several goals, which were considered important to the day-to-day operations within the organization.

Diverse Membership

To broadly increase RPSEA membership to include all stakeholder groups in the oil and gas community, RPSEA has made great strides in growing its membership base. Membership has more than doubled since January 2007, growing from 66 members to the current membership of 168 members (Figure 3.1). These members represent 25 states, the District of Columbia and the Province of Newfoundland, Canada. As previously stated, these members collectively have more than 650,000 employees worldwide and represent approximately 55 percent of U.S. natural gas and oil production. Thirty-five percent of RPSEA membership is U.S. small businesses.

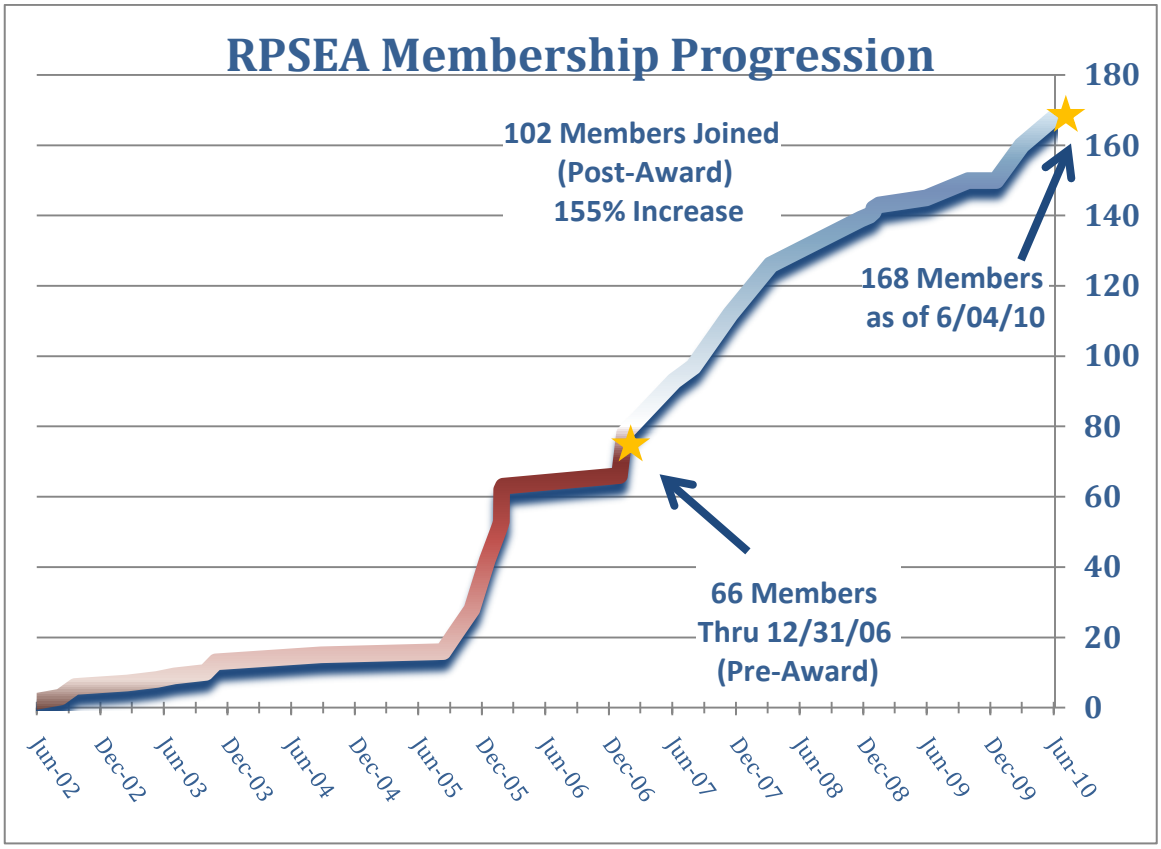


Figure 3.1: RPSEA Membership Progression

The overall RPSEA membership represents the diverse stakeholders in the oil and gas industry. The following graphic (Figure 3.2) depicts a percentage breakdown of RPSEA membership by industry group:

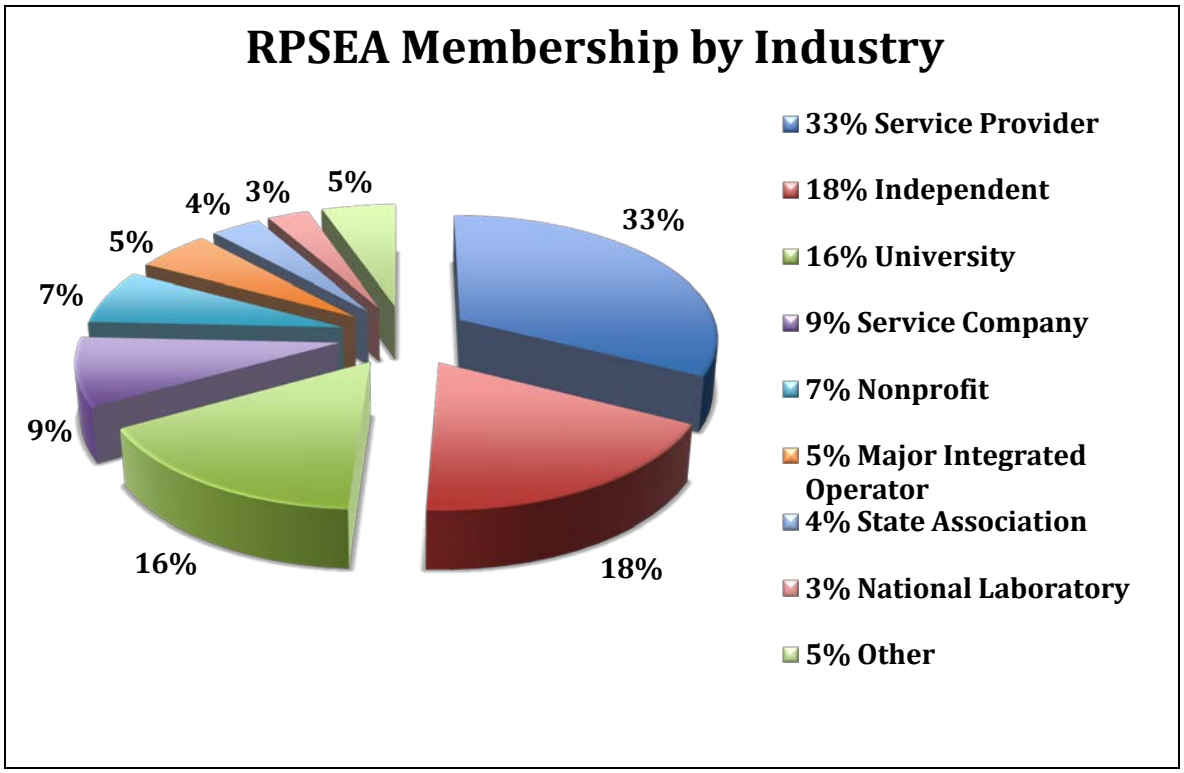


Figure 3.2: RPSEA Membership by Industry

Advisory Structure

RPSEA has developed a comprehensive advisory committee infrastructure from its diverse natural gas and oil constituency that efficiently and effectively provides input and direction to the overall Program goals, including development of high-level, program-level, and technical-level advisory committees, and small producer and environmental advisory groups. These groups meet multiple times a year to review overall Program goals, project ideas, and review and select projects. The PACs, TACs, and RAG have been the workhorse committees. In the overall process there have been 113 meetings with 2,372 participants who have volunteered approximately 9,100 hours of time and effort. As an example, the Ultra-Deepwater (UDW) PAC and TACs, combined, have met 79 times with 1,852 participants involving over 5,400 hours of time and effort. Participation on the advisory committees is an opportunity for industry experts to broadly ensure that the most promising technological approaches and solutions are brought to bear on the technical challenges associated with developing domestic resources. These advisory committees/groups are crucial for the successful execution of the Program and to ensure that the Program is aligned with the interest and requirements of industry, so that results will be rapidly applied to impact the nation's energy supply.

Member Forums

RPSEA has broadly reached out to involve the oil and gas community through an outreach program of technology forums, holding 27 forums hosted by member organizations (Table 3.1), in which 1,457 people participated (not including RPSEA, NETL, or the DOE personnel). This participation amounts to over 12,500 hours of participant commitment and does not include the hours of commitment from the host organization. The host commitment in terms of time, effort, and monetary support was substantial in all cases.

A list of the forums grouped by general themes and then sorted by date is as follows:

MEMBER FORUM	HOST	DATE
Ultra-Deepwater		
Technology Readiness Level Forum	Det Norske Veritas (USA)	2/23/2010
Long-Term Environmental Vision for Ultra-Deepwater Exploration and Production Research Forum	Houston Advanced Research Center	11/20/2008
Seafloor Engineering Forum	Texas A&M University	3/9/2007
Flow Assurance Forum	The University of Tulsa	2/8/2007
Vortex Induced Vibrations Forum	Massachusetts Institute of Technology	1/11/2007
Autonomous Intervention for Deepwater O&G Operations Forum	Massachusetts Institute of Technology	10/31/2006
Seismic E&P Forum	University of Houston	10/10/2006
Unconventional Resources – General		
Unconventional Gas Development in the Western Energy Corridor	Idaho National Laboratory	5/12/2009
Alaskan Unconventional Gas Resource Forum	The University of Alaska Fairbanks at the BP Energy Center	4/7/2008
Produced Water Forum	New Mexico Institute of Mining and Technology	12/14/2006
Unconventional Resources – Shales		
Coalbed & Shale Gas Forum 2010 (in conjunction with the International Coalbed & Shale Gas Symposium)	University of Alabama	5/19/2010
Mid-Continent Gas Shales Forum	Gas Technology Institute	6/3/2009
Coalbed & Shale Gas Forum 2009 (in conjunction with the International Coalbed & Shale Gas Symposium)	University of Alabama	5/18/2009

MEMBER FORUM	HOST	DATE
Coalbed & Shale Gas Forum 2008 (in conjunction with the International Coalbed & Shale Gas Symposium)	University of Alabama	5/21/2008
Fracture in Devonian Black Shale of the Appalachian Basin Workshop	West Virginia University	1/8/2008
Shale Plays Technology and Permian Basin Trends Symposium	Midland College	11/29/2007
Bakken Shale Forum	North Dakota Energy & Environmental Research Center	11/6/2007
Shale Gas Forum	The University of Oklahoma	12/5/2006
Tight Gas Shale Gas & Coalbed Methane Forum	Colorado School of Mines	11/14/2006
Environmental		
Low Impact O&G Operations in Environmentally Sensitive Areas Forum	Texas A&M University	5/30/2008
Technologies for Mitigation of Environmental Impact of Rocky Mountain Unconventional O&G Operations Forum	Colorado School of Mines	5/12/2008
CO_2		
CO_2 Operations and Opportunities to Advance Technology for Mature Fields Forum	The University of Texas at Austin	2/2/2009
CO_2 EOR & Carbon Sequestration Forum	The CO_2 Conference	4/23/2008
Small Producer		
Mid-Continent Small Producer Forum	Kansas Geological Survey (University of Kansas)	5/30/2009
Unconventional Plays & Research UDW needs for Appalachian Basin Small Producers Forum	West Virginia University	2/15/2007
Small Producer Forum	New Mexico Institute of Mining and Technology	12/15/2006
Problem Identification Forum	University of Southern California	11/29/2006

Table 3.1: RPSEA Forums

One of the unique aspects of the Program is a focusing of the specific challenges and technology needs for resource themes. RPSEA, in conjunction with other organizations or alone with our member institutions, has held these various forums across the United States where theme based technical experts from universities, service providers, producer/operators, and others within the oil and gas industry can present and discuss technical topics that address specific R&D perspectives. This broad based perspective is important as different oil and gas industry communities have different perspectives and

needs requirements. The process allows the forum participants to prioritize those ideas that they feel should be addressed through the Program. This process will continue to be utilized throughout the life of the Program.

In addition to the theme-based member forums listed above which focus on the Unconventional Resources and Small Producer Programs, the UDW uses a series of TAC meetings that identify technology gaps and, eventually, define specific project themes which will serve as the basis for solicitations. These meetings allow RPSEA to take advantage of the extensive technical expertise of RPSEA members at critical stages during program development and execution.

Technology Transfer and Outreach

The RPSEA technology transfer plan is described in Chapter 4. Successful technology transfer and the uptake of technology within an organization can be enhanced by a familiarity with RPSEA's ongoing process and the projects funded under this Program. To this end, RPSEA seeks to participate or exhibit at multiple industry functions to engage with industry stakeholders and to disseminate information on RPSEA and the Program. RPSEA has participated, exhibited, sponsored, or otherwise supported the following industry functions:

American Association of Drilling Engineers Completions Group Meeting 2009

American Association of Drilling Engineers Emerging Completions 2009

American Association of Petroleum Geologists (AAPG) Annual Convention 2008 through 2010

American Association of Petroleum Geologists (AAPG) Rocky Mountain Section Meeting 2010

American Institute of Chemical Engineers (South Texas Section) 2008

American Rock Mechanics Association Workshop 2007

Annual Convention of the Gulf Coast Association of Geological Societies 2007

Annual Gas Shale Summit 2008

Barnett Shale Produced Water Conference 2007

BOMA Optimizing Mature Assets 2007

Center for International Energy and Environmental Policy 2009

Clean Technology Conference and Expo 2009

Colorado Oil & Gas Association (COGA) Conference 2006 through 2009

CO_2 Flooding Conference 2007 through 2009

Deep Offshore Technology (DOT) and Demo2000 Conference 2007

Developing Unconventional Gas (DUG) 2007through 2010

Disappearing Roads Competition 2008 and 2010

Drilling Engineering Association 2009

Energy and Environment Subcommittee Meeting 2008

Energy Technology Venture Capital Conference 2007 and 2008

Energy in Transition Houston Technology Center (HTC) 2008

Florida Independent Petroleum Producers Association (FLIPPA) Annual Meeting 2007

Gas Shales Summit 2008

Global New Energy Summit 2009

Global Technology Summit 2008

Greater Houston Partnership Energy Summit 2009

Greater Houston Partnership Marketing in the Oilfield Conference 2009

Hart's Research and Development in Exploration 2008

Houston Small Business Administration 2007

Independent Oil and Gas Association of New York 2007

Independent Petroleum Association of America (IPAA) Crude Oil Committee Mid-Year Meeting 2007 & 2009

Independent Petroleum Association of America (IPAA) Offshore Committee 2007 and 2009

Industry Technology Facilitator (ITF) Reservoir Imaging in Difficult Environments 2009

Independent Petroleum Association of Mountain States (IPAMS) Annual Meeting 2007

Insight Gas Shales Summit 2008

International Association of Drilling Contractors (IADC)/Drilling Engineering Association (DEA) Forum 2007

International Association of Drilling Contractors (IADC) Drilling Onshore Conference 2009

International Coalbed & Shale Gas Symposium 2008 through 2010

International Petroleum and Biofuels Environmental Conference 2009

INTSOK 2007through 2009

Interstate Oil and Gas Compact Commission (IOGCC) Annual Meeting 2008

Interstate Oil and Gas Compact Commission (IOGCC) Mid-Year Conference 2007

Louisiana Oil and Gas Association (LOGA) 2009

Marine Technical Society 2008

Massachusetts Institute of Technology Natural Gas Advisory Committee 2008 through 2010

Mid-America Regulatory Conference (MARK) 2008

More Bytes & More Barrels –Digital Energy Conference & Exhibition 2008 and 2009

New Mexico Oil and Gas Day 2009

North American Prospect Expo (NAPE) 2007through 2010

Offshore Technology Conference (OTC) 2007through 2010

Oil & Gas Innovation Center organizational sponsor

Oklahoma Independent Petroleum Association (OIPA) Annual Meeting 2008 and 2009

Oklahoma State University Energy Conference 2010

Pennwell Unconventional Gas Conference 2009

Residual Oil Workshop 2009

Rice Alliance Business Plan Competition 2008 and 2009

Rice Alliance Energy and Clean Technology Venture Forum 2007through 2009

Rice Nanotechnology Venture Forum 2008 and 2009

Rice University Congressional Field Hearing 2008

Rocky Mountain Energy Technology Conference 2008

Science Engineering Fair of Houston 2008 through 2010

Society of Exploration Geophysicists (SEG) Annual Meeting 2007 through 2009Society of Petroleum Engineers (SPE) Workshop on Delivering and Using Emerging Technology in the E&P Business 2009

Society of Petroleum Engineers (SPE) Workshop on Life of Field Surveillance for Unconventional Gas 2007

Society of Petroleum Engineers (SPE) Seismic While Drilling Advanced Technology Workshop 2007

Society of Petroleum Engineers (SPE) Annual Technical Conference Exhibition 2007 through 2009

Society of Petroleum Engineers (SPE) Digital Energy Conference 2009

Society of Petroleum Engineers (SPE) Tight Sands Workshop 2009

Southern Methodist University Geothermal Conference 2009

Subsea Tieback Forum 2010

Sustainable Opportunities Summit 2010

SW Petroleum Show 2008

Texas Alliance Expo and Annual Meeting 2008 through 2010

Texas Independent Producers and Royalty Owners Association Annual conference 2010

Texas Renewable Energy Industries Association 2008

The Making of Energy Policy: Where Are We Going? Conference 2008

The University of Tulsa Energy Management Program 2008 and 2009

University of Colorado at Boulder Renewable & Sustainable Energy Institute Conference 2009

U.S. – Mexico Border Energy Forum 2009

Washington Post Energy Conference 2007

World Energy Technology Summit 2010

Young Professionals in Energy (YPE) website sponsor 2008 and 2009

In addition to its responsibilities under EPAct, RPSEA has sought to leverage its efforts in ways that also provide broad public benefit, such as the creation of an industry/education partnership by establishing and managing a Fellowship/Scholarship Program. With designated financial resources supplied from RPSEA members Schlumberger and Strata Production Company, RPSEA has awarded multiple scholarships to date to the following member universities: Colorado School of Mines, Louisiana State University, New Mexico Institute of Mining and Technology, Stanford

University, Texas A&M University, The University of Texas at Austin, The University of Oklahoma, and West Virginia University.

Chapter 4 Technology Transfer

In order to meet the RPSEA Program goal of maximizing the value of the nation's natural gas and oil resources, as well as increasing federal royalty receipts and enhancing America's energy security, it is essential that technology developed under this Program be rapidly and effectively applied by operators exploring for and developing new hydrocarbon resources. The goal for technology transfer under this Program is to assure the engagement of participants all along the technology value chain, from conceptual development to commercial application, in order to maximize the impact of Program technology.

The general approach that RPSEA uses for technology transfer, including coordination with NETL, is illustrated in Figure 4.1. Rather than being solely an activity that is initiated after a project is completed, technology transfer occurs within the timeframe and throughout the progress of any given research project. Through monthly reports, project updates and reviews, and presentations at public meetings, RPSEA investigators interact with members of advisory committees and other potential technology users at all stages of each project. These interactions not only serve to create interest and demand for the new results, but also to provide valuable feedback to investigators to ensure that their efforts are well aligned with anticipated needs. During this process, NETL includes interim project results in its various outreach activities. When a project does reach completion, successful examples and case studies generated during the course of the project are the basis for formal technology transfer efforts. These efforts include workshops and other means of dissemination as described below. Input from users and potential users of project results drive the benefits assessment conducted by NETL.

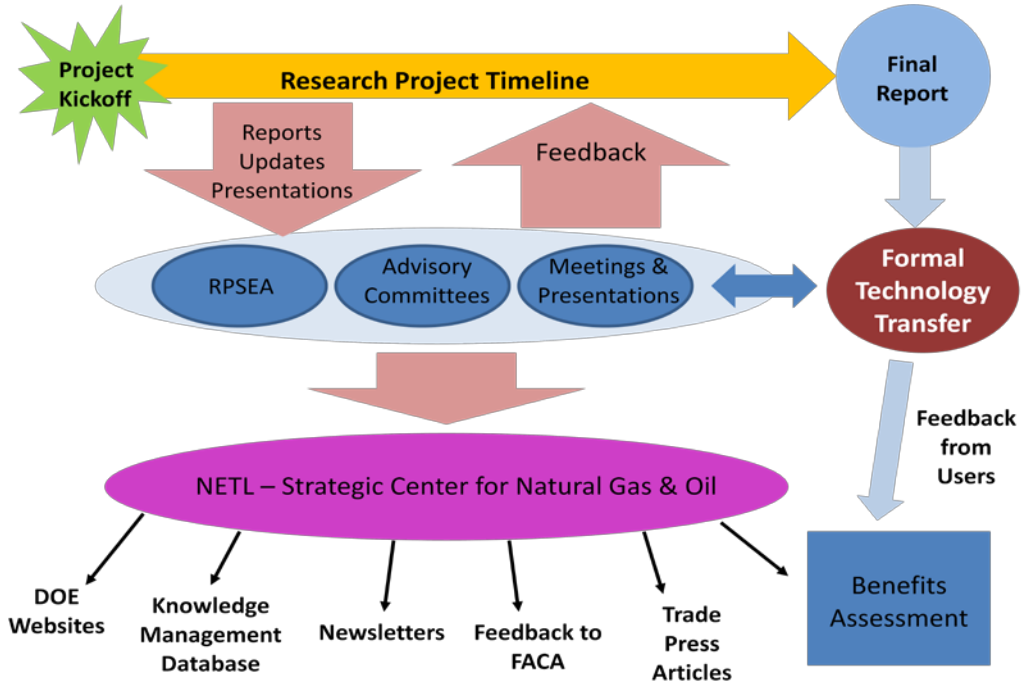


Figure 4.1: Flow Chart for Technology Transfer

Specific technology transfer approaches incorporated in the Program include:

1. The engagement of PAC and TAC committee members through involvement in needs assessment, project selection, and ongoing project review in order to promote ongoing interests in developing projects and facilitate field tests and demonstrations using operating company wells, data, and facilities. Operators and service companies represented on these committees represent the likely "early adopters" of Program technologies who will lead the way for wider industry adoption and provide the real-world examples that will facilitate meaningful technology transfer. While the law requires that 2.5 percent of the project funding be set aside for technology transfer, this industry engagement reflects a component of the technology transfer approach beyond the effort funded by the set-aside.
2. Active communication and coordination between RPSEA and NETL on a Knowledge Management Database (KMD) that will serve as a publically available archive of data and results associated with RPSEA projects.
3. Continuing commitment to enhance the functionality and value of the RPSEA website by adding relevant, value-added data and information regarding RPSEA's individual projects, as well as overall Program direction and impact.
4. Provisions in the project awards that require a minimum of 2.5 percent of the funding for each project to technology transfer activities. The solicitations incorporate language that require each applicant for an award to propose a technology transfer approach with the understanding that up to 40 percent of the 2.5 percent designated (1 percent of the total project value) may be directed by RPSEA for program-level technology transfer. The model contract provides for the coordination of technology transfer across multiple related projects using the funding approach described above. Some of the activities to be funded at the program level are described in the Program-Level Activities section below.

The approach to technology transfer is designed to address program-level goals through ongoing industry engagement, documentation of results on the RPSEA website and in a KMD, and through a coordinated process that combines the technology transfer efforts associated with related projects, while honoring the contractual commitment to fund technology transfer through the allocation of 2.5 percent of Program funding for this purpose.

The R&D contracts awarded will include requirements for the expenditure of funds allocated to technology transfer in accordance with the program-level plan. In some cases, especially in large projects with few deliverables, the technology transfer may be handled entirely by the recipient in accordance with an approved plan. In other cases, especially for smaller projects, technology transfer efforts may be more effective if coordinated with other projects.

Project-Level Activities

Project-level technology transfer activities are a key part of the project selection and management approach used by RPSEA in each of the programs.

- In the UDW program, ongoing projects are reviewed at TAC meetings, which are open to all interested parties. The relatively small size and regional concentration of the offshore community results in strong representation among potential technology adopters at the TAC meetings in which projects are reviewed. These meetings serve as an effective forum for introducing developing technology, ensuring that the resulting products are well aligned with industry requirements and identifying potential participants in field trials. While TAC events form a key part of project-level technology transfer, they are supplemented by presentations, publications, and other activities outlined in the technology transfer plans developed jointly by the contractors and RPSEA project management staff.
- While the unconventional gas community is similarly involved in the selection and review of projects under the Unconventional Resources Program, this numerically larger and more geographically dispersed community requires additional emphasis on approaches designed to reach the widest possible cross-section of potential adopters of program technology. In addition to providing funds for contractors to engage in project-level technology dissemination, RPSEA has organized program-level activities to provide opportunities for additional dissemination and cross-fertilization of program results.
- The Small Producer Program faces the challenge of connecting with the thousands of small producers operating across the nation. While engagement of service providers and others in the operation of the program will help ensure that new technologies are available to these small producers, a particular emphasis on program-level activities is required.
- The degree to which industry engagement by RPSEA results in awareness of technologies developed under the Program is illustrated by the appearance of articles such as the one in the January 2010 issue of *Hart's E&P* magazine explaining the goals of The Environmentally Friendly Drilling Systems Program project. A number of other articles have been published, and links are posted on the RPSEA website. This type of coverage in widely read trade and technical publications is a direct result of active industry participation in the planning, management, and execution of the Program and provides an effective context for the directed technology transfer efforts that are funded by the 2.5 percent set-aside.

Program-Level Activities

RPSEA will conduct the following program-level technology transfer activities as an intrinsic part of the program-management approach.

- RPSEA will continue to post on its website a list of projects and related information, such as abstracts, technical status assessments, results,

accomplishments, reports, and key personnel contact information. The information on the RPSEA website will be coordinated with the KMD, developed by NETL under the Section 999 complementary program, and appropriate links to information in the KMD will be provided.

- Periodic project reviews with the PACs, TACs, and the RAG (as appropriate) that are conducted as part of the RPSEA program-management process are designed to ensure that the results of related projects are presented to highlight their interconnection and allow the various advisory bodies to identify opportunities for the evaluation and application of project results. This coordinated methodology enhances the effectiveness of the entire technology transfer effort.
- In 2010, the UDW program hosted the first UDW TAC Conference. This event provided an outlet for every active UDW Program project to be reviewed by a project champion. Additionally, it included various question-and-answer opportunities for the audience, which was comprised of subject matter experts from the entire UDW community and other stakeholders. The event allowed for numerous opportunities to discuss issues, ongoing activities, and potential collaboration opportunities. Lessons learned from this immensely popular and productive first conference will be used to plan similar annual events.
- Like the UDW TAC Conference, the Unconventional Resources Program hosts an Annual Unconventional Gas Conference that aims to disseminate information and offer the opportunity for the unconventional gas community to hear the latest perspectives and exchange ideas on current RPSEA-sponsored collaborative research projects.
- The Small Producer Program has hosted a Small Producer Program Showcase in which members of the Small Producer community have the opportunity to network and exchange ideas with research providers and discuss potential collaboration opportunities. Similar events will be held around the country as the technologies being developed within the program mature to a point at which they are of interest to the small producer community in a given region.

In addition, RPSEA has implemented the following approach to maximize the impact of the 2.5 percent allocated to technology transfer:

- Each solicitation includes the requirement for a plan for technology transfer. The solicitation instructs offerors to propose an approach for technology transfer for their project, understanding that up to 40 percent of the 2.5 percent (or 1 percent of total project funding) designated for technology transfer may be designated by RPSEA for use in program-level technology transfer activities.
- RPSEA and each selected recipient will jointly develop a project-level technology transfer approach to be coordinated with program-level efforts.

Examples of program-level technology transfer activities include the following:

Website Enhancement
The RPSEA website will continue to be enhanced to assist technology transfer beyond the simple availability of reports. Developing suitable materials to support such an effort and providing a website with the required functionality to support interactive technology transfer will come from the programmatic funding through a designated portion of the 2.5 percent technology transfer allocation. Additional website capability will also be required to interface the RPSEA website with the KMD in order to provide an effective tool for current and archival access to data and information generated through the program. The shear amount of technology transfer materials generated through the projects necessitates the addition of website tools and adds to its complexity. This effort is meant to ease the burden of the public in searching for, finding, and utilizing technology transfer materials. It will not only result in a more streamlined product, but should also encourage faster adoption of technology.

Leveraging Via Participation and Coordination with Existing Conferences, Forums, and Workshops
There are an abundance of industry conferences, forums, and workshops. These events are produced and sponsored by a variety of entities, including for-profit companies, governmental/regulatory agencies, professional societies, and other non-governmental organizations (NGOs). Event objectives for organizers may range from simply earning a profit to transferring technology ; event quality and effectiveness at meeting desired goals can vary significantly. RPSEA, on a regular basis, will review existing industry events and on a prioritized basis work with the organizers to incorporate an effective RPSEA technology transfer component. Factors to be considered include:

- Quality and reputation of event
- Alignment between the event's existing delegate base and RPSEA's target audience for the technology to be disseminated
- Level and visibility of RPSEA's participation
- Cost, in terms of actual out-of-pocket registration/exhibit fees, transportation and logistics, as well as indirect costs such as staff's time and effort.

RPSEA has an established working relationship with OTC, PTTC, SPE, AAPG, SEG, Hart's, PennWell, Quest Offshore, and others. RPSEA will work with these groups by participating as session chairs, on planning and program committees, in speaking roles, and/or in other roles as appropriate to leverage RPSEA's limited resources. The objective of this participation will be the timely and cost effective dissemination of RPSEA-sponsored project results and targeting existing events with audiences that have specific needs for the technologies being presented.

RPSEA *GasTips*
The now-dormant *GasTips* publication was an excellent vehicle for providing wide exposure to research results. The relatively short articles and wide distribution list generated a lot of interest in new technology, which could be further pursued through in-depth references or discussions with subcontractors. RPSEA has initiated discussions

with Hart's and potential industry sponsors regarding restarting this publication as a vehicle for highlighting the results of the Section 999 Program. Even though *GasTips* has had a recent hiatus from publication, it is a recognized communication vehicle with established credibility in the industry.

Select/Focused RPSEA Workshops and Forums

In some technical areas, several contractors work on different aspects of a single key challenge. The most effective technology transfer occurs when these contractors each present their own results, but do so in a way that emphasizes their contribution to the solution of the larger problem. RPSEA will first investigate leveraging existing conferences and forums; however, there are situations where the volume of technology and the focus of the technology may best be accomplished as a standalone event. In these cases, RPSEA will organize focused workshops targeted on a particular technology or closely-related suite of technologies. While these workshops will be open to the public, RPSEA will encourage key stakeholders and technology adopters to attend. These workshops are designed to be interactive, involving a relatively small number of participants (target less than 50), along with experts from the technology developer or the operator participating in the initial field trials. In some cases, the workshops are presented multiple times in regions that benefit from the application of the subject technology. Depending on the nature of the technology, the workshop might involve simulations, training based on case studies, or exposure to the actual application of the technology in a field setting. The desired result is to enhance the capability of the operator/staff to make appropriate decisions regarding the application of new, commercially available technology that is developed through the program. Program-level technology transfer funding will be required to support a third-party organization capable of organizing, conducting, and securing appropriate participation in regional workshops.

In addition to the focused workshops as mentioned, RPSEA has sponsored a series of forums hosted by various RPSEA members across the country. These forums have served as excellent vehicles for identifying critical research needs and obtaining input for research program content that drives the future of each RPSEA program. As the RPSEA Program develops research results, these forums will shift to greater emphasis on Program results and the transfer of information, while maintaining a technical input component.

RPSEA Technical Conferences

Technical conferences held at a national or large regional scale can highlight a range of technologies applicable to a particular resource type or geographic area. Presentations will be made by RPSEA contractors, as well as operators or service companies that have experience in the testing or application of new technologies. The primary audience will be the operator community positioned to apply the results of the program to the development of new resources. R&D contractors and organizations offering commercial services based on Program technology or otherwise relevant to the conference topic may secure booth space. Such conferences can be very effective in creating visibility and credibility for the results of the program, but significant program-level technology

transfer funding will be required to organize, publicize, and conduct thoroughly professional, national-scale technical conferences. Some expenses will be recovered by charging for attendance, but a low cost of attendance is one way to distinguish RPSEA conferences from other topical meetings for which revenue generation for the sponsor is a primary goal.

Webcasts/Podcasts
Webcasts and podcasts have become a popular and effective medium for communication. Presentations by researchers and discussions among researchers, service companies, and producers regarding potential applications are among the types of material that might be appropriate for this medium.

Follow-on Projects and/or Unfunded Projects
Future phases of projects from 2007 through 2010 that may not be funded or promising project ideas not selected in the rigorous program development process are important to retain. Finding funding or a continuation vehicle for these projects to ensure that the research initiated by RPSEA is not lost is an activity worthy of emphasis in the technology transfer effort.

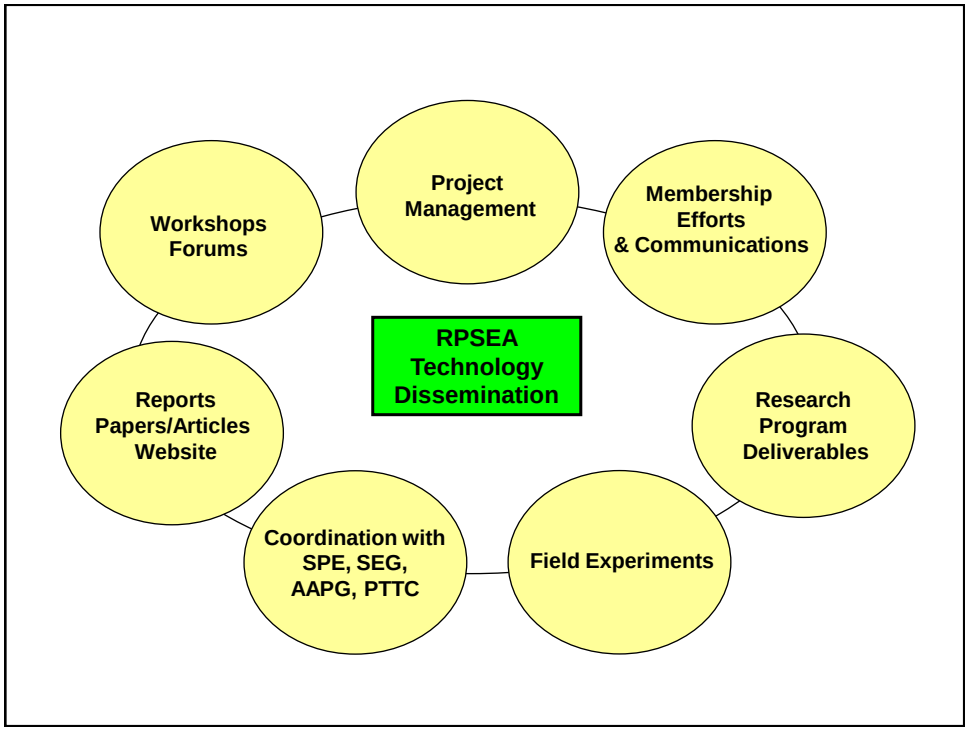


Figure 4.2: RPSEA Technology Dissemination Efforts

Technology Transfer Assistance
In an effort to more effectively cover the industry and disseminate technological progress and developments, RPSEA has subcontracted with PTTC. RPSEA also supported PTTC's larger technology transfer proposal directly to NETL, so the choice of PTTC as a technology transfer subcontractor ensures that RPSEA work is well coordinated in an

overarching technology transfer plan among all NETL related activities. The subcontractor will assist on several fronts, including:

- Working with investigators to collect and edit articles for publications associated with the RPSEA program.
- Working with publishers to assemble content.
- Organizing Technology Transfer/Project Review meetings during which investigators on RPSEA projects present their results and receive feedback from other investigators and RPSEA advisory groups.
    - Objectives include technology transfer, as well as enhancing communication among investigators and looking for opportunities for coordination and cooperation among investigators.
    - Specific duties would include working with RPSEA to schedule and select locations for the events, working with RPSEA and investigators to establish agendas and schedules, meeting logistics and finances, promotion, and on-site support, as directed by RPSEA.
- Additional technology transfer options that will be reviewed for assistance include:
    - Topical webinars
    - PTTC workshops incorporating RPSEA presentations as part of the offering
    - Topical short courses building on results from one or more RPSEA-funded projects
    - Special "Emerging Technology" cooperative events that may be developed with organizations such as NAPE, Rice Technology Alliance
    - Special sessions for AAPG Section or National meetings; SPE Section, Regional, or International events; OTC events; SEG events; other conferences such as University of Tulsa's Integrated Petroleum Environmental Conference, etc.
    - Various state oil and gas/ producer association meetings and events
- Work with RPSEA staff and website contractors to enhance the technology transfer capability of RPSEA's website.
    - Compensate vendors for making required upgrades to the website.
    - In particular, develop means for effectively coordinating the RPSEA website with the NETL KMD.
- Supporting technology dissemination through webcasts and podcasts.

Events

The schedule for RPSEA technology transfer events is dynamic, driven by progress on individual projects and coordination with other industry activities. The RPSEA Calendar of Events lists upcoming, as well as past, events. Recent events include participation as a Supporting Organization at OTC, where several offshore technologies being developed

under the UDW were highlighted, and the 2010 RPSEA Unconventional Gas Conference in Golden, CO. A more extensive list of technology transfer events and activities is given in Appendix C, Technology Transfer Accomplishments. As new events are scheduled, they will be included on the RPSEA Calendar of Events.

Chapter 5 Ultra-Deepwater (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."*

A. Mission & Goals

The mission of the UDW program is 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.

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

As of this writing, a Presidential commission as well as other investigations are underway collecting and reviewing factors surrounding the Deepwater Horizon incident. As one of the largest nonprofit group of experts with over 160 member organizations, RPSEA will be closely monitoring the results as they are released and targeting high value research and development needs with a priority on safety and environmental stewardship and emergency prevention, preparedness, response and recovery.

Relevant EPAct definitions for the UDW program element include:

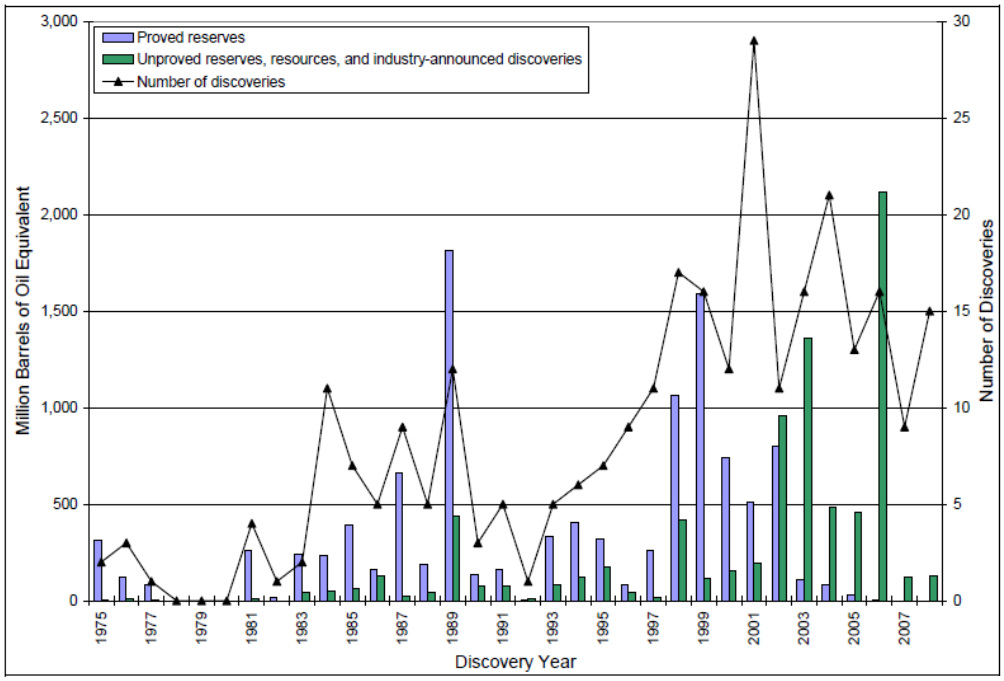
- **Ultra-Deepwater -** a water depth that is equal to or greater than 1,500 meters (~5,000 feet). The program also includes technologies applicable to formations in the OCS deeper than 15,000 subsurface
- **Ultra-Deepwater architecture -** the integration of technologies for the exploration for, or production of, natural gas or other petroleum resources located at ultra-deepwater depths
- **Ultra-Deepwater technology** - a discrete technology that is specially suited to address one or more challenges associated with the exploration for, or production of, natural gas or other petroleum resources located at ultra-deepwater depths

The goal of the UDW is to exploit the ultra-deepwater resource base and to convert currently identified (discovered) resources into economic recoverable (proven) reserves,

while protecting the environment, thereby providing the U.S. consumer with secure and affordable petroleum supplies. This goal will be achieved by:

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

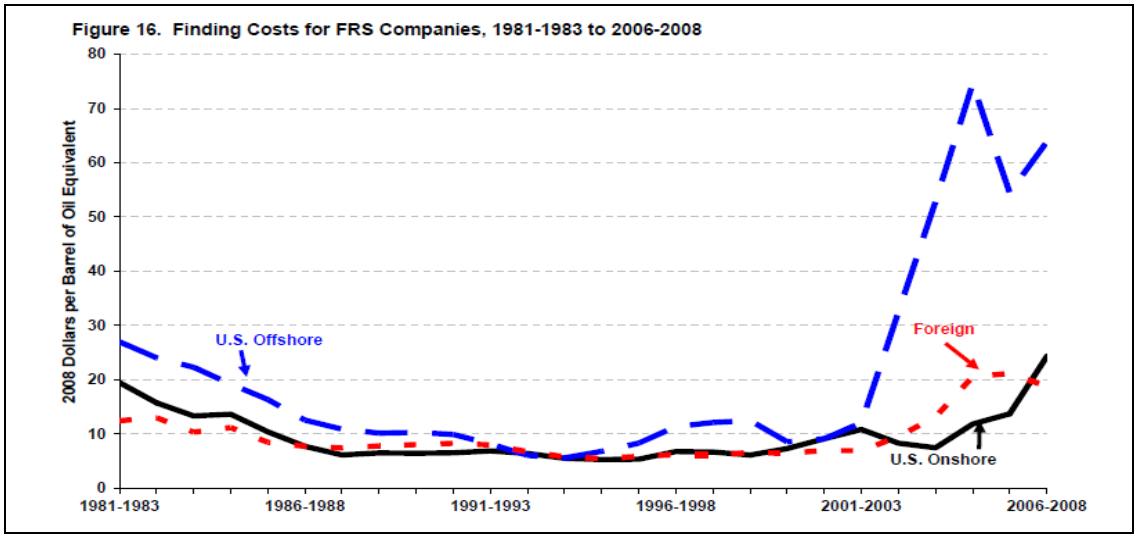
The significant importance of this goal is illustrated by Figure 5.1, which shows the difficulty the oil and gas industry has had since 2002 converting discovered resources into proven reserves (producing developments). Proven reserves add value to royalty revenues, consumers, and the oil and gas industry. Identified non-producing resources do not contribute to the supply base or generate royalties.



Latest Minerals Management Service (MMS) report 2009-016 shows an increasing lag between discovery and production in deepwater Gulf of Mexico – demonstrating the need to focus on development related technology development

Figure 5.1: Proven Reserves Add Value

Further evidence supporting UDW's goal to reduce cost can be found in Figures 5.2, 5.3, and 5.4 from the U.S. Department of Energy's Energy Information Administration (EIA). The data in Figure 5.2 vividly depict the much higher cost associated with UDW. To 'move' the resources depicted in the resource category in Figure 5.1 to proven reserves, cost must come out of the system.



Notes: Costs are the quotient of costs and reserve additions for each 3-year period. BOE = Barrels of oil equivalent. The above figures are 3-year weighted averages of exploration and development expenditures, excluding expenditures for proven acreage, divided by reserve additions, excluding net purchases of reserves. Natural gas is converted to equivalent barrels of oil at 0.178 barrels per thousand cubic feet. Sum of elements may not add to total due to independent rounding. Source: Energy Information Administration, Form EIA-28 (Financial Reporting System). http://www.eia.doe.gov/emeu/perfpro/0206(08).pdf

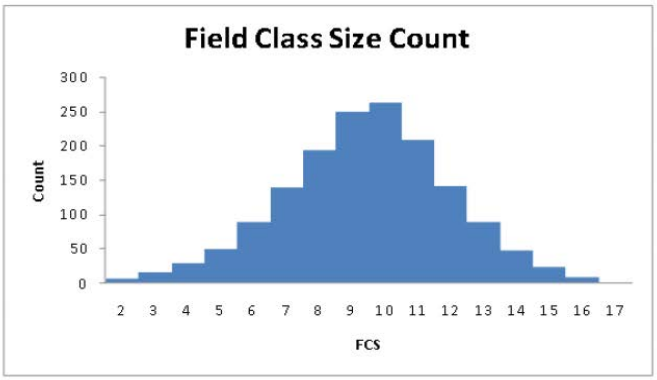
Figure 5.2: Need to Develop Technology to Control Finding Costs

Figure 5.3 from DOE's Energy Information Agency (EIA) shows that while 'small' fields are by definition small, the large number of small fields can contribute significantly to the overall resource base if they can be economically developed. The majority of UDW future fields are likely to be these smaller fields developed with extended sub-sea tie backs utilizing a 'hub and spoke' methodology with multiple small fields tied back to single surface hosts.

Undiscovered Resource Base

USGS Field Class Sizes

Pool Size Class	MMBO lower	MMBO upper	BCFG lower	BCFG upper
1	0.03125	0.0625	0.1875	0.375
2	0.0625	0.125	0.375	0.75
3	0.125	0.25	0.75	1.5
4	0.25	0.5	1.5	3
5	0.5	1	3	6
6	1	2	6	12
7	2	4	12	24
8	4	8	24	48
9	8	16	48	96
10	16	32	96	192
11	32	64	192	384
12	64	128	384	768
13	128	256	768	1,536
14	256	512	1,536	3,072
15	512	1,024	3,072	6,144
16	1,024	2,048	6,144	12,288
17	2,048	4,096	12,288	24,576
18	4,096	8,192	24,576	49,152
19	8,192	16,384	49,152	98,304
20	16,384	32,768	98,304	196,608



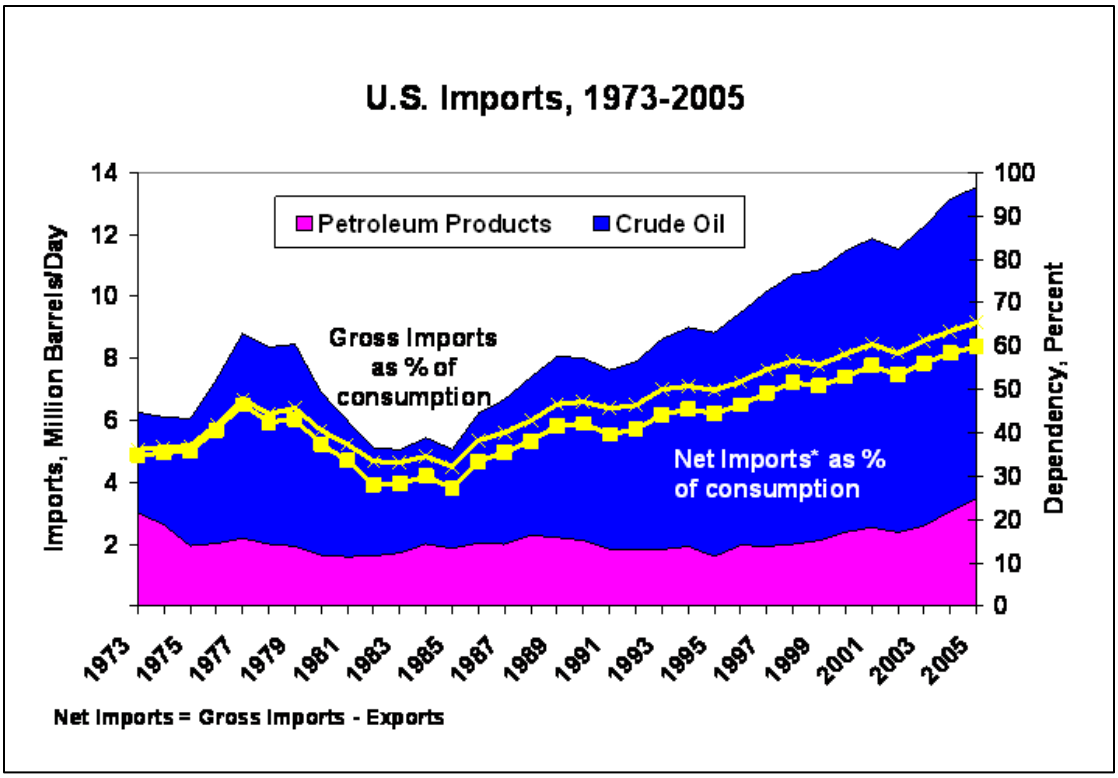
Total resource = 91 BBOE (EIA)

Data from the U.S. Department of Energy's EIA vividly shows that while 'small' fields are by definition small that the large numbers of them can contribute significantly to the overall resource base if they can be economically developed.

Figure 5.3: Undiscovered Resource Base by Field Class Size

Figure 5.4 depicts the continuing and growing US dependency on imports. The UDW program will focus on reducing overall development costs so that this resource base can safely and in an environmentally appropriate manner be utilized to:

- improve US energy security
- economically developed and resources produced for America's energy consumers
- promote American jobs and tax base
- improve America's trade balance



Data from the U.S. Department of Energy's EIA vividly shows the continuing increased US dependence on imports. http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/oil_market_basics/trade_image_us_imports.htm

Figure 5.4: Imports and GoM UDW Production

B. Objectives

To meet the goal of converting the UDW resource base to economically recoverable resources, the UDW program intends to fund activities to build new planning and analytical models; design and manufacture new equipment; develop new exploration and production technologies as well as integrated systems technologies; demonstrate that the equipment and technologies are dependable and reliable; and ultimately manufacture and deploy the technologies in commercial quantities. The UDW program established a series of objectives, first outlined in the 2007 Annual Plan, on which it continues to build.

Objective 1: Technology Needs Assessment – The 2007 - 2010 Annual Plans capitalized on DeepStar Systems Engineering Studies which identified the specific technology gaps that hinder ultra-deepwater development. Proposals were then solicited to address the identified gaps. These gaps have been and will continue to be periodically revisited throughout the Program duration utilizing UDW Technical Advisory Committees (TAC) input.

Objective 2: Technology Research & Development, and Applied Science – The early years of the UDW are forming a base of the technology development triangle (Figure 5.5). Subsequent years will fund additional technical development, demonstration, and potential commercialization of promising technologies. UDW has administered multiple rounds of solicitations for R&D contracts designed to meet the stated goal and identified "Needs" of the UDW. While many of these projects will be of interest and would no doubt generate value for the program and the American consumer, current limits on funding will dictate the need to prioritize and select only those that are deemed likely to result in the most significant increases in value through cost reduction, efficiency improvement, and effectiveness. Concurrently over the life of the UDW program, funding will be directed to innovative and novel projects as well as graduate study proposals that meet the needs and goal of the UDW program.

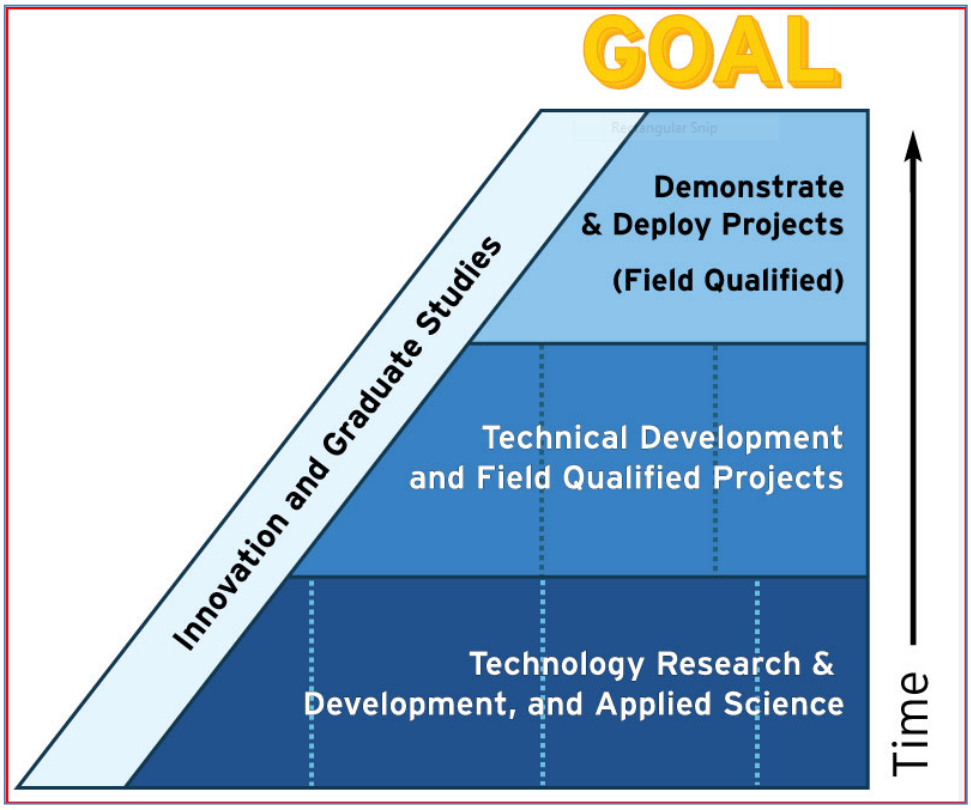


Figure 5.5: UDW Development Triangle

Objective 3: Awareness and Cost-Share Development – The UDW program will network with academia, industry, and other key stakeholders to increase its awareness, promote involvement, and identify cost-share funding for development of new technologies.

Objective 4: Technical Development and Field Qualified Projects – Through assessment of project results and additional solicitations (as needed), the UDW program will continue the development and maturation of the most promising technologies with a strong focus on field qualifying projects that carry the greatest potential for meeting the UDW goal.

Objective 5: Environmental and Safety Technology Development and Deployment – The UDW program will assess the environmental and safety impact of all UDW funded projects. This effort may take the form of individual solicitations or elements of more extensive project-based solicitations.

Objective 6: Technology Demonstration – The UDW program will work with industry, appropriate regulatory agencies, and other key stakeholders to provide seed-level funding and other incentives for demonstration and validation of newly developed technologies.

Objective 7: Emergency Prevention, Preparedness, Response and Recovery – The UDW program will work with appropriate regulatory agencies, industry and other key stakeholders to identify technology needs arising from the Deepwater Horizon incident.

C. Implementation Plan

DeepStar and Advisory Committee Roles in the UDW Program Element

The UDW program is managed by Chevron, through a subcontract with RPSEA, utilizing the Chevron administered DeepStar consortium. DeepStar, with ten deepwater operating companies and 60+ contributing member companies, is the world's largest ultra-deepwater stakeholder group and has a 20 year history of managing collaborative research. Through this arrangement, the UDW program accesses 700+ technical and management committee volunteers, as well as a successful process for technology research, development and commercialization. In addition to providing high-level input from oil and gas operating companies that are ultimately responsible for the production of deepwater energy resources, this highly developed process formally facilitates the direct input of universities, regulatory bodies, service companies and other key stakeholder groups. This process of broad engagement through expansive and inclusive advisory committees provides the UDW program with significant pro bono expertise, as well as potentially significant cost share funds to further accelerate the development of ultra-deepwater technologies.

The UDW program utilizes a PAC and TAC in an advisory role. The PAC provides high-level input on program priorities, field areas of interest and technology dissemination, as well as a link to the producer and research communities, but its primary role is project selection. PAC engagement in the process is critical as these operators will be the organizations called upon to actually deploy and operate the new technologies developed under the program.

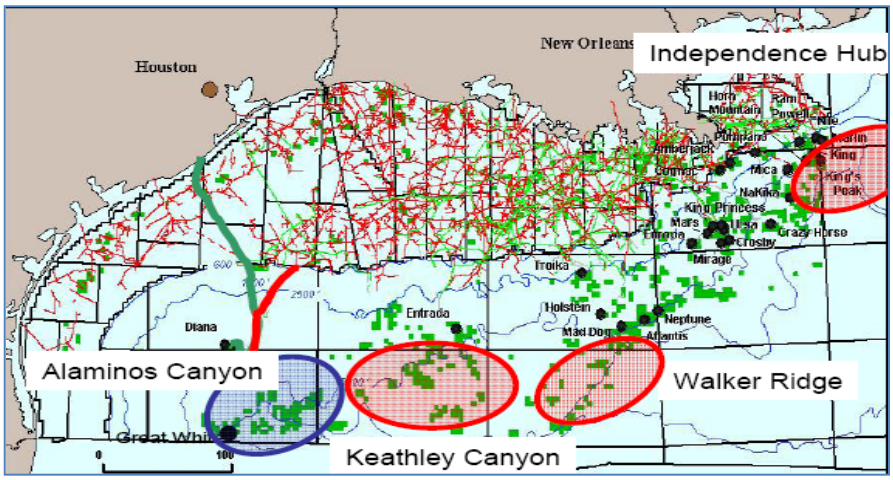
Supporting the PAC are nine TACs, each of which is focused on a particular ultra-deepwater technology area (see Table 5.1). The role of the TACs, with representation from Subject Matter Experts (SME) who study and apply ultra-deepwater technologies in real field situations, is to identify current technology gaps and define the specific R&D efforts needed to address these gaps. As such, the TACs provide a bottom-up, end-user-driven program.

Drilling & Completion and In-well Interventions	Environmental, Safety & Regulatory	Floating Facilities
Flow Assurance	Geoscience	Met-Ocean
Reservoir	Subsea Facilities	Systems Engineering

Table 5.1: UDW Technical Advisory Committees

Identification of Focus Areas for New Technology Development

The UDW focus areas for the initial solicitations (2007 and 2008) were developed using a DeepStar Systems Engineering study that was based on industry UDW experience and needs. Four base case field development scenarios were identified as representative of future Gulf of Mexico (GOM) ultra-deepwater developments with technical barriers, which challenge development. These scenarios are drawn from four key areas of activity in the deepwater GOM (Walker Ridge, Keathley Canyon, Alaminos Canyon, and the Eastern Gulf) and the associated technology challenges (Figure 5.6). Collectively these areas of activity represent a very large resource base as portrayed earlier in Figure 5.1. The initial 2007 & 2008 project selections and portfolio was developed based on these generic field types, with the UDW goal to develop new technologies to help convert these resources to proven reserves.



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

Figure 5.6: Technical Challenges for Identified Basins

Each of the above areas is characterized by challenges currently hindering technical and economic development which have been organized into a grouping of six technology UDW needs. Within each area of UDW need, various initiatives have been identified.

UDW projects are chosen based on their potential to address and satisfy the UDW needs and therefore meet the goal of converting UDW resources to proven reserves as shown in Figure 5.7.

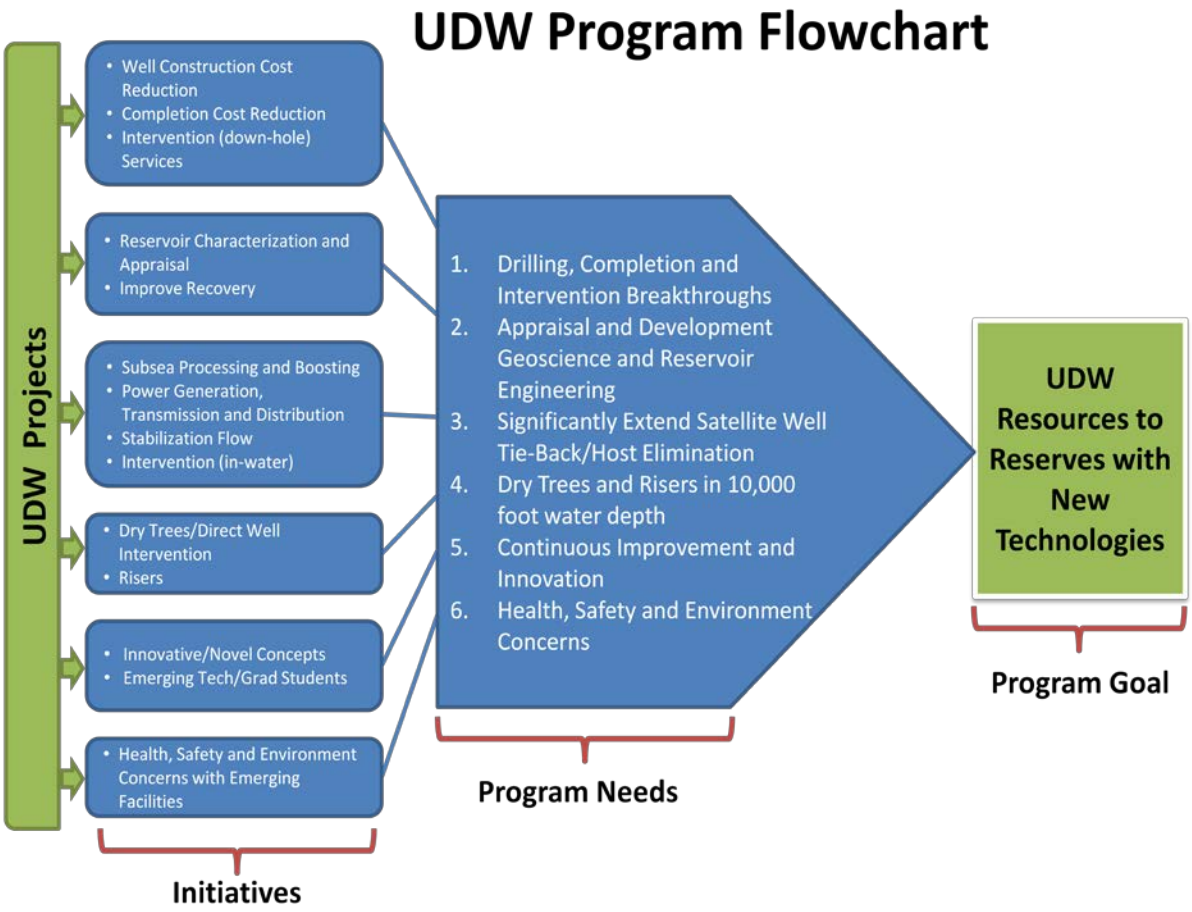


Figure 5.7: UDW Program Flowchart

2011 Solicitations

Upon transmittal of the 2011 Annual Plan to Congress, the 2011 requests for proposals (RFPs) will be developed and released. The primary focus of these RFPs is to fill-in technology gaps not addressed by the prior years' projects and solicitations. Solicitations for 2011 can be categorized into the following types:

- Emergency prevention, preparedness, response and recovery
- Next phase projects based on completed projects from the 2007 and 2008 program
- Specific project ideas to fill identified technical gaps
- Graduate Student and Innovative/Novel projects

Anticipated 2011 UDW RFPs will be crafted to meet the program goal by addressing the Needs and Initiatives as shown in Figure 5.7 and summarized below. The actual 2011 UDW RFPs may differ from the anticipated portfolio listed below and will be driven by further guidance from the UDW PAC, the timing associated with 2011 program funding, and other relevant factors such as results from the President's commission on the Deepwater Horizon incident.

Need 1: Drilling, Completion, and Intervention Breakthroughs

Proposals may be requested identifying novel ideas to reduce well construction and completion costs and funding follow-on recommendations from 2007 and 2008 projects.

Need 2: Appraisal and Development Geoscience and Reservoir Engineering

Proposals will be requested in the area of formation and reservoir characterization and/or surveillance. The goal of this effort is to improve recovery and reduce the amount of unproduced hydrocarbons upon well or field abandonment.

Need 3: Significantly Extend Subsea Tieback Distances/Surface Host Elimination

Proposals may be requested addressing follow-on recommendations from 2007 and 2008 projects. New proposals may be requested in one or more of the following areas:

- Ultra-deepwater flow assurance especially for the areas of solids (asphaltenes, hydrates, waxes, and scale) deposition and plug formation management
- Pressure boosting
- Autonomous underwater vehicles and intervention
- Subsea processing/produced water treatment

Need 4: Dry Trees/Direct Well Intervention and Risers in 10,000' Water Depth

This need area was addressed in the 2007 and 2008 UDW program. Next Phase proposals may be requested addressing recommendations from the 2007 and 2008 projects.

Need 5: Continuous Improvement and Innovation

Proposals in this need area may include:

- Advancing industry understanding of phenomena and science impacting ultra-deepwater operations
- Improvements in integrity management and reliability
- Additional graduate student and project funding
- Innovative technology high risk, high reward "long-shot "opportunities

Need 6: Associated Safety and Environmental Concerns

The UDW program will work with appropriate regulatory agencies, industry, and other key stakeholders to identify emergency prevention, preparedness, response and recovery technology needs suitable for UDW operations, which may include findings arising from the Deepwater Horizon incident.

Additionally, RPSEA will continue to focus on ensuring that technology development takes environmental impact and safety considerations into account. To accomplish this overarching task, RPSEA will seek to leverage ongoing research efforts and collaborate within existing forums and venues. RPSEA will integrate with ongoing UDW projects wherever feasible.

Anticipated Awards for 2011

Due to carry-over from earlier years, approximately $21 million is available for 2011 project awards. Cost sharing beyond the minimum is encouraged in all solicitations. In 2011, the UDW program will target the award of three to five large projects with a value of $1 to $5 million per project. Additionally, a number of smaller awards averaging $150,000 - $300,000 each will be funded under Need #5, "Continuous Improvement and Innovation." Each project will have duration of one to three years. The projects will be aligned with the six UDW needs. Project integration and cross-cutting approaches across multiple disciplines will be encouraged.

Under the stage/gate approach, all projects will be fully funded to the completion of the appropriate decision point identified in each contract, which may include multiple stages. If a decision is made to move to the next stage or decision point or to gather additional data, additional funding will be provided from available funds. This approach will take on additional significance as RPSEA approaches Section 999 program close-out.

D. Ongoing Activities

As implementation of the program continues, activities include administration of current contracts, solicitation of new proposals, and planning for the following year. In addition to developing and releasing RFPs, selecting, negotiating and awarding subcontracts, the Program Consortium will perform project management functions for the current contracts and for future awards throughout the year. Special emphasis is placed on the combination of ongoing research and development efforts, which are increasing in number and size, and their fit, in terms of both timing and funding, with planned future efforts and direction. As alluded to above, the ultimate goal is to efficiently and effectively develop an improved toolkit that will be available for use, and that will result in a more robust overall system, in terms of safety, environmental impact, and resource utilization.

A listing of all projects can be found in Tables 5.2, 5.3, and 5.4. Abstracts and additional project status information for each of the projects can be found on the RPSEA website at www.rpsea.org.

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW1201: Wax Control	The University of Utah	24 months $400,000	Evaluate current and new flow assurance technologies to develop options for flowline cold stable flow without pipe insulation	SINTEF Petroleum Research, BP, StatoilHydro, University of Tulsa
DW1301: Improvements to Deepwater Subsea Measurements	Letton-Hall Group	24 months $3,654,000	Address gaps in the deployment and use of multiphase and we gas meter technology in deepwater production systems.	Chevron, Shell, Total, ConocoPhillips, BHP, StatoilHydro, Petrobras, Oceaneering, Multiphase Systems Integration Welker Engineering, Lake Charles Instruments/Neftemer Axept, Intertek, BP, Southwest Research Institute, ENI, Anadarko, Devon, Schlumberger, Weatherford
DW1302: Ultra-High Conductivity Umbilicals	NanoRidge Materials	12 months $448,000	Engineering prototype of a working ultra-high conductivity 'wire' (conductor) utilizing nanotube technology and test and analytical data	Technip, Rice University, Duco
DW1401: Carbon Fiber Wrapped High Pressure Drilling and Production Riser Qualification Program	Lincoln Composites	24 months $400,000	Develop and qualify composite reinforced metal tubulars for 15 ksi WP riser service in 10,000 fsw	Stress Engineering
DW1402A: Ultra-Deepwater Dry Tree System for Drilling and Production	Houston Offshore Engineering	Stage1 3 months $106,000 (Optional additional stages)	Feasibility design of a (low motion) semisubmersible qualified to support dry tree risers in the GOM which can be integrated with its topside quayside	Keppel Fels, Kiewit Offshore Services
DW1402B: Ultra-Deepwater Dry Tree System for Drilling and Production	Floatech	Stage1 3 months $234,000 (Optional additional stages)	Feasibility design of a (low motion) semisubmersible qualified to support dry tree risers in the GOM which can be integrated with its topside quayside	Seadrill Americas, Inc., GE/VetcoGray, 2H Offshore
DW1403: Fatigue Performance of High Strength Riser Materials	Southwest Research Institute	18 months $800,000	Testing and material qualification program will collect fatigue performance data for high strength materials for riser design	
DW1501: Extreme Reach Development	Tejas Research & Engineering	9 months $200,000	Study, conceptualize tools and service capabilities required to safely drill, complete, produce, maintain, and abandon reservoirs located up to 20 miles away from the surface facilities	Total, Chevron
DW1603-A: Graduate Student Design Project. Design of Extreme High Pressure and High Temperature Subsurface Safety Valve	Rice University	24 months $150,000	Project will contribute to goals of the drilling and completions initiative	
DW1603-B: Graduate Student Design Project. Robotic MFL Sensor for Monitoring and Inspection of Deepwater Risers	Rice University	24 months $150,000	Project will contribute to the goals of the dry trees/direct well intervention and risers in 10,000' water depth	itRobotics

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW1603-C: Graduate Student Design Project. Hydrate Plug Charaterization and Dissociation Strategies	The University of Tulsa	24 months $150,000	Project will contribute to the goals of the stabilized flow initiative	BP
DW1603-D: Graduate Student Design Project. Flow Phenomena in Jumpers	The University of Tulsa	24 months $150,000	Project will contribute to the goals of the stabilized flow initiative	Chevron
DW1701: Improved Recovery	Knowledge Reservoir	18 months $1,600,000	Identification of improved recovery opportunities in the early stages of field development planning	Anadarko
DW1801: Effect of Global Warming on Hurricane Activity	National Center for Atmospheric Research (UCAR)	12 months $560,000	Study to assess the threat that global on Gulf of Mexico hurricane activity (intensity and/or frequency	Georgia Institute of Technology
DW1901: Subsea Processing System Integration Engineering	GE Global Research	12 months $1,200,000	Process simulator for a subsea production system	GE/VetcoGray
DW1902: Deep Sea Hybrid Power System	Houston Advanced Research Center	12 months $480,000	Evaluate alternative methods for locally generating significant electrical power on the seafloor near large consumption points	Lawrence Livermore National Laboratory, Naval Facilities Engineering Service Center, Yardney Lithion, GE, Shell, Chevron
DW2001: Synthetic Benchmark Models of Complex Salt	SEAM	24 months $2,000,000	Project will generate realistic benchmark geological models, associated synthetic seismic and potential field data	3DGeo Development, Anadarko, BHP Billiton, CGGV Veritas, Chevron, Conoco Phillips, Devon, EMGS ASA, ENI, Exxon Mobil, Geotrace Technologies, Hess Corporation, ION, Landmark Graphics, Maersk Oil, Marathon Oil, Petrobras, PGS Americas, Repsol Services, Rock Solid Images, StatoilHydro, Total, WesternGeco

Table 5.2: 2007 UDW Selections

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW1502: Coil Tubing Drilling and Intervention System Using Cost Effective Vessel	Nautilus International LLC	12 months $820,000	Provide the basis for detailed design of a cost-effective deep water Coil Tubing (CT) system for down-hole work in deep water Gulf of Mexico (GOM) satellite wells without need for a Mobile Offshore Drilling Unit (MODU).	GE Oil & Gas; NOV CTES; INTECSEA; Tidewater Marine, LLC; The University of Tulsa; Texas A&M University; General Marine Contractors; Huisman Equipment BV
DW2101: New Safety Barrier Testing Methods	Southwest Research Institute	12 months $128,000	Develop more efficient and effective means of evaluating safety barriers, such as valves and blow-out preventers.	

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW2301: Riserless Intervention System	DTC International, Inc	27 months $3,382,000	Develop a Deepwater Riserless Intervention System (RIS) capable of conducting typical wireline interventions in water depths up to 10,000 feet.	Superior Energy Services; NOV Texas Oil Tools; Deepwater Research, Inc.; Det Norske Veritas (USA)
DW2502: Advanced Steady-State and Transient, Three-Dimensional, Single and Multi-phase, non-Newtonian Simulation System for Managed	Stratamagnetic Software, LLC	18 months $360,000	Provide an integrated suite of simulation tools capable of modeling the complete gamut of fluid flow problems encountered in managed pressure drilling.	
DW2902-02: Technologies of the Future for Pipeline Monitoring and Inspection	The University of Tulsa	24 months $120,000	Provide a system for monitoring and maintaining deepwater pipelines which would predict and allow proactive measures to be taken to avoid the problems associated with pipeline fouling or plugging or other deleterious conditions in the pipeline.	T.D. Williamson, Inc.
DW2902-03: Wireless Subsea Communications Systems	GE Global Research	12 months $120,000	Explore the limits and capacity of wireless communications for Subsea operations using RF conduction.	Northeastern University
DW2902-04: Replacing Chemical Biocides with Targeted Bacteriophages in Deepwater Pipelines and Reservoirs	Phage Biocontrol, LLC	25 months $120,000	Evaluate the use of bacteriophage in a focused approach to reduce the agents of microbiologically induced corrosion.	Texas A&M University; Shell International Exploration & Production; ConocoPhillips Company; Petrobras America, Inc.; Halliburton; Nalco Company; Multi-Chem Corporation; BJ Services Company; Champion Technologies, Inc.; Intertek Group plc; INTECSEA; Livermore Instruments, Inc.
DW2902-06: Enumerating Bacteria in Deepwater Pipelines in Real-Time and at a Negligible Marginal Cost Per Analysis: A Proof of Concept Study	Livermore Instruments Inc.	9 months $120,000	Utilize BioAerosol Mass Spectrometry (BAMS) technology to provide real time bioassays for flood water that will allow the design of an effective biocide regimen..	Phage Biocontrol, LLC; Texas A&M University; ConocoPhillips Company; Shell International Exploration & Production; Petrobras America, Inc.; Halliburton; Nalco Company; Multi-Chem Corporation; BJ Services Company; Champion Technologies, Inc.; Intertek Group plc; INTECSEA
DW2902-07: Fiber Containing Sweep Fluids for Ultra Deepwater Drilling Applications	The University of Oklahoma	24 months $120,000	Develop fiber sweep systems that improve hole cleaning in UDW drilling operations, reduce drilling costs and improve operational safety, and minimize the impacts of drilling on the natural environment.	M-I SWACO
DW2201: Heavy Viscous Oil PVT for Ultra Deepwater Proposal	Schlumberger Limited	30 months $458,000	Development and recommendation of best practices for sample handing and laboratory measurement methods for heavy viscous oil PVT measurement.	
DW1501: Early Reservoir Appraisal, Utilizing A Well Testing System	Nautilus International LLC	13 months $820,000	Design a low-cost and rapid response well testing and intervention system for ultra-deepwater wells.	Knowledge Reservoir, LLC; Expro International Group Ltd.; General Marine Contractors LLC; INTECSEA; Louisiana State University; The University of Tulsa; Texas A&M University; GE Oil & Gas; Tidewater Marine, LLC

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW2701: Ultra-Deepwater Resources To Reserves Development And Acceleration Through Appraisal	The University of Texas at Austin	18 months $200,000	Develop methodology and tools to estimate connectivity and properties of typical deepwater reservoirs based on a statistical treatment of geologic models.	Marathon Oil Corporation; Quantitative Clastics Laboratory (QCL); Center for Petroleum Asset Risk Management (CPARM)
DW2801: GOMEX 3-D Operational Ocean Forecast System Pilot Project	Portland State University	30 months $1,248,000	Demonstrate, evaluate, and establish an operational forecast system for ocean currents in the Gulf of Mexico.	Chevron Corporation; BP America, Inc.; Jet Propulsion Laboratory; UCLA; North Carolina State University; Princeton University; Naval Research Laboratory; Texas A&M University; Coast Survey Development Lab (CSDL); National Ocean Service (NOS); National Centers for Environmental Prediction (NCEP); National Weather Service (NWS); National Oceanic and Atmospheric Administration (NOAA)
DW2901: Ultra-reliable deepwater electrical power distribution system and power components	GE Global Research	36 months $5,000,000	Design an electrical power transmission and distribution system to enable subsea oil and gas production for a deepwater field development scenario, and design, build, and qualify critical components in a system demonstration to advance technology readiness level.	Texas A&M University; Rensselaer Polytechnic Institute; GE Oil & Gas

Table 5.3: 2008 UDW Selections

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING*	DESCRIPTION	PARTICIPANTS
UDW Seabed Discharge of Produced Water and/or Solids	Fluor Enterprises, Inc.	12 months $450,000	Evaluate the technical, environmental and regulatory factors associated with seabed discharge of produced water and solids in an ultra-deepwater environment.	The University of Tulsa; Colorado School of Mines; University of Houston; Rice University; Texas A&M University; Louisiana State University; Cameron; FMC Corporation; NATCO Group Inc.; GE Oil & Gas; Schlumberger Limited; Halliburton; Baker Petrolite; Coastal Chemical Company; Oceaneering International, Inc.; Subsea 7 Limited; Framo Engineering; Roxar
Displacement & Mixing in Subsea Jumpers Experimental Data and CFD Simulations	The University of Tulsa	24 months $255,000	Conduct an experimental and computational study of the mixing and displacement phenomena that take place during hydrate inhibition of jumper type configurations using MEG and methanol.	Anadarko Petroleum Corporation; BG Group; BP America, Inc.; BHP Billiton; Calsep International Consultants; Champion Technologies, Inc.; Chevron Corporation; Eni S.p.A.; Statoil; ONDEO; Nalco Company; Marathon Oil Corporation; Petrobras America, Inc.; TOTAL E&P USA, Inc.
Autonomous Inspection of Subsea Facilities	Lockheed Martin	12 months $994,000	Develop, integrate and test technology for autonomously conducting a pre/post hurricane inspection of a facility.	Florida Atlantic University; Seanic Ocean Systems
High Resolution 3D Laser Imaging for Inspection, Maintenance, Repair, and Operations	3D at Depth, LLC	13 months $499,000	Improve the accuracy and efficiency of the inspection, maintenance, and repair of ultra deepwater assets by designing and testing in a lake environment a 3-D laser scanning system.	UTEC Survey Inc.; CDL Inc.
Sensors & Processing for Pipe, Riser, Structure, & Equipment Inspection to Provide Detailed Measurements, Corrosion Detection, Leak	Blueview Technologies Inc	12 months $468,000	Apply advanced acoustic sensing technology developed with DOD funding to inspection of equipment in an UDW environment.	
Development of Carbon Nanotube Composite cables for udw Oil and Gas Fields	Los Alamos National Laboratory	36 months $2,000,000	Develop a new technology for electrical power cables, using a composite of carbon nanotubes (CNT) and copper. The composite cable should have twice the conductivity of an equivalent size pure copper cable and should also be lighter and stronger.	Chevron Energy Technology Company
Intelligent Production System for udw with Short Hop Wireless Power & Wireless Data Transfer for Lateral Production Control & Optimization	Tubel LLC	24 months $1,103,000	Develop and test a prototype system specifically for deployment in Ultra Deepwater horizontal wells and the lateral sections in multilateral wells to control and monitor hydrocarbon production.	University of Houston
Fatigue Testing Of Shrink-Fit Riser Connection For High Pressure Ultra Deepwater Risers	Subsea Riser Products	12 months $350,000	Conduct resonant fatigue testing of a Shrink-Fit connection which, as an alternative to welding, facilitates the fabrication of riser joints from high and ultra-high strength steel (80>130ksi)	BP America, Inc.; Chevron Corporation

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING*	DESCRIPTION	PARTICIPANTS
Deepwater Subsea Test Tree and Intervention Riser System	DTC International, Inc.	19 months $1,551,000	Develop a Deepwater Subsea Test Tree and Intervention Riser System that are capable of conducting Riser–Based intervention operations on subsea completed wells with wellhead shut-in pressures up to 20,000 psi and wellhead flowing temperatures up to 350 °F in water depths up to 12,000 feet.	Stress Engineering Services, Inc.; Titanium Company; Det Norske Veritas
Gyroscope Guidance Sensor for Ultra-Deepwater Applications	Laserlith Corporation	12 months $489,000	Development of an inertial guidance system for directional drilling, based on MEMS gyroscope technology.	Colorado School of Mines; MicroAssembly Technologies, Inc.; Ideal Aerosmith, LLC; X-FAB Silicon Foundries Group
A 1,000 level Drill Pipe Deployed Fiber Optic 3C Receiver Array for Deep Boreholes	Paulsson, Inc.	24 months $1,994,000	Develop a 1,000 level drill pipe deployed borehole seismic receiver array system using fiber optic sensor technology and build a 100 level demonstration system operational to 30,000 ft in a GOM UDW well.	US Sensor Systems, Inc.; Premier Drill Pipe, LTD; Kemlon Products, Inc.; Optiphase, Inc.; NORSAR

***** Note that duration and award amounts on 2009 projects have not been finalized

Table 5.4: 2009 UDW Selections

E. Metrics

Overall metrics for RPSEA in general are discussed in Chapter 8. Shorter-term metrics specific to the UDW program include the completion of annual milestones that show progress toward meeting the program element objectives. As a minimum, short term metrics to be completed before the end of FY 2011 include:

- Issue five solicitations for 2011
- Finalize portfolio, prepare and issue 2010 RFPs
- Select and award three to five large projects for 2010
- Establish FY 2011 R&D priorities based on results of 2007 - 2010 contracts, project selections, solicitations, and inputs from the TACs, PAC, and UDAC
- Prepare the 2012 Draft Annual Plan

Chapter 6 Unconventional Natural Gas and Other Petroleum Resources Program

A. Mission

The mission of the Unconventional Natural Gas and Other Petroleum Resources Program (Unconventional Resources Program) is to identify and develop economically viable technologies to locate, characterize, and produce unconventional natural gas and other petroleum resources in an environmentally acceptable manner.

Unconventional natural gas and other petroleum resources are defined in Section 999G of EPAct as "*natural gas and other petroleum resource[s] located onshore in an economically inaccessible geological formation, including resources of small producers."*

B. Goal

The overall goal of the Unconventional Resources Program is to increase the supply of domestic natural gas and other petroleum resources through the development, demonstration, and commercialization of technologies that reduce the cost and increase the efficiency of exploration for and production of such resources, while improving safety and minimizing environmental impact.

The contribution of natural gas to the nation's gas supply from three specific unconventional resources, gas shales, coal seams, and tight sands, has grown significantly during the past 20 years. These resources have been highlighted by the EIA and others as important supply sources during a minimum of the next 20 years (2008 Update to the National Petroleum Council Report: *Hard Truths: A Comprehensive View to 2030 of Global Oil and Natural Gas).* According to the latest estimate by the National Petroleum Council 2003 Natural Gas Study (NPC 2003), the volume of technically recoverable gas from these three resources in the lower 48 states is in excess of 293 trillion cubic feet (TCF). A 2008 report prepared by ICF International for the INGAA Foundation estimates these gas resources to be 624 TCF. In their 2009 report, the Potential Gas Committee estimates the lower 48 shale gas resource alone to be 616 TCF. Unconventional gas is clearly an important component of the U.S. energy portfolio and a valuable U.S. endowment. It is a goal of this program to provide the technology to both grow the resource base and convert technical resource into economic gas production. The primary beneficiary is the U.S. gas consumer who will have a more secure and fairly priced gas supply.

Due to their potential significance and in view of the limited resources available to the research program, gas shales and tight gas sands are the primary focus for the program. Novel technologies for coalbed methane development are also included, but at a secondary level. Opportunities to leverage developed technologies through application to other unconventional natural gas and petroleum resources will be sought, and other petroleum resources may be specifically targeted in subsequent years

In order for the program to be successful by maximizing the value of natural gas and other petroleum resources of the United States through new technology, the transfer of that technology to companies operating in the targeted resources is an integral part of the program planning and execution. Additionally, any development of new resources must be accomplished in an environmentally acceptable manner, so it will be important that technologies developed under the program be applied in ways that minimize the impact of resource development on the environment.

Consistent with an increased emphasis on the safety and environmental sensitivity of onshore operations, RPSEA will be expanding the role of the EAG and other stakeholders to ensure that appropriate priorities are placed on developing technologies and performing environmental studies that lead to a more complete understanding of the potential safety and environmental consequences of onshore gas development activities. This will likely lead to an increased effort on factors such as wellbore integrity, blowout prevention and control in onshore gas wells, safe hydraulic fracturing practices, and effective response and clean-up of spills and other incidents.

C. Objectives

Objectives for the Unconventional Resources Program were developed with input from the Unconventional Resources PAC. This input has been combined with information gathered during an ongoing series of efforts to identify and prioritize the technology challenges associated with the development of unconventional resources.

Recent efforts include: (1) participation by RPSEA staff in industry meetings, addressing unconventional resources organized by professional societies, such as SPE and AAPG, as well as organizations such as Hart's Energy Publishing, Platts and PennWell, (2) input provided to the 2009 Annual Plan by the URTAC, (3) input provided by PAC and TAC members involved with the selection process for the 2009 program, and (4) discussions at events such as the 2010 RPSEA Unconventional Gas Conference in Golden, CO and the 2010 RPSEA Coalbed and Shale Gas Forum in Tuscaloosa, AL.

All of these inputs were combined to arrive at the prioritized list of technology challenges that underlie both the objectives of this program and the list of solicitation topics found in the implementation plan. The issued solicitations will likely be further focused as a result of the selections made for the 2010 program.

The objectives are tied to the three resources described above (shales, tight sands, and coalbed methane). All three resources are important, but gas shales, the most difficult to economically extract and least developed of the three, was initially identified as the top priority. It was the consensus of the advisory groups that gas shales promised the greatest potential return on investment in terms of reserves additions. As the current portfolio reflects a strong emphasis on shale gas, the 2011 solicitations will emphasize both shales and tight sands. The desired balance among the three development categories has not changed significantly as the program has evolved:

- Existing - Active development drilling and production (~45%)

- Emerging - Formations, depth intervals, or geographic areas from which there has been limited commercial development activity and very large areas remain undeveloped (~45%)
- Frontier Area - Formations, depth intervals, or geographic areas from which there has been no prior commercial development (~10%)

The intended relative balance of the program's focus among these three categories from prior year Annual Plans is indicated above. In practice, the number of projects that apply to all three development categories has given the Frontier category a weight of approximately 15% in the 2007 through 2009 programs. No significant change in emphasis is planned for 2011.

Specifically, the objectives of the Unconventional Resources Program are:

Near Term
Objective 1: Develop tools, techniques, and methods that substantially increase commercial production and ultimate recovery from established unconventional gas formations and accelerate development of existing and emerging unconventional gas plays in an environmentally sound manner.

Objective 2: Develop tools, techniques, and methods that substantially decrease the environmental impact of unconventional gas development, with particular emphasis on water management and/or operations footprints.

Objective 3: Integrate the results and deliverables of the existing portfolio of projects to ensure that new technologies are demonstrated to, and applied by, industry to enhance safe and environmentally responsible production of the domestic unconventional gas resource base. Successful technology transfer is an important component of this objective.

Longer Term
Objective 4: Develop techniques and methods for exploration and production from high priority emerging gas shale, coal, and tight sand fields, as well as frontier basins and formations, where these operations have been hindered by technical, economic, or environmental challenges.

Development of an Integrated Program
An important aspect of this program is encouragement of teaming efforts to address integrated production needs of a particular unconventional gas resource. To the extent possible, integration of geologic concepts with engineering principles to overcome production and environmental issues is encouraged. The intent is to develop a coordinated program as opposed to individual projects, such that the whole has much greater value than the sum of the parts.

In order to accomplish this integration, projects will continue to be focused on two or three specific unconventional gas development areas. While the results of the program

will be applicable across a wide range of resources and basins, synergy among individual projects will best be achieved when there is an opportunity for multiple projects to share common datasets and coordinate their efforts to apply a range of technologies to the solution of common problems.

D. Implementation Plan

The Unconventional Resources Program is being implemented by developing and administering solicitations for R&D projects in areas that address the objectives outlined above. The objectives, technology targets, field projects, and technology dissemination components utilize an approach illustrated within Figure 6.1. The program components are prioritized for a particular resource target that has been identified as having significant potential. The highest ranking technology needs are identified and form the basis for the R&D solicitations. The projects are not implemented individually but are linked and coordinated one to another wherever possible. All projects are focused on a particular region(s) and coupled to program technology dissemination efforts. A coordinated program as opposed to individual projects is a primary implementation goal.

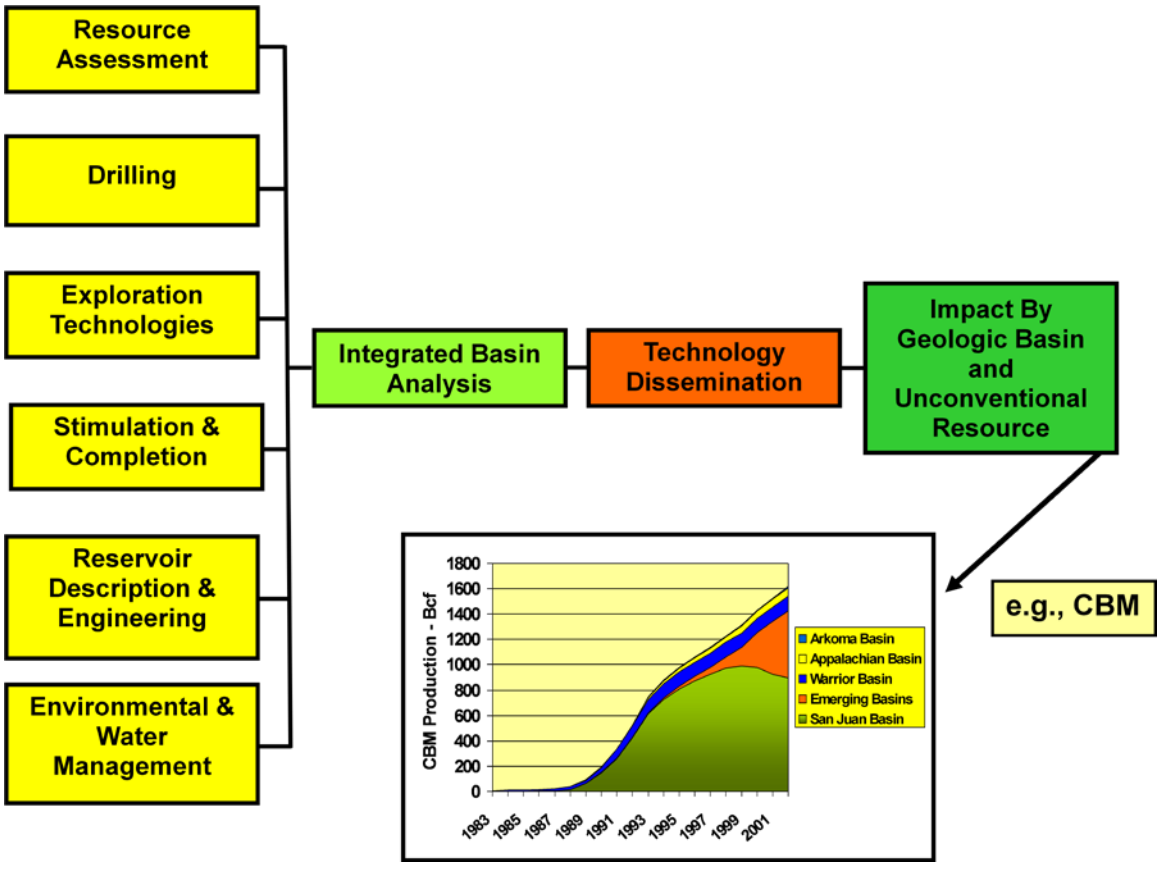


Figure 6.1: Program Development Component and Implementation Approach

The following section outlines the major steps in the implementation plan.

Development of Solicitations to Address Prioritized Technology Challenges
The 2007 and 2008 solicitations were broad in scope in order to allow consideration of a broad range of technical solutions, but they placed particular emphasis on addressing key technical or resource gaps within the current portfolio of projects. The 2009 program solicitations encouraged the development of integrated programs targeting specific resources with a focus on technology or resource gaps that remain in the program after the 2007 and 2008 selections. The 2010 solicitation is aligned with specific key resource targets and technology needs that emerged from the portfolio of projects chosen for the 2007 through 2009 program years. The 2011 solicitation will be particularly focused on the integration of results from earlier projects and their application to specific unconventional resource development challenges.

Two Integrated Basin Analysis projects were funded during the 2007 program year, focusing on the New Albany Shale in the Illinois Basin and tight sands in the Piceance Basin. A Marcellus Shale project was funded in the 2009 program. Another Integrated Basin Analysis project targeting an additional shale or tight gas resource is being sought through the 2010 program year solicitation. The PAC has recommended that these projects serve as anchor projects to focus program efforts on these specific resources. While it is intended that the technologies developed through the program will be applicable to a wide range of shale and tight sand resources, the recommended approach will allow individual researchers to develop coordinated efforts addressing the key challenges associated with specific targeted resources. In addition to the synergies that will arise from having teams of researchers work with common datasets on related problems, more effective workflows will be developed as a result of combining the best practitioners and researchers from multiple disciplines in a coordinated approach to development of the targeted resources.

Description of Planned Solicitations
The solicitations issued during the 2011 program year will be designed to integrate and build on the portfolio of projects developed during the 2007-2010 program years. They will be designed to ensure a coordinated program that addresses the technology challenges of resource development in at least three specific unconventional gas resources. While it will be important to confirm that the solicitations fill any program gaps remaining after the 2010 projects are chosen, a crucial need will be the integration of the results of individual projects and project application to the technical challenges associated with the development of specific unconventional gas resources. Thus, in addition to addressing specific technical needs, the 2011 solicitations may seek resources to plan and manage field-scale projects that result from the application of technology developed in previous program years. In order to successfully integrate the results of projects funded in previous years and bring appropriate technologies to the field trial stage, active technical management, with an emphasis on supervision of field experiments at the well site, will be required. The 2011 solicitations will likely seek proposals to provide such technical management and integration.

At least one, but no more than three, solicitations are anticipated to be issued during the 2011 program year, depending upon the evolving needs of the program. As proposals

involving the coordination of field trials or the integration of the results of multiple technologies are likely to be larger than early-stage technology development projects, it is anticipated that fewer and larger awards will result from the 2011 solicitation.

Safety and environmental impact have been key elements of the program since its inception. While a number of previous projects address the development of technologies that promise to decrease the environmental impact of unconventional gas development, some assessment of the vulnerabilities of existing technologies may be appropriate to ensure that any risks are fully understood and effectively mitigated. While there is no intent to duplicate work being done by other institutions and agencies, the 2011 program may include specific efforts to more fully define any risks associated with unconventional gas development, and ensure that appropriate technologies are available to mitigate those risks. In addition, priorities may include developing technologies and performing environmental studies concerning response, clean-up and the value of ecosystem services that may be impacted if an emergency situation should arise during exploration and production activities.

Some or all of the areas below may be covered by solicitations during the 2011 program year.

Solicitations will be directed toward the development and application of tools, techniques, and methods to substantially increase in an environmentally sound manner, commercial production, ultimate recovery from established unconventional gas resources, and accelerate the development of gas from emerging and frontier unconventional plays. For technologies that have reached the appropriate stage of development, field demonstrations may be encouraged. The areas of research shown below apply to each of the targeted unconventional resources, but priorities will be defined by program needs at the time the 2011 solicitations are issued.

Solicitations may be issued addressing the highest level goals below (1, 2, 3…) or targeting specific technology areas (a, b, c…), depending on program needs.

1. Develop and execute innovative approaches to integrate the results of individual research projects to address key technical issues in the development of unconventional gas resources and develop such research into commercially available services.
    a. Plan and manage field trials of previously developed technologies applied to the development of unconventional gas resources. Field trials will have as a focus the testing of developing technologies in the field at producer well sites and/or areas of field activity.
    b. Provide technical management services that integrate the results of existing projects and ensure that appropriate contractors work together to apply the most effective new technologies to the development of targeted unconventional gas resources.

c. Plan with RPSEA the dissemination of these results to the appropriate producer communities.

2. Develop an integrated program involving key technologies necessary to enable development of a specific unconventional gas resource in a particular geographic area. The program may include research in some or all of the areas a. through i., listed below, depending on the specific barriers to development of the targeted resource. Proposals for integrated programs are encouraged to incorporate and build upon the results of prior and currently active RPSEA projects. Concepts to be pursued within a given area of research may include, but are not limited to the areas listed as i., ii., iii., etc., below.

   a. Resource Assessment

      i. Evaluate the potential resources associated with new or underdeveloped unconventional gas plays and identify technical and economic barriers to their development

      ii. Link the research program to national assessment efforts for gas resources (e.g. Potential Gas Committee (PGC), Energy Information Administration (EIA)) to enable the program research results to be reflected as soon as practical on the annual assessments of the U.S. natural gas endowment.

   b. Geosciences

      i. Characterize geological, geochemical, and geophysical framework of unconventional resource plays

      ii. Develop surface-based and borehole-based technologies that identify drilling sweet spots

      iii. Develop real-time downhole techniques for evaluation of the source potential of hydrocarbon bearing shales

      iv. Characterize fracture attributes (orientation, intensity, openness, fluid saturation)

      v. Develop methods to optimize the position and orientation of vertical and horizontal wellbores

      vi. Determine stress fields

      vii. Apply geosciences to improve the design and implementation of hydraulic fracturing

   c. Basin Analysis and Resource Exploitation

      i. Characterize geological, geochemical, geophysical, and operational parameters that differentiate high-performing wells, areas and/or fields

      ii. Develop and demonstrate techniques to analyze large volumes of data in real-time for application during unconventional resource development

   d. Drilling

i. Progress the use of extra-extended single and multi-lateral drilling techniques

ii. Develop improved drilling methods that lower cost, reduce time on location, use less materials, or otherwise increase the efficiency and effectiveness of well construction

e. Stimulation and Completion

i. Utilize multi-zone completion and stimulation methods

ii. Cultivate steerable hydraulic fractures as appropriate

iii. Develop "domain stimulation" methods that impact a larger volume of reservoir volume

iv. Advance suitable low-cost fracturing fluids and proppant materials, e.g. non-damaging fluids and/or high strength, low density proppant materials

v. Develop techniques for zonal-isolation

vi. Develop methods for re-stimulation and identification of candidate wells for re-stimulation

vii. Mature stimulation methods that require less water and other fluids to be injected into the subsurface

viii. Identify more environmentally benign stimulation fluids

ix. Utilize stimulation methods that result in a lower volume of treatment fluids produced to the surface

x. Develop approaches for improved treatment, handling, reuse and, disposal of fluids produced and/or used in field operations, including reuse of recovered waters

xi. Improve fracturing and stimulation techniques for gas shales

f. Water Management

i. Advance comprehensive approaches for the conservation and management of water resources used and produced during all aspects of unconventional gas development

ii. Extend water management approaches that minimize the impact of drilling, completion, stimulation, and production operations on natural water resources

iii. Develop methods for the treatment of produced water and fracturing fluids with intermediate and high total dissolved solids in order to minimize the potential impact on natural water resources

iv. Develop methods for the sustainable beneficial use of produced water

v. Improve methods to control fines production

vi. Widen techniques to minimize the volume of water produced to the surface

g. Reservoir Description and Management
   i. Mature methods to accurately assess the potential for shale gas production from common industry petrophysical methods
   ii. Expound on accurate delineation of natural fracture systems
   iii. Extend the commercial life of a well through reduction or elimination of workovers and recompletions, as well as reduction of production costs
   iv. Progress methods to manage production in order to maintain the permeability generated through stimulation operations and minimize formation damage over time

v. Exploit methods to manage reservoirs to ensure maximum efficient recovery

h. Reservoir Engineering
   i. Elaborate on methods to plan, model, and predict the results of gas production operations
   ii. Develop real-time simulation and modeling of reservoirs

i. Environmental
   i. Develop advanced drilling, completion, and/or stimulation methods that allow a greater volume of reservoir to be accessed from a single surface location
   ii. Build on advanced drilling approaches that minimize the surface impact of well construction associated with the targeted unconventional gas resource
   iii. Advance completion, stimulation and/or reservoir management approaches that minimize the environmental impact associated with the development of the targeted resource
   iv. Cultivate methods to plan and select sites that minimize the surface footprint and the impact of drilling and production operations
   v. Develop surface mitigation methods applicable to all environments
   vi. Improve technologies to recycle water
   vii. Upgrade technologies to detect and capture emissions from unconventional oil and gas operations

3. Conduct early-stage research on novel concepts that may be applied to the development of unconventional gas resources. Such methods may include biological enhancement of gas production from unconventional resources.
4. Evaluate the environmental and safety aspects of current approaches to unconventional gas development. Identify any vulnerability and provide guidance on approaches to reduce and mitigate any risks. Specific topics may include, but are not limited to the following.

a. Conduct a comprehensive evaluation of the environmental risks associated with unconventional gas development and production operations associated with any general or specific unconventional gas resource.

b. Develop technologies to advance the science of warning systems to mitigate or prevent any safety or environmental accidents at any onshore oil and gas operation

c. Develop technologies to advance the science of damage control regarding safety and environmental accidents at any onshore oil and gas operations

d. Develop methods to further minimize the environmental impact of any onshore oil and gas operations

e. Develop methods to further improve safety procedures impacting personnel involved with onshore oil and gas operations

f. Perform environmental studies concerning the value of ecosystem services that may be impacted if an emergency would arise during exploration and production activities.

For new technologies to have an impact on energy production, they must be applied by energy producers. Many producers active in the targeted resources lack the full array of resources or organizational experience to take new technology from the research stage to the point at which it can be applied in field operations. For this reason, the evaluation criteria will be designed to encourage work leading to field applications that will demonstrate the applicability of new technology and encourage its commercial availability. In many cases, however, the developers of innovative new technology lack the resources and expertise to bring new products to the stage of field application and commercial availability. For this reason, number one (1) in the description above is designed to support activities that will integrate the results of individual projects and lead to field demonstrations of new approaches to unconventional gas development using results selected from the entire portfolio of projects.

The evaluation criteria will also be designed to encourage partnerships between oil and gas producers and research organizations. Partnerships are encouraged in order to facilitate the transition from research to application. In addition, the solicitation will encourage oil and gas producers, who may not be familiar or have expertise in proposal submissions, to partner with universities and service companies, who are familiar with this process.

Project Selection Process

Proposals submitted for the Unconventional Resources Program are divided into topic areas (e.g., Completion, Reservoir Engineering, Resource Assessment, etc.) for review in order to align the technical expertise and experience of reviewers with the content of the proposals. Three or more reviewers provide technical evaluations of the proposals within each topic area. To the greatest extent possible, all of the proposals within a topic area are evaluated by the same set of reviewers.

The PAC recommends proposals for funding based on the technical evaluations and the priorities associated with the various topic areas and targeted resources. Prior to considering individual proposals, the PAC assigns priorities to each of the topic areas for each of the targeted resources (currently gas shales, tight sands, and coalbed methane). The highest priority resource/topic area combinations are given the most weight in project selection, although all proposals with competitive technical review scores are considered for funding. The PAC considers factors such as balance among the time scales associated with technology and resource development, diversity of technical approach, and the geographic distribution of targeted resources when developing a portfolio of projects intended to maximize the probability of meeting program goals.

Funds Available and Anticipated Awards

It is anticipated that there will be $13.7 million available for funding the Unconventional Resources Program during each fiscal year. Approximately four to eight awards are anticipated to be awarded in 2011.

The typical award is expected to have duration of one to three years, although shorter or longer awards will be considered if warranted by the nature of the proposed project. The solicitation will specify a maximum award duration that is consistent with the authorized ending date for the program.

Under the stage/gate approach, all projects will be fully funded to the completion of the appropriate decision point identified in each contract, which may include multiple stages. If the decision is made to move to the next stage or decision point or to gather additional data, additional funding will be provided from available funds.

E. Ongoing Activities

Thirty-nine projects have been awarded based on selections from the 162 proposals submitted in response to the 2007 through 2009 solicitations for the Unconventional Resources Program. Table 6.1 below illustrates the breakdown of the current projects by technology area and primary resource target.

	Gas Shales	Tight Sands	Coalbed Methane
Integrated Basin Analysis	New Albany (GTI) $3.4 *Marcellus (GTI) $3.2* *Mancos (UTGS) $1.1*	Piceance (CSM) $2.9	
Stimulation and Completion	Cutters (Carter) $.09 Frac (UT Austin) $.69 Refrac (UT Austin) $.95 Frac Cond (TEES) $1.6 *Stimulation Domains (Higgs-Palmer) $0.39* *Fault Reactiviation (WVU) $0.85*	Gel Damage (TEES) $1.05 Frac Damage (Tulsa) $.22 *Foam Flow (Tulsa) $0.57* *Fracture Complexity (TerraTek) $0.83*	Microwave CBM (Penn) $.08
Reservoir Description & Management	Hi Res. Imag. (LBNL) $1.1 Gas Isotope (Caltech) $1.2 Marcellus Nat. Frac./Stress (BEG) $1.0 *Frac-Matrix Interaction (UT-Arl) $0.46* *Marcellus Geomechanics (PSU) $3.1*	Tight Gas Exp. System (LBNL) $1.7 Strat. Controls on Perm. (CSM) $0.1 *Fluid Flow in Tight Fms. (MUST) $1.2*	
Reservoir Engineering	Decision Model (TEES) $.31 Coupled Analysis (LBNL) $2.9 *Shale Simulation (OU) $1.05*	Wamsutter (Tulsa) $.44 Forecasting (Utah) $1.1 Condensate (Stanford) $.52	
Exploration Technologies	Multi-Azimuth Seismic (BEG) $1.1		Coal & Bugs (CSM) $.86
Drilling	*Drilling Fluids for Shale (UT Austin) $0.6*		
Water Management	Barnett & Appalachian (GTI) $2.5 Integrated Treatment Framework (CSM) $1.56	Frac Water Reuse (GE) $1.1	
Environmental	Environmentally Friendly Drilling (HARC)* $2.2	*	*
Resource Assessment	Alabama Shales (AL GS) $.5 Manning Shales (UT GS) $.43	Rockies Gas Comp. (CSM) $.67	

2007 Projects

2008 Projects

2009 Projects

Table 6.1: 2007, 2008, 2009 Project Selections Classified by Primary Resource Target and Technology Area

Table 6.1 also illustrates the way in which the projects selected for the 2008 and 2009 programs addressed some of the technology gaps left in the program after previous years' selections. The 2010 solicitation was designed to strengthen the integrated approach to the technology challenges associated with specific unconventional gas resources and identify an additional Integrated Basin Analysis project to serve as an anchor project for the program.

Figure 6.2 shows how the existing projects are beginning to achieve a program focus on specific resource areas anchored by Integrated Basin Analysis projects and supported by projects with a regional focus and projects that cross-cut the various geographic areas. The 2010 solicitation is designed to strengthen the program focus so that the maximum value is derived from the coordination and interaction of the funded projects.

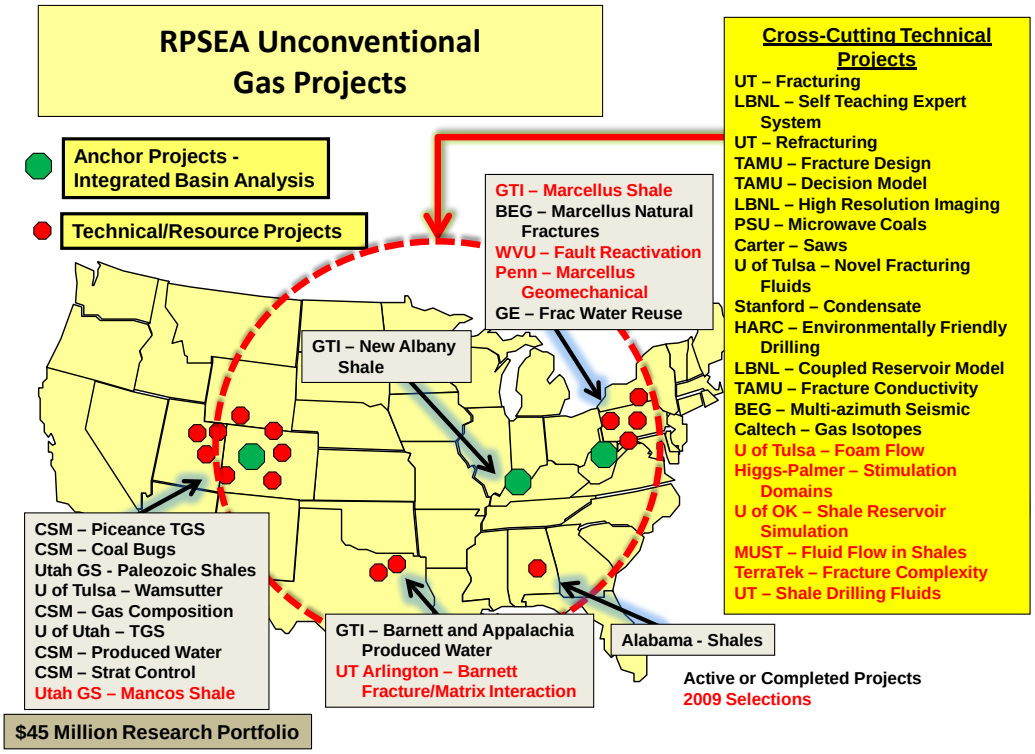


Figure 6.2: 2007, 2008 and 2009 Project Focus Areas

Project Highlights

Two projects from the 2007 program have been completed. These two projects are representative of those whose purposes are to progress innovations of new technologies not being applied today.

Novel Concepts for Unconventional Gas Development in Shales, Tight Sands and Coalbeds *(Project # 07122-07)* was performed by Carter Technologies along with The University of Oklahoma, University of Houston, and M-I L.L.C. The project objective was to define and provide a conceptual evaluation of an alternative method of formation stimulation to increase the net production of gas from shale while reducing the environmental impact due to the amount of water required.

The project has met the objective of defining and evaluating a new method of formation stimulation that may be able to connect hundreds of thousands of square feet of the formation face directly to the well bore. The preferred method uses a downhole cable saw to cut a pathway or "slot" into the formation all along the length of a horizontal lateral well bore within a shale formation. Estimates are that the method could cut 100-foot deep slots all along a 2500-foot long horizontal well.

Theory indicates that these slots may also reduce production decline, reduce the effects of formation damage, and allow a larger percentage of the in-place gas to be recovered

compared to conventional completions. The method appears to have a low capital cost and be sufficiently robust to withstand the rigors of the downhole drilling environment.

The computer model developed during the work indicates that the deep longitudinal slots can produce 50 to 100 times as much surface area as a horizontal well alone. These slots may be thought of as steerable oriented fractures. They are over an inch wide, and thus are more resistant to plugging than a hydro-fracture. They can be left open or packed with sand or pea gravel. Since their size and position are controlled rather than random, they can be placed in a grid or pattern to maximize production from a given zone, well, or lease acreage.Inventions and improvements to concepts have been made as a result of the project, and a provisional patent application has been filed with intension to file for U.S. and foreign patents.

Collaborative associates for the project have included M-I L.L.C., a Smith/Schlumberger Company, Smith International, and professors Peter Valco from Texas A&M University, and Younane Abousleiman from the University of Oklahoma.

The second completed project is entitled ***Enhancing Appalachian Coalbed Methane Extraction by Microwave-Induced Fractures*** *(Project # 07122-27),* performed by The Pennsylvania State University along with Nottingham University. The project objective was to perform preliminary laboratory evaluation of the use of short-bursts of microwaves for developing new fractures and enhancement of cleat apertures in bituminous coal (exposed with and without application of simulated hydrostatic stress). It was confirmed that the exposure of microwaves to a coal core can generate new fractures and increase the existing cleat apertures for an un-stressed core. Similar observations were found in the coal core under simulated hydrostatic stress during microwave exposure, indicating there is potential to use microwave exposure to improve connectivity between a horizontal wellbore and coal seam. Cleat/fracture volume, determined from micro-focused X-ray computed tomography, following microwave exposure increased from 1.8% to 16.1% of the unconfined core volume. The cleat/fracture volume increased from 0.5% to 5.5% for the core exposed while under simulated hydrostatic stress. Induced fractures were often horizontal and terminated at the existing cleat system. Cleat aperture enhancements were also noted.

Two other projects, still in progress, have been recognized by industry and are highlighted below:

The ***New Albany Shale Gas*** *(Project # 07122-16)* is one of the Integrated Basin Analysis projects that serve as an anchor for that geographical area. This project integrates geologic, geochemical, reservoir engineering, and production stimulation studies to bring together cross cutting technologies to allow for comprehensive study of the New Albany Shale. This project represents an integrated, scientific look at the factors controlling production in a marginally economic shale resource, with an objective of developing methods that will improve the economics of the New Albany shale, while also generating a level of fundamental understanding of shale resources that will guide the development of similar shales with currently marginal economics. The project is coming to a close as this plan is being prepared and operators are currently applying the results of the study.

When preliminary results were presented at the 24th World Gas Conference in Buenos Aires, Argentina the project received a best project award in recognition of its interdisciplinary, scientific approach to the development of a marginal shale resource..

Another award winning project is ***Environmentally Friendly Drilling*** *(Project #08122-35).* The goal of the Environmentally Friendly Drilling Systems (EFD) Program is to further advance to knowledge and development of environmentally friendly oil and gas activities with the objective of identifying, developing and demonstrating low-impact technologies/systems that can be used in environmentally sensitive areas that are currently off-limits. The EFD Program was selected by the Interstate Oil and Gas Compact Commission's Stewardship Award Subcommittee as the winner in the Environmental Partnership category. The award was presented at the Commission's annual meeting in Biloxi, Mississippi on October 5, 2009, where it was noted that "The program has become a clearing house of knowledge on reducing the impact of oil and gas operations through presentation, publications and the Web site."

Table 6.2 below provides a listing of the ongoing projects. Table 6.3 lists the projects that have been selected for the 2009 program year and their contracts are currently being finalized. Included for each selection is the project title, the recipient, project duration, the primary project deliverable, and other participants. Additional information can be found at www.rpsea.org and on the NETL/Strategic Center for Natural Gas and Oil webpage at www.netl.doe.gov/technologies/oil-gas/EPAct2005.

PROJECT	RECIPIENT	RPSEA FUNDING/ COMPLETION DATE	DELIVERABLE	OTHER PARTICIPANTS
A Self-Teaching Expert System for the Analysis, Design and Prediction of Gas Production from Shales	Lawrence Berkeley National Laboratory	$1,700,000 Oct 2010	User friendly software package for gas shale production prediction	Texas A&M University; University of Houston; University of California Berkeley; Anadarko; Southwestern Energy
Advanced Hydraulic Fracturing Technology for Unconventional Tight Gas Reservoirs	Texas A&M University	$1,000,000 Sep 2011	Design methodology for hydraulic fracturing considering new conductivity model	Carbo Ceramics; Schlumberger; Halliburton Energy Services; BJ Services
An Integrated Framework for the Treatment and Management of Produced Water	Colorado School of Mines	$1,600,000 Mar 2011	Best practices protocol for handling and processing produced water in the Rocky Mountains	Kennedy/Jenks Consultants; Argonne National Laboratory; Stratus Consulting; Eltron Research and Development; Chevron; Pioneer Natural Gas; Marathon; Triangle Petroleum; Anadarko; Awwa Research Foundation; Stewart Environmental; Southern Nevada Water Authority; Veolia Water; Hydration Technology; Petroglyph Operating
Application of Natural Gas Composition to Modeling Communication Within and Filling of Large Tight-Gas-Sand Reservoirs, Rocky Mountains	Colorado School of Mines	$670,000 Aug 2011	Fundamental understanding of gas composition as vs. migration pathways	U.S. Geological Survey; University of Oklahoma; University of Manchester; Fluid Inclusion Technology Permedia Research Group; Williams Exploration and Production; ConocoPhillips; ExxonMobil; Newfield Exploration; BP; Anadarko; EnCana Oil & Gas; Bill Barrett Corporation

PROJECT	RECIPIENT	RPSEA FUNDING/ COMPLETION DATE	DELIVERABLE	OTHER PARTICIPANTS
Comprehensive Investigation of the Biogeochemical Factors Enhancing Microbially Generated Methane in Coal Beds	Colorado School of Mines	$860,000 Dec 2011	Identification of critical factors for generating gas microbially in coal formations	University of Wyoming; U.S. Geological Survey; Pioneer Natural Resources; Pinnacle Gas Resources; Coleman Oil and Gas; Ciris Energy
Enhancing Appalachian Coalbed Methane Extraction by Microwave-Induced Fractures	The Pennsylvania State University	$79,000 May 2010	Fundamentals of efficacy of using microwaves as a CBM stimulation technique	Nottingham University
Gas Condensate Productivity in Tight Gas Sands	Stanford University	$520,000 Dec 2011	Production protocols to minimize formation damage due to liquids precipitation near the wellbore	
Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures	The University of Utah	$1,100,000 Sep 2011	Best Practices for development of Utah gas shales integrating natural and hydraulic fracture interaction	Utah Geological Survey; Golder Associates; Utah State University; HCItasca; Anadarko; Wind River Resources Corp
Geological Foundation for Production of Natural Gas from Diverse Shale Formations	Geologic Survey of Alabama	$500,000 Jul 2011	Geologic characterization of diverse shales in Alabama	
Improved Reservoir Access through Refracture Treatments in Tight Gas Sands and Gas Shales	The University of Texas at Austin	$950,000 Aug 2011	Strategy for refracture of tight gas and gas shale wells. Define window of refracture opportunity	Noble Energy; BJ Services; Anadarko; Jones Energy; Pinnacle Technologies
Improvement of Fracturing for Gas Shales	The University of Texas at Austin	$690,000 Apr 2011	Design and field test of lightweight proppant materials in the Barnett shale	Daneshy Consultants; BJ Services
New Albany Shale Gas	Gas Technology Institute	$3,400,000 Jul 2010	Well completion strategy for New Albany Shale wells focusing on well stimulation	Amherst College; University of Massachusetts; ResTech; Texas A&M University; Pinnacle Technologies; West Virginia University; Texas Bureau of Economic Geology; Aurora Oil and Gas; CNX Gas; Diversified Operating Corporation; Noble Energy; Trendwell Energy Corporation; BreitBurn Energy
Novel Concepts for Unconventional Gas Development in Shales, Tight Sands and Coalbeds	Carter Technologies	$91,680 COMPLETE	Feasibility study for the utilization of cables for cutting rock formations in a wellbore for stimulation purposes	University of Oklahoma; University of Houston; M-I L.L.C.
Novel Fluids for Gas Productivity Enhancement in Tight Formations	The University of Tulsa	$220,000 Sep 2011	Model for the mitigation of gel damage due to hydraulic fracturing in the near wellbore region	Williams Exploration & Production
Optimization of Infill Well Locations in Wamsutter Field	The University of Tulsa	$440,000 Jun 2011	Simulation technique for high-grading downsized spacing locations in a tight gas reservoir	Texas A&M University; Devon Energy
Optimizing Development Strategies to Increase Reserves in Unconventional Gas Reservoirs	Texas A&M University	$310,000 Aug 2011	Reservoir and decision model incorporating uncertainties	Unconventional Gas Resources Canada Operating Inc.; Pioneer Natural Resources

PROJECT	RECIPIENT	RPSEA FUNDING/ COMPLETION DATE	DELIVERABLE	OTHER PARTICIPANTS
Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities	Utah Geologic Survey	$430,000 Aug 2011	Characterization of Paleozoic shales, identification of highest potential areas, best practices for drilling and completion	Bereskin and Associates; GeoX Consulting; Halliburton Energy Services; Shell; Sinclair O&G; EnCana Oil & Gas; Bill Barrett Corporation; CrownCrest Operation LLC
Petrophysical Studies of Unconventional Gas Reservoirs Using High-Resolution Rock Imaging	Lawrence Berkeley National Laboratory	$1,100,000 Oct 2011	Development of recovery strategies mitigating condensate precipitation based on high resolution rock imaging	Schlumberger; BP; Chevron
Reservoir Connectivity and Stimulated Gas Flow in Tight Sands	Colorado School of Mines	$2,900,000 Sep 2010	Mamm creek field characterization and productivity criteria for application to similar environments	University of Colorado; Mesa State University; iReservoir; Bill Barrett Corporation; Noble Energy; Whiting Petroleum Corporation; ConocoPhillips
Barnett and Appalachian Shale Water Management and Reuse Technologies	Gas Technology Institute	$2,500,000 Aug 2011	Water management methods and technologies that reduce demands for freshwater, reduce environmental impact of brine disposal, and ensure supplies of water for well drilling and completion for shale gas development	The Bureau of Economic Geology/The University of Texas at Austin; Texerra; Geopure Water Technologies/Texas A&M University; Texas Oil and Gas Association; Chesapeake Energy Corporation; ConocoPhillips; Devon Energy Corporation; EnCana; EOG; Pittls Oil Company; Quicksilver; Range Resources; XTO; Barnett Shale Water Conservation and Management Committee; Appalachian Shale Water Conservation and Management Committee
Novel Gas Isotope Interpretation Tools to Optimize Gas Shale Production	California Institute of Technology	$1,190,000 Aug 2011	Novel diagnostic tools for predicting, monitoring and optimizing shale gas production	Devon Energy Corporation; BJ Services Company; GeoIsoChem Inc.
The Environmentally Friendly Drilling Systems Program	Houston Advanced Research Center	$2,200,000 Jul 2012	Identification and evaluation of critical technologies for low-impact drilling, transfer of technology to industry, and tools for selecting low-impact technologies appropriate for a given site	BP; CSI Technologies; Devon Energy Corporation; Gulf Coast Green Energy; Halliburton; Huisman; Jacarilla Apache Nation; KatchKan U.S.A.; M-I SWACO; Newpark Mats & Integrated Services; Weatherford; TerraPlatforms, LLC; Texas A&M University; Sam Houston State University; University of Arkansas; University of Colorado; Utah State University; University of Wyoming; West Virginia University; Argonne National Laboratory; Los Alamos National Laboratory; TerraPlatforms, LLC; Environmentally Friendly Drilling Joint Industry Partnership; The Nature Conservancy; Natural Resources Defense Council; New York State Energy Research and Development Authority
Pretreatment and Water Management for Frac Water Reuse and Salt Production	GE Global Research	$1,105,000 Aug 2011	Technology that enables recycle of nearly all fracturing flowback water as well as production of a salable salt by-product	STW Resources, Inc.
Stratigraphic Controls on Higher-Than-Average Permeability Zones in Tight-Gas Sands in the Piceance Basin	Colorado School of Mines	$110,000 Jul 2011	Evaluation of the stratigraphic controls on the distribution and quality of tight-gas reservoirs in the Piceance Basin	

PROJECT	RECIPIENT	RPSEA FUNDING/ COMPLETION DATE	DELIVERABLE	OTHER PARTICIPANTS
Coupled Flow-Geomechanical-Geophysical-Geochemical (F3G) Analysis of Tight Gas Production	Lawrence Berkeley National Laboratory	$2,900,000 Mar 2013	Knowledge regarding long-term behavior of fractured tight gas reservoirs	Texas A&M University; Stanford University; Baker Hughes Inc.; Unconventional Gas Resources, Inc.
Sustaining Fracture Area and Conductivity of Gas Shale Reservoirs for Enhancing Long-Term Production and Recovery	Texas A & M University	$1,615,000 Sep 2012	A methodology for reservoir typing and selection of fracture stimulations for preventing loss of productive fracture area and loss of fracture conductivity	TerraTek a Schlumberger Company; Devon Energy Corporation; EnCana Oil & Gas USA; Pennsylvania General Energy Co.
Multiazimuth Seismic Diffraction Imaging for Fracture Characterization in Low-Permeability Gas Formations	Bureau of Economic Geology, The University of Texas at Austin	$1,105,000 Oct 2012	Techniques for predicting fracture occurrence and attributes by combining seismic tools, fracture modeling, and fracture characterization based on wireline sampling techniques	The University of Texas at Austin; Bill Barrett Corporation
Evaluation of Fracture Systems and Stress Fields Within the Marcellus Shale and Utica Shale and Characterization of Associated Water-Disposal Reservoirs: Appalachian Basin	Bureau of Economic Geology, The University of Texas at Austin	$1,020,000 Sep 2012	Demonstration of how multicomponent seismic data can be used to evaluate fracture systems that control production of shale gas systems, quantify stress fields and elastic moduli that influence hydrofrac performance in shale reservoirs, and measure the capacity of porous sandstone units to accept flow-back water produced during hydrofrac operations.	University of Pittsburgh; Chesapeake Energy Corporation; Jeter Field Service; RARE Technology; AscendGeo; AOA Geophysics, Inc.; Austin Powder Company; Seismic Source

Table 6.2: Status Update on Awarded R&D Projects

PROJECT	RECIPIENT	DURATION/ RPSEA FUNDING*	DELIVERABLE	OTHER PARTICIPANTS
Gas Well Pressure Drop Prediction under Foam Flow Conditions	The University of Tulsa	$580,000 34 months	Correlation to calculate the pressure drop under foam flow for deep gas wells with small amounts of water production	Marathon; Chevron
Characterizing Stimulation Domains, for Improved Well Completions in Gas Shales	Higgs-Palmer Technologies	$390,000 19 months	A method and a prototype screening software tool to characterize how flow properties change within the domain of a well stimulation, both during and after the stimulation. Permeability-based stimulation diagnostics, and relate these to fracture treatment parameters. A guide to improvements in well stimulations. Demonstration the prototype tool by application to field data.	Aetman Engineering; PCM Technical; Southwestern Energy Company
Marcellus Gas Shale Project	Gas Technology Institute	$3,220,000 18 months	Develop technologies to overcome the technical and environmental challenges preventing the expansion of Marcellus production through a field-based project.	Pennsylvania State University; West Virginia University; Bureau of Economic Geology; Pinnacle Technologies; Restech
Prediction of Fault Reactivation in Hydraulic Fracturing of Horizontal Wells in Shale Gas Reservoirs	West Virginia University Research Corporation	$850,000 36 months	Develop an advanced method to predict fault reactivation and improve effectiveness of hydraulic fracturing stimulation of horizontal gas shale wells.	Range Resources; Appalachian, LLC
Cretaceous Mancos Shale Uinta Basin, Utah: Resource Potential and Best Practices for an Emerging Shale Gas Play	Utah Geological Survey	$1,080,000 36 months	This project will produce a GIS-based integrated geologic characterization of the Mancos Shale along with drilling, completion, and stimulation method recommendations.	University of Utah; Halliburton Energy Services
Simulation of Shale Gas Reservoirs Incorporating Appropriate Pore Geometry and the Correct Physics of Capillarity and Fluid Transport	Board of Regents of the University of Oklahoma	$1,050,000 36 months	Production of a reservoir simulator that provides for the appropriate pore geometry complexity, and models the processes with valid physical assumptions.	BP; Chesapeake Energy Corporation; Exco; Newfield; Total; Computer Modeling Group, Inc.
Integrated Experimental and Modeling Approaches to Studying the Fracture-Matrix Interaction in Gas Recovery from Barnett Shale	The University of Texas at Arlington	$460,000 24 months	The outcomes of this proposal will bridge the knowledge gaps in the pore connectivity effect on diffusive gas transport and gas recovery in fractured shale system.	Carrizo Oil and Gas, Inc.
Using Single-molecule Imaging System Combined with Nano-fluidic Chips to Understand Fluid Flow in Tight and Shale Gas Formation	Missouri University of Science and Technology	$1,210,000 36 months	The project will improve the understanding of the flow behavior of natural gas and introduced fluids (water, surfactant solutions and polymers) in nano-darcy range of tight gas and shale formations by using advanced single-molecule imaging system combined with nano-fluidic chips and pore-scale numerical simulation techniques.	Colorado School of Mines; BJ Services; HESS Corporation

PROJECT	RECIPIENT	DURATION/ RPSEA FUNDING*	DELIVERABLE	OTHER PARTICIPANTS
Improving Reservoir Contact for Increased Production and Recovery of Gas Shale Reservoirs (Achieving Management of Fracture Complexity)	TerraTek, A Schlumberger Company	$830,000 25 months	The main objective of this theoretical and experimental project is to understand the operational drivers of fracture complexity (pumping rate, fluid viscosity, and proppant) and provide guidance for maximizing this opportunity.	New Ventures; Encana Oil and Gas; Unconventional Gas Completion Research; Shell; William Duncan; Cimarex Energy Company; Devon Energy
A Geomechanical Model for Gas Shales Based on the Integration of Stress Measurements and Petrophysical Data from the greater Marcellus Gas System	The Pennsylvania State University	$3,140,000 36 months	Development of an integrated, predictive geomechanical model that integrates rock stress and petrophysical properties for the Marcellus gas system. The model can be generalized for application in other shale plays.	Chesapeake Energy Corporation; Schlumberger; Range Resources
Improved Drilling and Fracturing Fluids for Shale Gas Reservoirs	The University of Texas at Austin	$600,000 36 months	Develop nano-particle based water-based drilling fluids that are compatible with reactive gas shales and cost a lot less than the oil-based fluids being used today.	Conoco Phillips; Chevron Energy Technology Company; Mi SWACO

***** Note that duration and award amounts on 2009 projects have not been finalized

Table 6.3: Status Update on 2009 R&D Project Selections

F. Metrics

Overall metrics for the Program in general are discussed in Chapter 8. Shorter-term metrics specific to the Unconventional Resources Program include the completion of annual milestones that show progress towards meeting the program objectives. Short-term metrics to be completed before the end of FY 2011 include:

- Issue and complete at least one solicitation
- Engage the PAC to review that the solicitation reflects sufficient breadth and depth of industry experience
- Select and award 4 - 8 projects
- Establish FY2012 R&D priorities based on results of 2007-11 solicitations and other inputs from stakeholders, including the program advisory committees and the URTAC

Chapter 7 Small Producer Program

A. Mission

The mission of the Small Producer Program is to increase the supply from mature domestic natural gas and other petroleum resources through reducing the cost and increasing the efficiency of production of such resources, while improving safety and minimizing environmental impact, with a specific focus on the technology challenges of small producers.

Small producer is defined in EPAct as "*an entity organized under the laws of the United States with production levels of less than 1,000 barrels per day of oil equivalent."*

B. Goals

The goal of the Small Producer Program is to address the needs of small producers by focusing on areas including complex geology involving rapid changes in the type and quality of the oil and gas reservoirs across the reservoir; low reservoir pressure; unconventional natural gas reservoirs in coalbeds, deep reservoirs, tight sands, or shales; and, unconventional oil reservoirs in tar sands and oil shales.

C. Objectives

The small producer community is quick to adopt new technology that has been shown to have an economic benefit in their operating environment, but it does not generally have the time or resources to provide a test bed for technology development efforts or the demonstration of new applications of existing technology. The Small Producer Program has a crucial role in ensuring that leading edge exploration and production technology is made available to small producers, allowing them to maximize their important contribution to the nation's secure energy supply. The Section 999 small producer classification is roughly equivalent to the Category III operators as defined by the EIA. In 2007, the EIA reported that these 13,121 operators produced 186 million barrels of oil or 11% of U.S. oil production for that year.

The approach to enhancing the impact of small producers on energy production involves two related, but distinct activities. First, individual small producers facing representative challenges will be engaged to work with technology providers on the development and application of technology to enhance economic and environmentally responsible production and resource recovery. The support provided through the program will mitigate the economic risk normally associated with the application of new technologies. Second, the information acquired as a result of projects funded through the program will serve as the basis for technology transfer efforts that will promote appropriate novel technology applications throughout the small producer community.

The specific objectives of the Small Producer Program are:

Near Term
Objective 1: Apply technologies in new ways to enable improvements in water management and optimization of water use in mature fields.
Objective 2: Apply technologies in new ways to improve oil and gas recovery from mature fields, extending their economic life.

Objective 3: Apply technologies in new ways to reduce field operating costs.

Longer Term
Objective 4: Apply lessons from all near-term projects to new basins/areas and develop new technologies to address the problems of Objectives 1 through 3.

D. Implementation Plan

The Small Producer Program is being implemented by developing and administering solicitations for R&D projects in areas that address the objectives outlined above. The following section outlines the major steps in the implementation plan.

Small Producer Program Advisory Groups
The Small Producer Program receives guidance from the RAG, consisting of industry and academic representatives that are closely tied to the national small producer community. The RAG focuses on identifying, targeting, and prioritizing specific technology needs. This advisory group also provides a key communications focal point for encouraging the formation of the requisite research consortia (see next subsection for description of this requirement). After projects are initiated, the RAG follows each project's progress, plans, and results with particular attention to technology transfer. All projects are reviewed by the RAG annually.

While the RAG will be responsible for directing the Small Producer Program, the Unconventional Resources Program PAC will remain responsible for oversight of the entire onshore program, which includes the Small Producer Program, as well as the Unconventional Resources Program. The RAG will interact with the Unconventional Resources PAC through the RPSEA Unconventional Resources Program Vice President and through its chairman, who will hold a seat on the Unconventional Resources PAC.

Development of a Solicitation to Address Prioritized Technology Challenges
The Small Producer Program has been able to draw on the input from the exercises and workshops listed in the Unconventional Resources Program section of this DAP (see Chapter 6, part C), as well as specific events aimed at small producers. The overarching theme expressed by small producer representatives at these events and through feedback from the RAG in regular conference calls was the need for technology, which allows small producers to maximize the value of the assets they currently hold primarily in mature fields.

Accordingly, solicitations under this program are aimed toward developing and proving the application of technologies that will increase the value of mature fields by reducing operating costs, decreasing the cost and environmental impact of additional development,

and improving oil and gas recovery. Reducing risk is seen as key to reducing costs and, thus, extending the well life and improving recovery. Improved field management, best practices, and lower cost tools (including software) are all within the scope of this effort.

The 2011 solicitation(s) will continue to focus on the theme of advancing technology for mature fields; however, opportunities will be sought to further focus the program to complement the project selections in the 2007-2010 programs.

In order to ensure that technologies developed under this program are applied to increase production in a timely fashion, each proposal has been required to outline a path and timeline to an initial application. A specific target field for an initial test of the proposed development must be identified; and ideally, the field operator will be a partner in the proposal.

In compliance with Section 999B(d)(7)(C) of EPAct, all awards resulting from this solicitation *"shall be made to consortia consisting of small producers or organized primarily for the benefit of small producers."* For the purposes of the solicitation, a consortium shall consist of two or more entities participating in a proposal through prime contractor-subcontractor or other formalized relationship that ensures joint participation in the execution of the scope of work associated with an award. The participation in the consortium of the producer that operates the asset that is identified as the initial target for the proposed work is highly encouraged.

The 2011 solicitation(s) may request proposals addressing the following technology challenges:

- Development of approaches and methods for water management, including produced water shutoff or minimization, treatment and disposal of produced water, fluid recovery, chemical treatments, and minimizing water use for drilling and stimulation operations (Objective 1)
- Development of methods for improving oil and gas recovery and/or extending the economic life of reservoirs (Objective 2)
- Development of methods to reduce field operating costs, including reducing production related costs, as well as costs associated with plugging and abandoning wells and well site remediation; consideration will be given to those efforts directed at minimizing the environmental impact of future development activities (Objective 3)
- Development of cost-effective, intelligent well monitoring and reservoir modeling methods that will provide operators with the information required for efficient field operations (Objectives 2 and 3)
- Development of improved methods for well completions and recompletions, including methods of identifying bypassed pay behind pipe, deepening existing wells, and innovative methods for enhancing the volume of reservoir drained per

well through fracturing, cost-effective multilaterals, in-fill drilling, or other approaches (Objectives 2 and 3)

- Implementation and documentation of field tests of emerging technology that will provide operators with the information required to make sound investment decisions regarding the application of that technology (Objective 3)
- Collection and organization of existing well and field data from multiple sources into a readily accessible and usable format that attracts additional investment (Objectives 1, 2, 3, and 4)
- Creative capture and reuse of industrial waste products (produced water, excess heat) to reduce operating costs or improve recovery (Objectives 1, 2, and 3)
- Leverage of existing wellbores and surface footprint to maximize recovery of additional hydrocarbons (Objective 2)
- Addressing novel concepts that may be applied to increase production from mature fields (Objective 4)

The items in the above list are examples only and are not meant to exclude appropriate technologies and topics that may not be included therein. Additional solicitations may be issued based on assessment of proposals received and available funding.

For new technologies to have an impact on energy production, they must be applied by energy producers. Most small producers lack the full array of resources or organizational experience to take new technology from the research stage to the point at which it can be applied in field operations. For this reason, the evaluation criteria will be designed to encourage work leading to field applications that will demonstrate the applicability of new technology and encourage its commercial availability. In many cases, however, the developers of innovative new technology lack the resources and the expertise to bring new products to the stage of field application and commercial availability. For this reason, the solicitations will highly encourage the participation of at least one small producer in the consortium of two or more organizations required for each award under the Small Producer Program. In addition, the Small Producer Program intends to leverage other successful efforts such as the Petroleum Technology Transfer Council (PTTC) in order to reach the geographically dispersed small producer community.

Project Selection Process

Proposals submitted for the Small Producer Program are evaluated by the RAG. The RAG consists of representatives of small producers operating in various geographic areas, as well as academics, and researchers with experience working with small producers on topics related to the program theme, advancing technology for mature fields. In addition to technical merit, alignment with program goals and capabilities of the proposer, the RAG considers factors such as balance among technology time scales, diversity of technical approach, and the geographic distribution of resources impacted when selecting projects intended to maximize the probability of meeting program goals.

Funds Available and Anticipated Awards
It is anticipated that $3.17 million will be available for the Small Producer Program during fiscal year 2011.

Approximately four to seven awards are anticipated to be awarded under solicitations in 2011. The typical award is expected to have duration of one to three years, although shorter or longer awards may be considered if warranted by the nature of the proposed project.

Under the stage/gate approach, all projects will be fully funded to the completion of the appropriate decision point identified in each contract, which may include multiple stages. If a decision is made to move to the next stage or decision point or to gather additional data, additional funding will be provided from available funds.

E. Ongoing Activities

The 2007 and 2008 solicitations focused on application of available technologies for oil and gas recovery, water management issues, and minimizing the environmental impact on the surface. Seven projects were selected from the 2007 solicitation and six from the 2008 solicitation. These are listed in Table 7.1. Several projects built upon the theme of improving recovery from mature reservoirs, while others expanded into new theme areas of improved reservoir characterization and utilization of waste industrial products. All awards were made to consortia consistent with EPAct, with the prime contractor listed as the awardee and the other consortia members listed as participants. The 2009 solicitation was issued in October of 2009 and had the same general focus as that for the previous two years as consultation with advisory group members and information from participants in industry forums had indicated that the focus established by the initial solicitation is still the most important for small producers. Six projects were selected from the 2009 solicitation and these are listed in Table 7.1. The 2010 solicitation will again focus on application of available technologies for oil and gas recovery, water management issues, and minimizing the environmental impact on the surface as was outlined in the 2010 Annual Plan.

Figure 7.1 provides a summary of the type and a general geographic location of the projects awarded thus far. Additional information can be found at www.rpsea.org and on the NETL/SCNGO webpage at www.netl.doe.gov/technologies/oil-gas/EPAct2005.

Several of the 2007 projects are near completion; two are highlighted below.

Reducing Impacts of New Pit Rules on Small Producers *(Project 07123-07)* performed by New Mexico Institute of Mining and Technology in cooperation with the Independent Petroleum Association of New Mexico (IPANM) and the New Mexico Oil Conservation Division (NMOCD). The primary objective of this project was to make available a variety of data that New Mexico oil and gas producers would need to present when they file a pit closure plan (C-144 form). New rules in the state required operators to provide a significant amount of data; obtaining this data can be costly and time-consuming and is a particular burden on smaller companies. Other objectives included making the data available in useful formats that would be accepted by the NMOCD, and creating an

interactive version of the C-144 form that could be easily and automatically populated with some of the data obtained from the various databases accessed by this project.

The results of this project can be seen at http://ford.nmt.edu/react/pitrules_index.html. The real importance of the work is the mapping portal, which takes users to an online GIS system. Users can select pit locations, move locations, and query a great number of map layers for pertinent information, such as distances to water, residences, depths to groundwater, topography, etc. Although the OCD still requires operators to perform a site analysis, this tool provides a quick look for operators, enabling them to get an idea of issues they may at a particular location. In addition, the web site also allows users to create maps and diagrams of locations, and provides checklists and warnings of issues that may need attention as the forms are completed. The impact of this project has already been proven; the OCD has received and approved a number of forms that contain maps printed from this web site, and several operators have reported using it for a variety of purposes – not just the initial intent of completion the C-144 form.

A second project, ***Near Miscible CO_2 Application to Improve Oil Recovery for Small Producers*** *(Project #07123-03)***,** performed by the University of Kansas in partnership with Carmen Schmitt is also near completion. The primary object of this project was to investigate the feasibility of using CO_2 displacement at near miscible conditions to improve oil recovery in Arbuckle reservoirs in Kansas. CO_2 injection for enhanced oil recovery is normally carried out at a pressure above the minimum miscibility pressure (MMP), which is determined by crude oil composition and reservoir conditions. Many mature reservoirs are not considered for CO_2 miscible flooding because the maximum reservoir pressure that can be attained is less than the MMP. There is a significant resource that could be tapped if these lower pressure reservoirs could be recovered by CO_2 recovery processes operating near the miscibility pressure.

The MMP defined by the slim-tube experiment was 1350 psig at reservoir temperature of 110 F. Phase behavior studies indicate that extraction is the primary mechanism for mass transfer between CO_2 and crude oil to recover oil during CO_2 displacement at near miscible conditions. Core flooding tests conducted at the current average reservoir pressure, 1150 psig with three groups of rock samples, Berea sandstone, Baker dolomite and Arbuckle core, have found that at least 50% of the remaining oil can be recovered from this process. Detailed results of core flooding experiment and phase behavior study can be found on paper SPE 129710 and SPE 129728 or from http://www.torp.ku.edu/research/Near-MiscibleProject_Overview.html. Progress on this project was sufficient that the same organization received a second RPSEA Small Producers award to continue the work by expansion into collection of accurate field data to improve reservoir models.

The 2009 projects are listed below, categorized into three theme areas:

Oil and Gas Recovery

Field Testing and Diagnostics of Radial-Jet Well Stimulation for Enhanced Oil Recovery from Marginal Reserves *(Project # 09123-03)*

The objective of this research is field demonstration of radial jet technology for production enhancement from low-permeability reserves. Diagnostic techniques for monitoring lateral direction and placement will be developed and field tested. It is expected that successful completion of this project will answer the following questions: control and diagnosis of placement and direction of laterals during a radial jet enhancement, cost effectiveness of lateral jet enhancement, and determining preferred reservoir conditions and lateral patterns for deployment of radial jet technology from an existing wellbore.

Creating Fractures Past Damage More Effectively With Less Environmental Damage *(Project # 09123-20)*

The goal of this project is develop a more cost effective and environmentally friendly fracturing fluid to support a novel fracturing process. The process utilizes substantially less fluid volume than conventional treatments, and the frac fluid to be studied is comprised of a biodegradable polymer that will hydrolyze in an aqueous environment to monomeric forms of organic materials, eliminating the need for transition metal cross-linkers, breakers and other commonly used chemicals required with traditional cross-linked frac fluids.

Enhanced Oil Recovery from the Bakken Shale Using Surfactant Imbibition Coupled with Gravity Drainage *(Project # 09123-09)*

The objective of this project is to determine whether surfactant solutions can alter the wettability of the Bakken shale in North Dakota's Williston Basin to enhance oil recovery via gravity drainage. The research will investigate the ability of various surfactant solutions to alter the wettability of the formation without causing formation damage.

Characterization of Potential Sites for Near Miscible CO_2 Applications to Improve Oil Recovery in Arbuckle Reservoirs *(Project # 09123-18)*

This project will collect field data regarding reservoir pressure, residual oil saturation, reservoir properties and the nature of the flow from well to well in a Arbuckle reservoir. Single well transient pressure tests, multiple well interference tests, single well tracer tests, and interwell tracer tests will be conducted to determine the nature of the flow paths and average properties in the reservoir, to assess the effect of geology on process performance, to calibrate a reservoir simulation model, and to identify operational issues and concerns for future near miscible CO_2 applications.

Produced Water Management

Treatment and Beneficial Reuse of Produced Waters Using A Novel Pervaporation-Based Irrigation Technology *(Project # 09123-11)*

This project will explore and evaluate the application of a novel pervaporation (PV) based irrigation technology for treating and reusing oil and natural gas produced water.

Objectives for this research project are evaluation of the performance of the PV irrigation technology for treating oil/gas produced waters;, assessment of critical process design and operation issues associated with the PV irrigation technology through bench and pilot-scale tests, development of engineering and design information for implementing the PV irrigation technology in full-scale installations; and finally, development of a user friendly model for the PV irrigation technology to facilitate its implementation as a produced water management alternative.

Utilizing Waste Industrial Products

Green Oil™ CO_2-Enhanced Oil Recovery for America's Small Oil Producers *(Project # 09123-14)*

The objective of this project is to develop truck-portable equipment for generating CO_2 on-site at small producer fields on a scale of operation of approximately 1 million cubic feet per day. The system uses steam to reform biomass into CO_2 and hydrogen, following which the gases are separated, with the CO_2 used for enhanced oil recovery and the hydrogen used to generate several megawatts of electricity, which can be used locally or sold to the local grid. The study will also examine mature oil fields that are typical of small producer holdings to determine optimum locations for application of this technology.

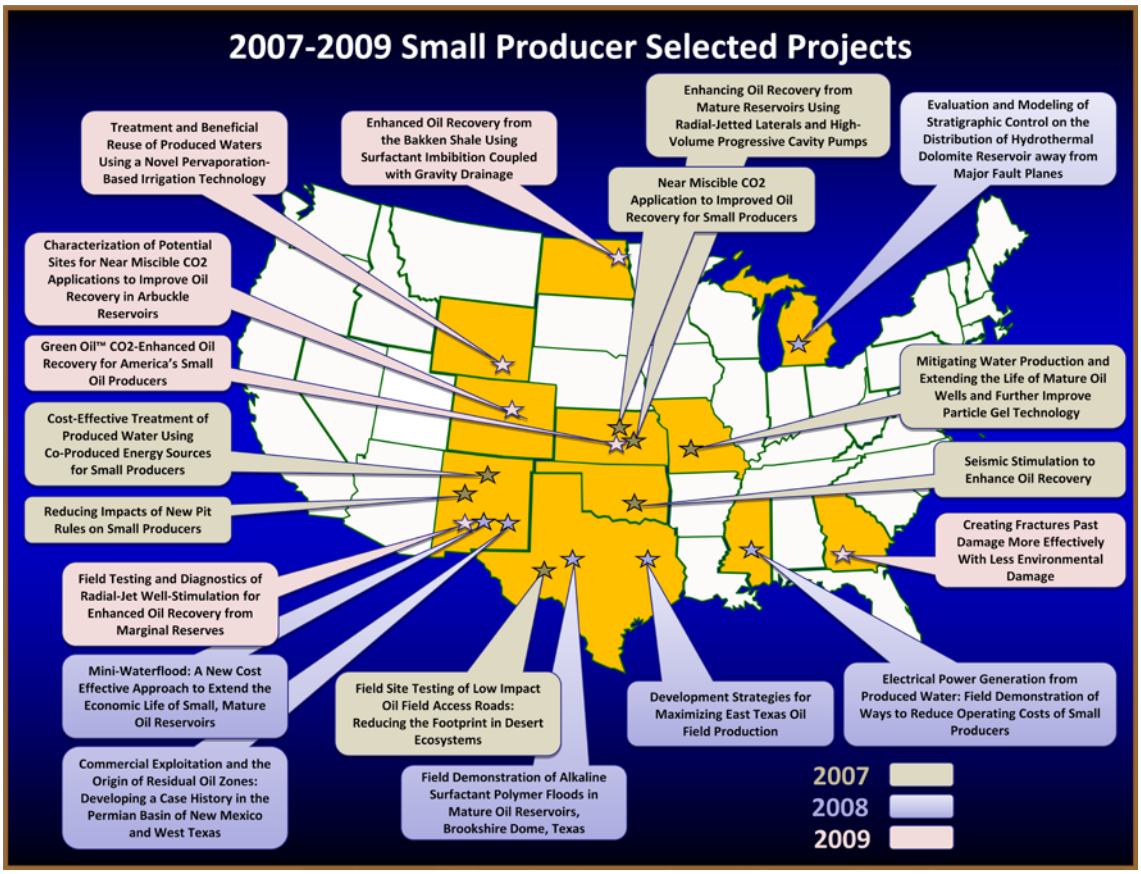


Figure 7.1: Small Producer Project Selections

2007 PROJECTS	AWARDEE	DURATION/ RPSEA FUNDING	DELIVERABLE	OTHER PARTICIPANTS
Cost-Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers	New Mexico Institute of Mining and Technology	24 months $457,253	A process to purify produced water at the wellhead	Robert L. Bayless, Producer LLC; Harvard Petroleum Company
Enhancing Oil Recovery from Mature Reservoirs Using Radial-Jetted Laterals and High-Volume Progressive Cavity Pumps	The University of Kansas	12 months $248,385	Application of available technology to increase oil recovery while effectively disposing of water	Kansas Geological Survey; American Energies Corporation
Field Site Testing of Low Impact Oil Field Access Roads: Reducing the Footprint in Desert Ecosystems	Texas A&M University	24 months $284,839	Identify materials and processes that will lessen the environmental impact of oilfield operations	Rio Vista Bluff Ranch; Halliburton
Near Miscible CO2 Application to Improved Oil Recovery for Small Producers	The University of Kansas	24 months $274,171	Define the potential for CO2 recovery or sequestration in near-miscible reservoirs	Carmen Schmitt
Preformed Particle Gel for Conformance Control	Missouri University of Science and Technology	24 months $520,212	Assessing gel performance in mitigating water production in fractured systems	ChemEOR Company; BJ Services
Reducing Impacts of New Pit Rules on Small Producers	New Mexico Institute of Mining and Technology	24 months $509,185	Access to online compliance data and automating permitting process	Independent Petroleum Association of New Mexico; New Mexico Oil Conservation Division
Seismic Stimulation to Enhance Oil Recovery	Lawrence Berkeley National Laboratory	24 months $723,373	Methodology to predict if a reservoir is amenable to seismic stimulation	U.S. Oil & Gas Corporation; Berkeley GeoImaging Resources
2008 PROJECTS	**AWARDEE**	**DURATION/ RPSEA FUNDING**	**DELIVERABLE**	**OTHER PARTICIPANTS**
Commercial Exploitation and the Origin of Residual Oil Zones: Developing a Case History in the Permian Basin of New Mexico and West Texas	The University of Texas of the Permian Basin	24 months $631,001	Examination of regional data to clarify extents, locations, and origins of residual oil zones in Permian Basin	Chevron Corporation; Legado Resources; Yates Petroleum; Petroleum Technology Transfer Council; Midland College; Applied Petroleum Technology Academy
Evaluation and Modeling of Stratigraphic Control on the Distribution of Hydrothermal Dolomite Reservoir Away from Major Fault Planes	Western Michigan University	24 montha $393,369	Study of lateral variability of reservoir quality hydrothermal dolomites to improve prediction of laterally persistent reservoir zones in the Albion-Scipio trend of southern Michigan.	Polaris Energy Company
Development Strategies for Maximizing East Texas Oil Field Production	Bureau of Economic Geology, The University of Texas at Austin,	36 months $984,985	Exploration of short to midterm strategies for maximizing recovery from East Texas Oil Field.	Danmark Energy LP; John Linder Operating Co. LLC

2007 PROJECTS	AWARDEE	DURATION/ RPSEA FUNDING	DELIVERABLE	OTHER PARTICIPANTS
Mini-Waterflood: A New Cost Effective Approach to Extend the Economic Life of Small, Mature Oil Reservoirs	New Mexico Institute of Mining and Technology	24 months $318,943	Demonstrate the feasibility of waterflooding small oil reservoirs that are not conducive to a fully-developed, patterned waterflood.	Armstrong Energy Corporation; Keltic Wall Services
Field Demonstration of Alkaline Surfactant Polymer Floods in Mature Oil Reservoirs Brookshire Dome, Texas	Layline Petroleum 1, LLC	24 months $597,936	Conduct a pilot study in Brookshire Dome field demonstrate applicability of alkaline surfactant polymer flooding to improve incremental oil production.	Tiorco LLC; The University of Texas at Austin
Electrical Power Genergation from Produced Water: Field Demonstration of Ways to Reduce Operating Costs of Small Producers	Gulf Coast Green Energy	6 months $229, 796	Demonstrate a relatively small low cost heat exhange device that converts heat from produced water to electricity.	Denbury Resources; ElectraTherm Inc.; Dry Coolers Inc.; Southern Methodist University; Texas A&M University
2009 PROJECTS	**AWARDEE**	**DURATION/ RPSEA FUNDING**	**DELIVERABLE**	**OTHER PARTICIPANTS**
Field Testing and Diagnostics of Radial-Jet Well-Stimulation for Enhanced Oil Recovery from Marginal Reserves Enhanced Oil	New Mexico Institute of Mining and Technology	24 months $656,537	Field evaluation of radial jet technology for pro-duction enhancement to determine effectiveness, directional control and placement of jets	Well Enhancement Services LLC; Harvard Petroleum Company LLC
Recovery from the Bakken Shale Using Surfactant Imbibition Coupled with Gravity Drainage	University of North Dakota	36 months $573,834	Investigate the ability of certain surfactant solutions to alter the wettability of the Bakken formation, without causing formation damage	North Dakota Industrial Commission; Tiorco – Stepan; Champion Technologies; Hess Corporation
Treatment and Beneficial Reuse of Produced Waters Using A Novel Pervaporation-Based Irrigation Technology	University of Wyoming	36 months $413,230	Evaluate the application of a novel pervaporation (PV) based irrigation technology for treating and reusing oil and natural gas produced water	Imperial College London; WyoTex Ventures LLC; DTI Group
Green Oil™ CO_2-Enhanced Oil Recovery For America's Small Oil Producers	Pioneer Astronautics, Inc.	24 months $550,000	Developmpment and testing of truck-portable equipment for generating CO2 on-site at small producer fields	J & L Allen Inc.; American Pioneer Ventures; New Mexico Institute of Mining and Technology
Characterization of Potential Sites for Near Miscible CO2 Applications to Improve Oil Recovery in Arbuckle Reservoirs	University of Kansas Center for Research, Inc.	24 months $607,704	Collection of field data needed to help model Arbuckle reservoirs to predict recovery in a future near-miscible CO2 flood	Tertiary Oil Recovery Project; University of Kansas; Kansas Geological Survey; Carmen Schmitt, Inc.
Creating Fractures Past Damage More Effectively With Less Environmental Damage	DaniMer Scientific, LLC	12 months $455,000	Development of a more environmentally-friendly fracture fluid and technique for mature reservoirs	CSI Technologies LLC; Texas A&M University

***** All awards made to consortia with prime listed as awardee and other members listed as participants
****** Note that duration and award amounts on 2009 projects have not been finalized

Table 7.1: Small Producer Program Selected Projects

F. Metrics

Overall metrics for the Program in general are discussed in Chapter 8. Shorter-term metrics specific to the Small Producer Program include the completion of annual milestones that show progress towards meeting the program objectives. Short-term metrics to be completed before the end of FY 2010 include:

- Issue and complete at least one solicitation
- Engage the RAG to review that the solicitation reflects sufficient breadth and depth of industry experience
- Select and award 4 - 7 projects
- Establish FY2011 R&D priorities based on results of 2007-10 solicitations and other inputs from stakeholders, including the program advisory committees and the URTAC

Chapter 8 Program Benefits and Performance Benchmarking

The primary overall goal of Section 999 is to increase the supply of domestic natural gas and oil by increasing the supply through cost reduction and efficiency improvement. RPSEA and its SAC will provide support and advice to the NETL-led effort to develop a methodology for determining benefits related to the Program. In general, a comprehensive benefits analysis that evaluates a full range of impacts stemming from the Program is anticipated.

There are four primary objectives of the planned benefits assessment methodology:

- To accurately characterize the full suite of benefits to be assessed, as to both type and timing
- To define reasonably accurate methods for quantifying these benefits as they accrue or for estimating how they are likely to accrue in the future
- To produce benefits assessments considered valid and reasonable by a panel of knowledgeable experts
- To further develop the methodology needed to estimate increases in royalty receipts resulting from the Program

In addition to the benefits assessment, the Program will monitor and report on short-term performance metrics, as well as program management performance and budget metrics. The methodologies for measuring these metrics are provided below.

A. Monitoring Short-Term Performance Metrics

The Program will develop quantitative, short-term performance metrics. The degree to which project milestones are completed on time, papers are delivered, patents are filed, companies contribute cost-share funds, and new technologies are determined to be successful and become commercialized are important indicators of the Program's success. The long-term success of the Program will ultimately be determined by the degree to which these short-term achievements are translated into the benefits outlined earlier. Some specific short-term metrics include:

- Number of solicitations issued
- Number of compliant proposals received
- Number of selections made
- Percent of selections resulting in contracts
- Time from selection to contracting
- Research award adherence to budget and schedule
- Amount of cost share in excess of the minimum requirement
- Milestone performance

B. Monitoring and Reporting Program Management Performance and Budget Metrics

As detailed within the RPSEA Management Plan, a monitoring process has been implemented for tracking budgeted versus actual financial information and other project schedule parameters. This monitoring process includes measurements of:

1. **Obligated/Uncosted Funding in Relation to Total Funds** – RPSEA will establish a database to track obligated funding, as well as uncosted amounts for the total Program (including administration) and each project. Funds will be tracked by year appropriated in order to determine the age of all funds in all categories.

2. **Research Project Performance Data Collection** - RPSEA utilizes research project monthly reports to efficiently collect project performance data. Each research project is required to submit a monthly report containing the following information:

    - Actual Expenditures by Month
    - Highlights and Accomplishments
    - Issues or Concerns
    - Corrective Actions

In addition to the above, RPSEA is developing procedures to capture, monitor, and analyze data related to:

- Minimization of the amount of time from invoice to payment
- The number of small business, minority owned, and other disadvantaged category Program participants

Appendix A: RPSEA Membership and Committee Lists

RPSEA Members

Acute Technological Services, LLC
Advanced Resources International, Inc.
Advantek International, Corp.
AeroVironment, Inc.
Altira Group LLC
Alcoa Oil and Gas
American Gas Association
Anadarko Petroleum Corporation
Apache Corporation
APS Technology, Inc.
At Balance Americas LLC
Baker Hughes Incorporated
Big Cat Energy Corp.
Bill Barrett Corporation
BJ Services Company
BlueView Technologies Inc.
BP America, Inc.
Brownstein Hyatt Farber Schreck, LLP
Cameron/Curtiss-Wright EMD
Campbell Applied Physics
Capstone Turbine Corporation
CARBO Ceramics, Inc.
Chesapeake Energy Corporation
Chevron Corporation
City of Sugar Land
Colorado School of Mines
Colorado Oil & Gas Association
ConocoPhillips Company
Conservation Committee of California Oil & Gas Producers
Consortium for Ocean Leadership
Consumer Energy Alliance
Correlations Company Inc.
CSI Technologies, Inc.
DCP Midstream, LLC
Cubility AS
DeepFlex Inc.
Deepwater Structures, Inc.
Deepwater XLP Technology, LLC
Det Norske Veritas (USA)
Devon Energy Corporation

Drilling & Production Company
EnCana Corporation
EnerCrest, Inc.
Energy Corporation of America
Energy Valley, Inc.
ExxonMobil Corporation
Gas Techology Institute
GE Oil & Gas
Granherne, Inc.
Greater Fort Bend Economic Development Council
Greensburg Oil, LLC
GSI Environmental, Inc.
Gunnison Energy Corporation
Halliburton
Harvard Petroleum Corporation
HIMA Americas, Inc.
Houston Advanced Research Center
Houston Offshore Engineering, LLC
Houston Technology Center
HW Process Technologies, Inc.
Idaho National Laboratory
Independent Petroleum Association of America
Independent Petroleum Association of Mountain States
Independent Petroleum Association of New Mexico
Integrated Ocean Drilling Program
Intelligent Agent Corporation
Interstate Oil and Gas Compact Commission
Jackson State University
Kongsberg Oil & Gas Technologies, Inc.
Knowledge Reservoir, LLC
Lawrence Berkeley National Laboratory
Lawrence Livermore National Laboratory
Leede Operating Company, LLC
Letton-Hall Group
Lockheed Martin Corporation
Los Alamos National Laboratory
Louisiana State University
MAP Royalty Inc.
Marathon Oil Corporation
Massachusetts Institute of Technology
Merrick Systems, Inc.
Mississippi State University
M&H Energy Services
Nalco Company
Nance Resources Inc.
NanoRidge Materials, Inc.

National Oilwell Varco, Inc
Natural Carbon, LLC
Nautilus International, LLC
Neptec USA
New England Research, Inc.
New Mexico Institute of Mining and Technology
Nexen Petroleum USA Inc.
NGAS Resources, Inc.
NGO Development Corporation
NiCo Resources
Noble Energy, Inc
Novatek, LLC
Oceaneering International, Inc.
Oklahoma Independent Petroleum Association
OTM Consulting Ltd.
Oxane Materials, Inc.
Panther Energy Company, LLC
Paulsson Inc.
Petris Technology, Inc.
Petrobras America, Inc.
Petroleum Technology Transfer Council
Pioneer Natural Resources Company
Propel, Inc.
Q O, Inc.
Quanelle, LLC
Quest Integrated, Inc.
Quest Offshore Resources, Inc.
Rice University
Robert L. Bayless, Producer LLC
Rock Solid Images
RTI Energy Systems
Sandia National Laboratories
Schlumberger Limited
Shell International Exploration & Production
Simmons & Company International
SiteLark, LLC
Southern Methodist University
Southwest Research Institute
Spatial Energy
Stanford University
Statoil
Strata Production Company
Stress Engineering Services, Inc.
Subsea Riser Products
Technip USA Inc.
Technology International Inc.

Tejas Research & Engineering, LP
Tenaris Global Services (USA) Corp.
Texas A&M University
Texas Energy Center
Texas Independent Producers and Royalty Owners Association
Texas Tech University
The Discovery Group, Inc.
The Fleischaker Companies
The Ohio State University
The Pennsylvania State University
The University of Kansas
The University of Oklahoma
The University of Texas at Austin
The University of Tulsa
The University of Utah
Titanium Engineers, Inc.
Total E&P USA, Inc.
Tubel Energy LLC
University of Alaska Fairbanks
University of Colorado at Boulder
University of Houston
University of Southern California
U.S. Geothermal Inc. (pending)
Vista Resources, Inc.
Versa Marine Engineering, LLC
Watt Mineral Holdings, LLC
Weatherford International Ltd.
WellDog
Western Standard Energy Corp.
West Virginia University
WFS Energy & Environment
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Guy Lewis	Gas Technology Institute
Dirk McDermott	Altira Group LLC
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Brian Rovelli	TOTAL Exploration Production USA
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Jane Zhang	Shell International Exploration & Production
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Roy Long	National Energy Technology Laboratory (Ex-Officio)

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Dr. Dag Nummedal	Colorado School of Mines
Brook Phifer	NiCo Resources, LLC
Darrell Pierce	DCP Midstream, LLC
Dr. Jose Rueda	BP America, Inc.
Richard Sullivan	Anadarko Petroleum Corporation
Dr. Nafi Toksoz	Massachusetts Institute of Technology
Dr. Dennis Johnston	Devon Energy Corporation
Roy Long	National Energy Technology Laboratory (Ex-Officio)
Virginia Weyland	National Energy Technology Laboratory (Ex-Officio)

Small Producer Research Advisory Group (RAG)

NAME	AFFILIATION
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Chuck Boyer	Schlumberger Limited
Dr. Iraj Ershaghi	University of Southern California
Bob Kiker	Petroleum Technology Transfer Council
Ken Oglesby	Impact Technologies LLC
Dr. Douglas Patchen	West Virginia University
Brook Phifer	NiCo Resources, LLC
Don Solanas	Arrowhead Exploration Co.
Dr. W. Lynn Watney	Kansas Geological Survey
Roy Long	National Energy Technology Laboratory (Ex-Officio)
Chandra Nautiyal	National Energy Technology Laboratory (Ex-Officio)

Environmental Advisory Group (EAG)

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Dr. Steve Bryant	The University of Texas at Austin
Sharon Buccino	Natural Resources Defense Council
David Burnett	Texas A&M University
Kevin Harvey	KC Harvey
Chuck Horn	Technip USA
Dr. Russ Johns	The University of Texas at Austin
Dr. Joe Kiesecker	The Nature Conservancy
Roy Long	National Energy Technology Laboratory
Dr. Pam Matson	Stanford University
Dr. Charles Newell	Groundwater Services, Inc.
Øyvind Strøm	StatoilHydro
Dr. Mason Tomson	Rice University
Heidi VanGenderen	Worldwatch Institute

Appendix B: Solicitation Process

A. Eligibility

In accordance with Section 999 of EPAct, in order to receive an award, an entity must either be:

1. a United States-owned entity organized under the laws of the United States or
2. an entity organized under the laws of the United States that has a parent entity organized under the laws of a country that affords:

a. to United States-owned entities opportunities comparable to those afforded to any other entity to participate in any cooperative research venture similar to those authorized under this subtitle,

b. to United States-owned entities local investment opportunities comparable to those afforded to any other entity, and

c. adequate and effective protection for the intellectual property rights of United States-owned entities.

RPSEA is not eligible to apply for an award under this Program.

B. Organizational/Personal Conflict of Interest

The approved RPSEA Organizational Conflict of Interest (OCI) Plan will govern all potential conflicts associated with the solicitation and award process.

RPSEA was required to submit an OCI Plan, which in accordance with Section 999B(c)(3) of EPAct addressed the procedures, by which RPSEA will (1) ensure it's board members, officers, and employees in a decision-making capacity disclose to the DOE any financial interests in or financial relationships with applicants for or recipients of awards under the Program, and (2) require board members, officers, or employees with disclosed financial relationships or interests to recuse themselves from any oversight of awards made under the Program. The OCI Plan was reviewed by the DOE. After the DOE's comments and questions were addressed, a final OCI Plan was approved.

In addition, the contract between DOE and RPSEA includes the following OCI clauses: H.22 *Organizational Conflict of Interest (Nov 2005)*; H.23 *Organizational Conflict of Interest (OCI) Annual Disclosure*; and, H.24 *Limitation of Future Contracting and Employment.*

These contract clauses and the approved OCI will govern potential conflicts associated with the solicitation and award process.

C. Solicitation Approval and Project Selection Process

The overall structure of the solicitation approval and project selection process is illustrated in Figure Appendix B.1. Project selection will be through a fully open and competitive process. A two-step proposal process may be used where a technical volume

and cost summary is submitted prior to submission of a full-cost proposal and other associated detailed information. This two-step process eliminates unnecessary detailed cost development for proposals that are not selected after step one. Within the RPSEA project proposal review and selection process, advisory committees composed of subject matter experts and industry representatives will be responsible for providing technical reviews of proposals and for the selection of proposals to recommend to the RPSEA president for negotiation toward award. NETL will be responsible for the final review and approval of recommended projects.

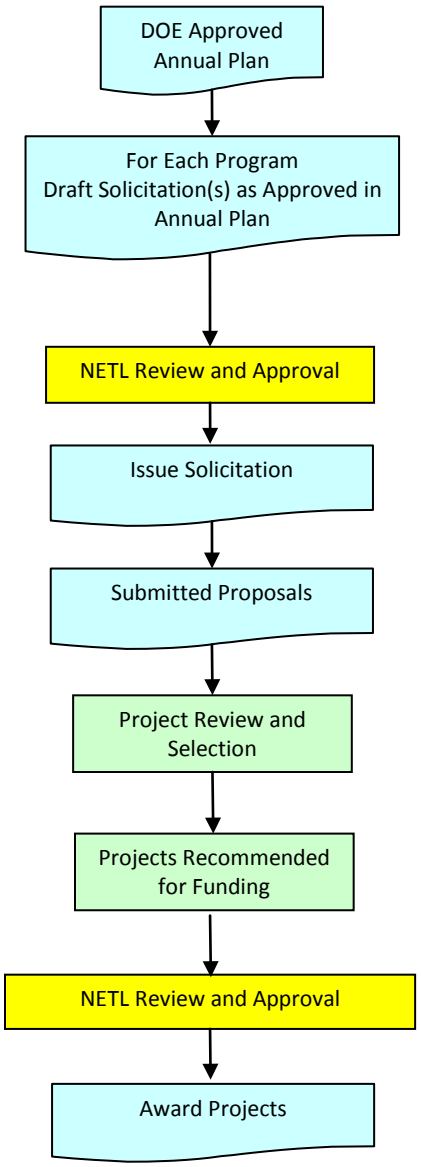

Figure Appendix B.1: Project Solicitation Process

D. Selection Criteria

The following general criteria (which will be more defined in the individual solicitations) will be used, as applicable, to evaluate proposals submitted under the Program. The

details of the selection criteria and the weighting factors will vary depending on the specific technology area and will be clearly identified in each solicitation.

- Technical merit and applicable production or reserve impact
- Statement of project objectives
- Personnel qualifications, project management capabilities, facilities and equipment, and readiness
- Technology transfer approach
- Cost for the proposed work
- Cost share
- Environmental impact (including an assessment of the impacts, both positive and negative, that would result from the application of a developed technology)
- Health and safety quality assurance/quality control

Bidders may be required to meet with the review committee to present their proposal and to answer any outstanding questions.

In the Small Producer Program, the following criteria will be used to evaluate proposals in addition to those stated above: approach to application of the results, involvement of small producers, and the overall strength of the Program.

E. Schedule and Timing

The 2011 solicitation(s) will be conducted after approval and posting of the 2011 Annual Plan and will remain open for a minimum of 60 days. Additional activities for RPSEA shown on the timeline in Table Appendix B.1 will be the active administration of all R&D awards, planning and development of the Program for 2012, and holding program-level technology transfer workshops.

2011 RPSEA Program Timeline		Aug 10	Sept 10	Oct 10	Nov 10	Dec 10	Jan 11	Feb 11	Mar 11	Apr 11	May 11	Jun 11	Jul 11	Aug 11	Sept 11
Month		*-2*	*-1*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
2011 Draft Plan Submitted (July 15, 2010)	♦														
Plan Published		♦													
Plan Approved						♦									
Obtain DOE Approval of Solicitation							♦								
Solicitation Open Period															
Proposal Evaluation and Selection															
DOE Approval												♦			
Contract Negotiation and Award															
Administer 2011Awards															
Administer 2007, 2008, 2009 & 2010 Awards															
Report Program Deliverables															
Conduct Technology Transfer Workshops & Activities															
Establish 2012 R&D Priorities & Annual Plan															

Table Appendix B.1: 2011 RPSEA Program Timeline

F. Proposal Specifications

The structure and required elements of proposals submitted in response to each of the solicitations, as well as the specific details regarding format and delivery, will be developed in consultation with the DOE and will be provided in each solicitation.

G. Funding Estimates

It is anticipated that for fiscal year 2011, $14.79 million per year will be available for the UDW, with approximately five to ten awards, and $13.73 million per year for the Unconventional Resources Program, with approximately five to 15 awards. The typical award is expected to have duration of one to three years, although shorter or longer awards may be considered if warranted by the nature of the proposed project. Under the stage/gate approach, all projects will be fully funded to the completion of the appropriate decision point identified in each contract, which may include multiple stages. Once a decision is made to move to the next stage or decision point, additional funding will be provided from available funds.

It is anticipated that $3.17 million per year will be available for the Small Producer Program. Approximately four to 12 awards are anticipated during fiscal year 2011. The

typical award is expected to have duration of two years, although shorter or longer awards may be considered if warranted by the nature of the proposed project.

H. Advertising of Solicitations

Advertising of each solicitation will be implemented in a manner that insures wide distribution to the specific audience targeted by each solicitation.

The vehicles used will include but not be limited to:

- Publication on the NETL website, supported by the DOE press releases
- Publication on the RPSEA website, supported by RPSEA press releases and newsletters
- Announcements distributed via e-mail to targeted lists (e.g. small producer solicitation to members of state producer organizations and IPAA)

Other vehicles that may be used include:

- Advertising in recognized industry publications (e.g., *Oil and Gas Journal, Hart's E&P, Offshore Engineer, American Oil and Gas Reporter, World Oil, JPT,* etc.)
- Presentations at industry meetings by both RPSEA and NETL representatives, as appropriate given the timing of the solicitations
- Working with the various professional, industry, state, and national organizations to utilize their established networks

Appendix C: Technology Transfer Accomplishments

Technology transfer is foremost in the mission of RPSEA and its Section 999 Program. The ***Technology Transfer Policy*** states that RPSEA shall designate at least 2.5% of the amount of each award made under Section 999, EPAct 2005 for technology transfer and outreach activities. As interpreted by DOE, the amount of each award is the sum of the amount provided by RPSEA and the amount contributed as cost share. A portion of the 2.5% may be retained by RPSEA from each award for programmatic level technology transfer and outreach activities

The solicitations for all RPSEA program elements specify that some fraction of the 2.5% of contract funds designated for technology transfer will be set-aside for technology transfer activities as directed by RPSEA. This fraction is nominally 40% of the required 2.5% Technology Transfer reserve, or 1% of the total project value, but the exact amount may vary as specified in each contract. The intent is to ensure that some portion of the contract R&D funds designated for technology transfer are available for activities that cover the results of multiple R&D contracts in a coordinated fashion.

It is accomplished by several modes, including:

- Website enhancements and database population
- Workshops and forums
- RPSEA technical conferences
- Organization and facilitation of presentations and publications by multiple subcontractors
- Technical support
- Exhibition costs when supporting technology transfer
- Other technology transfer methods and opportunities

Many of these technology transfer mechanisms have become active as results have been generated by the Program. Other events, such as the workshops/forums and poster presentation opportunities at exhibitions or technical conferences, are ongoing and are anticipated to continue through the contractual period of the Program. Some of these events, such as a RPSEA Technical Conference, will require significant advance planning.

Below is a partial, though by no means exhaustive, list of technology transfer to date:

Date	Description	Program/ Contract No.	Event Title
Mar-09	Program Presentation	Overall Program	***Global New Energy Summit***, Santa Fe, NM
Apr-09	Program Presentation	Overall Program	***Center for International Energy & Policy Meeting***, Austin, TX
Apr-09	Program Presentation	Overall Program	***Small Producer Forum (mid-continent area needs)***, Wichita KS
Apr-09	Program Presentation	Overall Program	***Hart's Developing Unconventional Gas (DUG) Conference)***, Fort Worth, TX
Apr-09	Program Presentation	Overall Program	***Society of Petroleum Engineers Digital Energy Conference)***, Houston, TX
May-09	Clean Tech Panel Discussion Presentation: "*Traditional Energy – Natural Gas: A Bridge, Enabler and a Destination"*	Overall Program	***Clean Tech 2009 Conference***, George R. Brown Convention Center, Houston, TX
May-09	Session co-chair and Presentation: "*Delivering and Using Emerging Technology to Make Money in Exploration & Production"*	Overall Program	***Society of Petroleum Engineers Emerging Technology Workshop***, Houston, TX
Jun-09	Keynote presentation, Program	Overall Program	***Nalco Laboratories Open House***, Houston, TX
Jun-09	Program Presentation	Overall Program	***Independent Petroleum Association of America Mid-year Meeting***, Denver, CO
Jul-09	Environmental Panel discussion	Overall Program	***Colorado Oil and Gas Association Annual Meeting***, Denver, CO
Aug-09	Program Presentation	Overall Program	***Colorado School of Mines Produced Water Project Advisor/Stakeholders' Meeting***, Golden, CO
Sep-09	Lecture	Overall Program	***Energy Management Program***, Tulsa University, Tulsa, OK
Oct-09	Panel discussion	Overall Program	***Renewable & Sustainable Energy Institute***, University of Colorado at Boulder, Boulder, CO
Oct-09	Plenary presentation	Overall Program	***Society of Exploration Geophysicists 2009 Forum***, ?
Oct-09	Presentation	Overall Program	***Innovation Showcase***, Rice University, Houston, TX

Date	Description	Program/ Contract No.	Event Title
Oct-09	Panel discussion and presentation: ***"The Confluence of Drilling and Digital Energy"***	Overall Program	***Society of Petroleum Engineers Annual Technical Conference & Exhibition, Digital Energy Session***, New Orleans, LA
Nov-09	Presentation: "***Overview of RPSEA Onshore***	Overall Program	***Drilling Engineering Association Quarterly Meeting,*** Houston, TX
Nov-09	Presentation: ***"Natural Gas – An Unconventional Future with Efficiency & Renewables"***	Overall Program	***Oklahoma Wind Conference***, Oklahoma City, OK
Mar-10	Presentation: **"*Natural Gas – An Unconventional Future with Efficiency & Renewables"***	Overall Program	***Sustainable Opportunities Summit***, Denver, CO
Feb-09	Project progress presentations and discussion	Small Producer Program	***CO2 Forum***, Austin, TX
Jan-09	Project progress presentations and discussion	UDW Program	***UDW Met-ocean Technical Advisory Meeting, Bellaire, TX***
Jan-09	Project progress presentations and discussion	UDW Program	***UDW Drilling and Completions Technical Advisory Meeting, Bellaire, TX***
Jan-09	Project progress presentations and discussion	UDW Program	***UDW Geoscience – Reservoir Engineering Integrated Technical Advisory Meeting, The Woodlands, TX***
Mar-09	Project progress presentations and discussion	UDW Program	***UDW Floating Systems Technical Advisory Meeting, Bellaire, TX***
Mar-09	Project progress presentations and discussion	UDW Program	***UDW Flow Assurance Technical Advisory Meeting, Bellaire, TX***
Mar-09	Project progress presentations and discussion	UDW Program	***UDW Subsea Systems Technical Advisory Meeting, Bellaire, TX***
May-09	Various (6) UDW Project progress poster presentations at RPSEA booth	UDW Program	***Offshore Technology Conference***, Houston, TX
May-09	OTC Panel Discussion Presentation: "*RPSEA: Ultra-Deepwater Program"*	UDW Program	***Offshore Technology Conference***, Houston, TX
May-09	OTC Panel Discussion Presentation: "*Technology Transfer and the Small Producer"*	UDW Program	***Offshore Technology Conference***, Houston, TX
May-09	Project progress presentations and discussion	UDW Program	***UDW Geoscience Technical Advisory Meeting, Bellaire, TX***
Jun-09	Project progress presentations and discussion	UDW Program	***UDW Reservoir Engineering Technical Advisory Meeting, Bellaire, TX***
Jun-09	Project progress presentations and discussion	UDW Program	***UDW Drilling & Completions Technical Advisory Meeting, Houston, TX***
Aug-09	Organized and Participated	UDW Program	***Composite Reinforced Drilling Risers Workshop***, Houston, TX

Date	Description	Program/ Contract No.	Event Title
Sep-09	Project progress presentations and discussion	UDW Program	***UDW Floating Systems Technical Advisory Meeting, Bellaire, TX***
Sep-09	Project progress presentations and discussion	UDW Program	***UDW Subsea Systems Technical Advisory Meeting, Bellaire, TX***
Sep-09	Project progress presentations and discussion	UDW Program	***UDW Flow Assurance Technical Advisory Meeting, Bellaire, TX***
Sep-09	Project progress presentations and discussion	UDW Program	***UDW Drilling & Completions Engineering Technical Advisory Meeting, The Woodlands, TX***
Sep-09	Project progress presentations and discussion	UDW Program	***UDW Systems Engineering Technical Advisory Meeting, Bellaire, TX***
Oct-09	Presentation: ***"Potential and Emerging Deepwater Completion and Intervention Technologies"***	UDW Program	***American Association of Drilling Engineers Emerging Completions Group Meeting***, Houston, TX
Oct-09	Project progress presentations and discussion	UDW Program	***UDW Met-ocean Systems Technical Advisory Meeting, Houston, TX***
Nov-09	Project progress presentations and discussion	UDW Program	***UDW Geoscience Technical Advisory Meeting, Houston, TX***
Oct-09	Project progress presentations and discussion	UDW Program	***Chevron Technology Showcase Meeting***, Houston, TX
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Drilling & Completions Engineering Technical Advisory Meeting, Bellaire, TX***
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Systems Engineering Technical Advisory Meeting, Bellaire, TX***
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Reservoir Engineering Technical Advisory Meeting, The Woodlands, TX***
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Floating Systems Technical Advisory Meeting, Bellaire, TX***
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Subsea Systems Technical Advisory Meeting, Bellaire, TX***
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Flow Assurance Technical Advisory Meeting, Bellaire, TX***
Jan-10	Project progress presentations and discussion	UDW Program	***UDW Met-ocean Technical Advisory Meeting, Houston, TX***
Mar-10	Presentation: ***"A Different Approach to Oilpatch and R&D Technology Development"***	UDW Program	***PennWell Subsea Tieback Forum***, Moody Gardens Hotel, Galveston, TX
Mar-10	Project progress presentations and discussion	UDW Program	***UDW Flow Assurance Technical Advisory Meeting, Bellaire, TX***
Mar-10	Project progress presentations and discussion	UDW Program	***UDW Subsea Systems Technical Advisory Meeting, Bellaire, TX***

Date	Description	Program/ Contract No.	Event Title
Mar-10	Project progress presentations and discussion	UDW Program	***UDW Floating Systems Technical Advisory Meeting, Bellaire, TX***
Mar-10	Project progress presentations and discussion	UDW Program	***UDW Drilling & Completions Engineering Technical Advisory Meeting, Bellaire, TX***
Mar-10	Project progress presentations and discussion	UDW Program	***UDW Systems Engineering Technical Advisory Meeting, Bellaire, TX***
Apr-09	Project progress presentations and discussion	Unconventional Resources Program	***Unconventional Resources Annual Project Review Meeting***, Golden, CO
May-09	Presentation: "*Unconventional Gas Development in the Western Energy Corridor"*	Unconventional Resources Program	***RPSEA Forum***, Boise ID
May-09	Program Presentation	Unconventional Resources Program	***International Shale Gas Symposium***, Tuscaloosa, AL
Jun-09	Presentations on "*New Albany Shale"*	Unconventional Resources Program	***RPSEA Mid-continent Gas Shales Forum***, Chicago, IL
Jun-09	Session chair	Unconventional Resources Program	***Society of Petroleum Engineers Tight Sands Applied Technology Workshop***, San Antonio, TX
Sep-09	Session co-chair and panel discussion	Unconventional Resources Program	***PennWell Unconventional Gas Conference***, Fort Worth, TX
Oct-09	Presentation: ***"Reservoir Imaging in Difficult Environments"***	Unconventional Resources Program	***Industry Technology Facilitator Theme Day***, ?
Nov-09	Presentation	Unconventional Resources Program	***Geothermal Conference***, Southern Methodist University, Dallas, TX
Nov-09	Presentation	Unconventional Resources Program	***Oklahoma Independent Petroleum Association Unconventional Gas Forum***, Tulsa, OK
Nov-09	Presentation	Unconventional Resources Program	***EDGER Seismic Forum***, University of Texas at Austin, Austin, TX
Dec-09	Nano-Umbilical Workshop, Rice University, Houston, TX	07121-1302	***Ultra-high Conductivity Umbilicals***
Sep-09	Minerals Management Service Technical Review, New Orleans, LA	07121-1402a & b	***Ultra Deepwater Dry Tree System for Drilling and Production***
Sep-09	U. S. Coast Guard Technical Review, New Orleans, LA	07121-1402a & b	***Ultra Deepwater Dry Tree System for Drilling and Production***
Jan-10	Rigless Intervention with Coiled Tubing Workshop, Houston, TX	07121-1502	***Coil Tubing Drilling and Intervention System Using Cost Effective Vessel***

Date	Description	Program/ Contract No.	Event Title
Mar-10	Presentation: ***"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 Technology," 12th Annual US-Norway Technology Partnership Workshop, Houston, TX***	07121-1701	***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 Technology***
Sep-09	Functional Requirements – Basis of Design document (<5kW, 1 – 10 MW, 10 – 30 MW, and 30 – 200MW cases)	07121-1902	***Deep Sea Hybrid Power Systems***
Oct-09	Poster Session presentation: ***Society of Exploration Geophysicists Annual Meeting,*** Houston, TX	07121-2001	***Geophysical Modeling Methods***
Oct-09	Presentation: ***Society of Exploration Geophysicists Annual Meeting,*** Houston, TX	07121-2001	***Geophysical Modeling for Studying Acquisition and Processing Methods in the Deepwater Gulf of Mexico***
Mar-09	Final Report- feasibility of slot-cutting mechanisms for low perm formation stimulations	07122-07	***Novel Concepts for Unconventional Gas Development of Gas Resources in Gas Shales, Tight Sands, and Coalbeds***
Mar-09	Constructed website with gas sample information and protocols for Jonah and Piceance Basin fields	07122-09	***Application of Natural Gas Composition to Modeling Communication Within and Filling of Large Tight-Gas-Sand Reservoirs, Rocky Mountains***
Dec-09	Article: ***"New Albany Shale Gas Project; A Joint Industry Project Sponsored by Research***	07122-16	***New Albany Shale Gas Project***
Dec-09	Article: ***"Identification of microbial and thermogenic gas components from Upper Devonian black shale cores, Illinois and Michigan basins"***, **The American Association of Petroleum Geologists. (AAPG) Bulletin**, v. 92, no. 3 (Paper), Anna M. Martini, Lynn M. Walter, and Jennifer C. McIntosh – GTI.	07122-16	***New Albany Shale Gas Project***
Dec-09	Article: ***"New Albany Shale Gas Project; A Joint Industry Project Sponsored by Research Partnership to Secure Energy for America (RPSEA)"***, **International Oil and Gas Review**, 2009, volume 7, Salehi, Iraj and Angelica Chiriboga.	07122-16	***New Albany Shale Gas Project***

Date	Description	Program/ Contract No.	Event Title
Dec-09	Presentation: ***"Natural fractures in the New Albany Shale and their importance for shale gas production",*** **2009 International Coalbed and Shale Gas Symposium**, Tuscaloosa, Alabama, Gale, Julia F. W. and Stephen E. Laubach."	07122-16	***New Albany Shale Gas Project***
Dec-09	Presentation: ***"Economic Impact of Reservoir Properties and Horizontal Well Length and Orientation on Production from Shale Formations, Application to New Albany Shale"***, **2009 SPE Eastern Regional Meeting**, Charleston, West Virginia, USA, 23–25 September 2009, Dahaghi, A. Kalantari and S. D. Mohaghegh."	07122-16	***New Albany Shale Gas Project***
Sep-09	Presentation: ***"Top-Down Intelligent Reservoir Modeling of New Albany Shale"***, **2009 SPE Eastern Regional Meeting**, Charleston, West Virginia, USA, 23–25 September 2009, Dahaghi, A. Kalantari and S. D. Mohaghegh.	07122-16	***New Albany Shale Gas Project***
Dec-09	Presentation: ***"New Albany Shale Gas Research Project",*** **Annual AAPG Meeting**, Perry, Kent and Iraj Salehi.	07122-16	***New Albany Shale Gas Project***
Dec-09	Article: ***"New Albany Shale Gas Project; A Joint Industry Project Sponsored by Research Partnership to Secure Energy for America (RPSEA)"***, **International Oil and Gas Review**, 2009, volume 7, Salehi, Iraj and Angelica Chiriboga.	07122-16	***New Albany Shale Gas Project***
Mar-09	Presentation: ***"New Albany Shale Gas Project; A Joint Industry Project Sponsored by Research Partnership to Secure Energy for America (RPSEA)"***, **Spring Tropical Conference,** Philadelphia, PA, March 2009, Luffel, Don and Jim Lorenzen.	07122-16	***New Albany Shale Gas Project***
Apr-09	Presentation: ***"New Albany Shale Gas Project Update",*** **RPSEA Unconventional Resources Annual Progress Review Meeting**, Denver, CO, 2009, 14 Apr., Salehi, Iraj.	07122-16	***New Albany Shale Gas Project***

Date	Description	Program/ Contract No.	Event Title
Mar-09	Presentation: ***"New Albany Shale Gas Project, An Industry-RPSEA-GTI Cooperative Project",*** presented at **Society of Professional Well Log Analysts (SPWLA) 2009 Spring Topical Conference**, 2009, 17 Mar., Iraj Salehi, GTI, presentation slides.	07122-16	***New Albany Shale Gas Project***
Feb-09	Participation in **EDGERS conference**, UT Austin, Iraj Salehi discussed NEW Albany Shale project with graduate students. No formal presentation.	07122-16	***New Albany Shale Gas Project***
Sep-09	Discussion with New Albany shale geologist during the **Regional AAPG Conference**, Evansville, IN	07122-16	***New Albany Shale Gas Project***
Feb-10	Poster presentation: ***"New Albany Shale Gas Project",*** **NAPE Conference**, Houston, TX	07122-16	***New Albany Shale Gas Project***
Mar-09	Presentation: ***"New Albany Shale Gas Research Project",*** **World Gas Conference 2009**, Amsterdam, The Netherlands, Perry, Kent, and Iraj Saleji	07122-16	***New Albany Shale Gas Project***
Mar-09	Presentation: ***"New Albany Shale Gas Research Project",*** **World Gas Conference 2009**, Amsterdam, The Netherlands, Perry, Kent, and Iraj Saleji	07122-16	***New Albany Shale Gas Project***
Oct-09	Presentation: ***World Gas Conference***, Buenos Aires, Argentina (Best Project Award)	07122-16	***New Albany Shale Gas***
Mar-09	Constructed website with Conasauga area (AL) shale gas sample information	07122-17	***Geological Foundation for Production of Natural Gas from Diverse Shale Formations***
Oct-09	Poster Session presentation: ***Geological Society of America Annual Meeting***, Portland, OR	07122-17	***Geological Foundation for Production of Natural Gas from Diverse Shale Formations***
Oct-09	SPE ATCE 2009 124974 Predicting Relative-Permeability Curves Directly From Rock Images, New Orleans, LA	07122-22	***Petrophysical studies of unconventional gas reservoirs using high-resolution rock imaging***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-22	***Petrophysical studies of unconventional gas reservoirs using high-resolution rock imaging***
Mar-10	A presentation at the Goldschmidt 2010 Conference has been accepted, http://www.goldschmidt2010.org/	07122-22	***Petrophysical studies of unconventional gas reservoirs using high-resolution rock imaging***

Date	Description	Program/ Contract No.	Event Title
1–3 March 2010	A paper authored by the team members has been submitted to the 2010 International Workshop on X-Ray CT for Geomaterials, New Orleans, LA	07122-22	***Petrophysical studies of unconventional gas reservoirs using high-resolution rock imaging***
Oct-09	Poster Session presentation: ***Society of Petroleum Engineers Annual Technical Conference & Exhibition,*** New Orleans, LA	07122-22	***Petrophysical Studies of Unconventional Gas Reservoirs Using High-resolution Rock Imaging***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-23	***A Self-Teaching Expert System for the Analysis, Design, and Prediction of Gas Production from Unconventional Gas Resources***
Sep-09	Presented papers SPE 124961-"A Numerical Study of Performance for Tight Gas and Shale Gas Reservoir Systems", New Orleans, LA	07122-23	***A Self-Teaching Expert System for the Analysis, Design, and Prediction of Gas Production from Unconventional Gas Resources***
Sep-09	Presented paper at the TOUGH Symposium 2009 in Berkeley, CA	07122-23	***A Self-Teaching Expert System for the Analysis, Design, and Prediction of Gas Production from Unconventional Gas Resources***
Sep-09	Presented papers SPE 124961-"A Numerical Study of Performance for Tight Gas and Shale Gas Reservoir Systems", New Orleans, LA	07122-23	***A Self-Teaching Expert System for the Analysis, Design, and Prediction of Gas Production from Unconventional Gas Resources***
Oct-09	Poster Session presentation: ***Society of Petroleum Engineers Annual Technical Conference & Exhibition,*** New Orleans, LA	07122-23	***A Self-Teaching Expert System For The Analysis, Design And Prediction Of Gas Production From Shales***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-29	***Gas Condensate Productivity in Tight Gas Sands***
Oct-09	A website has been created for the project for technology transfer: http://pangea.stanford.edu/ERE/research/suprid/projects/RPSEA/Gas_condensate_website2.htm	07122-29	***Gas Condensate Productivity in Tight Gas Sands***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-33	***Advanced Hydraulic Fracturing Technology for Unconventional Tight Gas Reservoirs***
Oct-09	Poster Session presentation: ***Society of Petroleum Engineers Annual Technical Conference & Exhibition,*** New Orleans, LA	07122-33	***Advanced Hydraulic Fracturing Technology for Unconventional Tight Gas Reservoirs***

Date	Description	Program/ Contract No.	Event Title
Oct-09	Poster Session presentation: ***Society of Exploration Geophysicists Annual Meeting***	07122-33	***Advanced Hydraulic Fracturing Technology For Unconventional Tight Gas Reservoirs***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-35	***Optimizing Development Strategies to Increase Reserves in Unconventional Gas Reservoirs***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-38	***Improvement of Fracturing in Gas Shales***
Oct-09	A website has been created for the project for technology transfer: http://www.cpge.utexas.edu/ifgs/	07122-38	***Improvement of Fracturing in Gas Shales***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-41	***Improved Reservoir Access Through Refracture Treatments In Tight Gas Sands And Gas Shales***
Apr-10	Published a paper in SPE journal: "Quantifying transient effects in altered-stress refracturing of vertical wells"	07122-41	***Improved Reservoir Access Through Refracture Treatments In Tight Gas Sands And Gas Shales***
Feb-10	Presented a paper at the Formation Damage Control Symposium SPE 127986: "Optimizing Fracture Spacing and Sequencing in Horizontal Well Fracturing ", Lafayette, LA	07122-41	***Improved Reservoir Access Through Refracture Treatments In Tight Gas Sands And Gas Shales***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-44	***Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures***
Feb-10	SPE 127888: "Modeling Fluid Invasion and Hydraulic Fracture Propagation in a Naturally Fractured Rock, a Three Dimensional Approach", Lafayette, LA	07122-44	***Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures***
Feb-10	Display project material at AAPG 2010 Annual Convention in New Orleans, Louisiana, April 11-14	07122-44	***Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-45	***Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities***
Dec-08	The Utah Geological Survey created and is maintaining a Web site (http://geology.utah.gov/emp/shalegas/index.htm	07122-45	***Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration***

Date	Description	Program/ Contract No.	Event Title
			Opportunities
Apr-10	Presentation of AAPG Paper: "Manning Canyon Shale: Utah's Newest Shale Gas Resource", New Orleans, LA	07122-45	***Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities***
Mar-09	Presentation:***"Is Reverse Osmosis Effective for Produced Water Purification: Viability and Economic Analysis,"*** SPE 115952, Muraleedaaran S., X. Li, L. Li, and R. Lee, prepared for Presentation at the 2009 SPE Western Regional Meeting Held in San Jose, USA, 24-26, March 2009.	07123-05	***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers***
Dec-09	***"Purification of Produced Water by Ceramic Membranes: Material Screening,"*** Li L. and R. Lee, **Process Design and Economics, Separation Science and Technology**, 44: 3455-3484, 2009	07123-05	***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers***
Feb-10	Technology Transfer – Presentation: "***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers"***, RPSEA Small Producer Technology Transfer Meeting, Midland, TX	07123-05	***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers***
Apr-10	Article: ***"A Humidification Dehumidification Process for Produced Water Purification"***, X. Li, S. Muraleedaaran, L. Li, and R. Lee, **Desalination and Water Treatment**, in press – 2010.	07123-05	***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers***
Mar-09	Presentation: ***"Reverse Osmosis Effective for Produced Water Purification: Viability and Economic Analysis"***, S. Muraleedaaran, X. Li, L. Li, and R. Lee, SPE 115952, **SPE Western Regional Meeting**, San Jose, CA, USA, 24-26, March 2009.	07123-05	***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers***
Sep-08	Technology Transfer - build website	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Mar-10	Technology Transfer - Semi-annual website updates	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Aug-08	Presentation: "***Reducing Impacts of New Pit Rules on Small Producers"***, Independent Petroleum Association of New Mexico Annual Meeting	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***

Date	Description	Program/ Contract No.	Event Title
Feb-10	Presentation: "***Reducing Impacts of New Pit Rules on Small Producers"***, **RPSEA Small Producers' Conference**, Midland, TX	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Aug-09	Article: "***Reducing Impacts of New Pit Rules on Small Producers"***, PRRC Review	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Aug-08	Direct Contacts, Assessment: Independent Petroleum Association of New Mexico Annual Meeting	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Aug-08	Data Presentation and Feedback: Independent Petroleum Association of New Mexico Annual Meeting	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Sep-08	Data Presentation and Feedback: New Mexico Oil Conservation Division	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Sep-08	Presentation: "***Reducing Impacts of New Pit Rules on Small Producers"***, **SPE Roswell Section Meeting**, Roswell, NM	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Oct-08	Data Presentation and Feedback: New Mexico Oil & Gas Association Meeting	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Nov-08	Second Data Presentation and Feedback: Project discussion, New Mexico Oil Conservation Division	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Oct-09	Second Data Presentation and Feedback: New Mexico Oil & Gas Association Annual Meeting	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Oct-08	Data Presentation and Feedback: Meeting with producers; Roswell, NM, and Artesia, NM	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Nov-08	Data Presentation and Feedback: Meeting with producers; Farmington, NM	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Jan-10	Presentation: "***Reducing Impacts of New Pit Rules on Small Producers"***, **SPE Four Corners Section Meeting**, Farmington, NM	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Aug-09	Web page www.efdsystems.com	08122-35	***The Environmentally Friendly Drilling Systems Program***
Jan-10	Publication in Hart's E&P: "Cooperative Efforts Lead to Safer Operations"	08122-35	***The Environmentally Friendly Drilling Systems Program***

Date	Description	Program/ Contract No.	Event Title
Dec-09	"Drilling Advances: Is Green Drilling on the Horizon?" World Oil, December 2009,	08122-35	***The Environmentally Friendly Drilling Systems Program***
Dec-09	"Prevention Technology Can Help Drilling, Service Rigs to Minimize Environmental Footprint at the Source," Drilling Contractor, November/December 2009	08122-35	***The Environmentally Friendly Drilling Systems Program***
Mar-09	Systems Approach and Quantitative Decision Tools for Technology Selection in Environmentally-Friendly Drilling SPE-120848-PP 2009 SPE Americas E&P Environmental & Safety Conference, March, 2009, San Antonio, TX.	08122-35	***The Environmentally Friendly Drilling Systems Program***
Dec-09	"Local Leaders' Perceptions of Energy Development in the Barnett Shale." *Southern Rural Sociology*24(1): 113-129.	08122-35	***The Environmentally Friendly Drilling Systems Program***
Dec-09	"Public Perception of Desalinated Water from Oil and Gas Field Operations: Data from Texas." *Society and Natural Resources* 22(7): 674-885.	08122-35	***The Environmentally Friendly Drilling Systems Program***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	08122-35	***The Environmentally Friendly Drilling Systems Program***
Apr-10	Luncheon keynote address at the annual AADE Wednesday April 7th (Low Impact drilling talk titled Environmentally Friendly Drilling is not an Oxymoron).	08122-35	***The Environmentally Friendly Drilling Systems Program***
Mar-10	Presentation to Houston Association of Professional Landmen.	08122-35	***The Environmentally Friendly Drilling Systems Program***
Dec-09	Best Practices Website is http://www.oilandgasbmps.org/	08122-35	***The Environmentally Friendly Drilling Systems Program***
Nov-09	Presented a paper titled "Public Opinion on Exploration and Production of Oil and Natural Gas in Environmentally Sensitive Areas" at the 16th International Petroleum & Biofuels Environmental Conference.	08122-35	***The Environmentally Friendly Drilling Systems Program***
Oct-09	Poster Session presentation: ***Society of Petroleum Engineers Annual Technical Conference & Exhibition,*** New Orleans, LA	08122-35	***The Environmentally Friendly Drilling Systems Program***

Date	Description	Program/ Contract No.	Event Title
Oct-09	Poster Session presentation: ***Geological Society of America Annual Meeting***, Portland, OR	08122-40	***Stratigraphic Controls On Higher-Than-Average Permeability Zones In Tight-Gas Sands, Piceance Basin***
Feb-10	Created a project webpage http://www.beg.utexas.edu/frac/geophysics.php	08122-53	***Multiazimuth Seismic Diffraction Imaging for Fracture Characterization in Low-Permeability Gas Formations***
Oct-09	Poster Session presentation: ***Society of Exploration Geophysicists Annual Meeting***	08122-53	***Multi-azimuth Seismic Diffraction Imaging for Fracture Characterization in Low-Permeability Gas Formations***
Oct-09	Poster Session presentation: ***Society of Exploration Geophysicists Annual Meeting***	08122-55	***Evaluation of Fracture Systems and Stress Fields Within the Marcellus Shale and Utica Shale and Characterization of Associated Water-Disposal Reservoirs: Appalachian Basin***
Oct-09	Residual Oil Zone Workshop, Midland, TX	08123-19	***Commercial Exploitation and the Origin of Residual Oil Zones: Developing a Case History in the Permian***

Table Appendix C.1: Technology Transfer

Acronyms

AAPG	American Association of Petroleum Geologists
AUV	Autonomous Underwater Vehicles
BOD	Board of Directors
BOEPD	Barrels Oil Equivalent Per Day
COGA	Colorado Oil & Gas Association
DAP	Draft Annual Plan
DEA	Drilling Engineering Association
DEEPSTAR	DeepStar Consortium
DOE	Department of Energy
DOT	Deep Offshore Technology
DUG	Developing Unconventional Gas
E&P	Exploration and Production
EAG	Environmental Advisory Group
EFD	Environmentally Friendly Drilling
EIA	Energy Information Administration
EOS	Equations of State
EPAct	Energy Policy Act 2005
FA	Flow Assurance
FACA	Federal Advisory Committees
FLIPPA	Florida Independent Petroleum Producers Association
GOM	Gulf of Mexico
GTI	Gas Technology Institute
HPHT	High Pressure/High Temperature
HTC	Houston Technology Center
IADC	International Association of Drilling Contractors
IOGCC	Interstate Oil and Gas Compact Commission
INGAA	Interstate Natural Gas Association of America
IPAA	Independent Petroleum Association of America
IPAMS	Independent Petroleum Association of Mountain States
IPANM	Independent Petroleum Association of New Mexico
ITF	United Kingdom's Industry Technology Facilitator
KMD	Knowledge Management Database
LOGA	Louisiana Oil & Gas Association
MARK	Mid-America Regulatory Conference
MMBOE	Million Barrels Oil Equivalent
MMP	Minimum Miscibility Pressure
MMS	Minerals Management Service
MODU	Mobile Offshore Drilling Unit
MPD	Managed Pressure Drilling

NAPE	North American Prospect Expo
NETL	National Energy Technology Laboratory
NGO	Non-Governmental Organization
NMOCD	New Mexico Oil Conservation Division
NMT	New Mexico Institute of Mining and Technology
NPC	National Petroleum Council
NRDC	National Resources Defense Council
O&G	Oil and Gas
OCI	Organizational Conflict of Interest
OCS	Outer Continental Shelf
OTC	Offshore Technology Conference
OIPA	Oklahoma Independent Petroleum Association
PAC	Program Advisory Committee
PGC	Potential Gas Committee
PRAC	Canada's Petroleum Research Atlantic Canada
PTTC	Petroleum Technology Transfer Council
PVT	Pressure, Volume and Temperature
R&D	Research and Development
RAG	Research Advisory Group
RFP	Request for Proposal
RPSEA	Research Partnership to Secure Energy for America
SAC	Strategic Advisory Committee
SAIC	Science Applications International Corporation
SCNGO	Strategic Center for Natural Gas and Oil
SEG	Society of Exploration Geophysicists
SOE	Secretary of Energy
SPE	Society of Petroleum Engineers
TAC	Technical Advisory Committee
TCF	Trillion Cubic Feet
TRL6	Technology Readiness Level 6
UDAC	Ultra-Deepwater Advisory Committee
UDW	Ultra-Deepwater Program
URTAC	Unconventional Resources Technology Advisory Committee
xHPHT	Extreme High Pressure/High Temperature
YPE	Young Professionals in Energy

Appendix C: Ultra-Deepwater Advisory Committee Report

The following 14 pages encompass the final report from the Ultra-Deepwater Advisory Committee charged with reviewing the 2011 Draft Annual Plan.

The Ultra-Deepwater Advisory Committee
Advisory Committee to The Secretary of Energy

April 11, 2011

The Honorable Steven Chu
Secretary of Energy
Washington, D.C. 20585

Dear Mr. Secretary:

On behalf of the Ultra-Deepwater Advisory Committee (UDAC) I would like thank you for your support as we offer comments and recommendations on the 2011 Annual Plan and its impact upon one of our most important strategic resources. Energy independence, sustainability, and reducing imports are important for long-term economic stability of the United States of America. Our country's energy supply depends strongly upon continued exploration and production from deepwater areas within the US. Recent production (2009) of oil from US deepwater Gulf of Mexico has reached nearly one-third of total US production. However, lessons emerging from the *Deepwater Horizon* incident are revealing the need for a meaningful review of ultra-deepwater exploration and production activities. This review must include more thorough research into risk identification, analysis and management; failure, accident and spill prevention; and spill containment and cleanup methodologies. Application of technology can be a double-edged sword. In the hands of well trained experts with good procedures, advanced technologies allow greater access to resources with greater efficiency and reliability. This is extremely relevant to extraction of energy from offshore ultra-deepwater environments. On the other hand these facilitating technologies can expose humans and the environment to new risks that must be managed.

In response to the potential for new risks UDAC has:

- Established a new subcommittee to specifically address risk assessment,
- Identified and prioritized new Research Portfolio areas which address technology or knowledge gaps specifically related to safety, environmental impact assessment, and environmental impact mitigation, and
- Recommended Program Process improvements to access new skill sets and accelerate the growth of the knowledge base.

To promote and address the goal of reducing risk and improving safety there is a need for increased cooperation between stakeholders within the offshore industry to share accepted best practices and potentially, research efforts.

The Committee recommends the Department of Energy continue advancing the program and identify avenues to increase funding, especially in light of the directional change in the program. Please find enclosed the UDAC Report of findings and recommendations.

Respectfully submitted,
Ultra-Deepwater Advisory Committee Chair
Dan Daulton

Ultra-Deepwater Advisory Committee

2011 Annual Plan

Comments, Findings and Recommendations

April 2011

An Advisory Committee to the Secretary of Energy

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1.0 INTRODUCTION

The Ultra-Deepwater Advisory Committee (UDAC or Committee) was formed pursuant to the provisions of Title IX, Subtitle J, Section 999D(a) of the 2005 Energy Policy Act (EPAct).

The Committee consists of:

- Individuals with extensive research experience or operational knowledge of offshore natural gas and other petroleum exploration and production; and
- Individuals broadly representative of the affected interests in ultra-deepwater natural gas and other petroleum production, including interests in environmental protection and safe operations.

The provisions of EPAct excluded Federal employees and board members, officers or employees of the Program consortium, known as Research Partnership to Secure Energy for America (RPSEA; or the Consortium).

The duties of the UDAC under EPAct Title IX, Subtitle J, Section 999D(a) are to advise the Secretary of Energy (Secretary) on the development and implementation of programs under Title IX, Subtitle J, related to ultra-deepwater (UDW) natural gas and other petroleum resources and to carry out section 999B(e)(2)(B) which is to comment on the draft annual plan.

See Section 4.0 for a list of Committee members.

The Department of Energy (DOE) Designated Federal Officer and the Secretary provided additional guidance for the Draft 2011 Annual Plan (the Plan) Review at the 14th Meeting of UDAC in Washington, DC on February 23, 2011.

The schedule of work for the review of the 2011 Plan included the following key milestones:

2-23-11 14th UDAC Meeting, Washington, DC: Convene UDAC, began initial review of the Program Consortium Draft 2011 Annual Plan (July 2010) and Department of Energy 2011 Annual Plan (Sept 2010), vote to maintain 2 Standing Subcommittees: the UDAC R&D Portfolio Subcommittee, and the UDAC R&D Program Process Subcommittee, assign membership to standing Subcommittees

3-2011 Meetings of the UDAC R&D Portfolio Subcommittee: reviews charter, identify R&D gaps, findings and recommendations, and create Subcommittee report.

3-2011 Meetings of the UDAC R&D Program Process Subcommittee: review and refine charter, discusses program process, identify findings and recommendations, and create Subcommittee report.

4-6/7-11 15th UDAC Meeting, Houston, TX: review Subcommittee reports; develop final findings and recommendations

4-8-2011 Meeting of the UDAC Editing Subcommittee: develops draft of UDAC Final Report on the *2011 Annual Plan*

4-13-2011 UDAC Editing Subcommittee delivers draft of UDAC Final Report to the UDAC members prior to final vote

04-19-2011 16th UDAC Meeting, Washington, DC: members vote to accept final UDAC report of comments, findings and recommendations on the *2011 Annual Plan*

2.0 EXECUTIVE SUMMARY

The UDAC wishes to thank Secretary Chu for personally addressing our February 23th meeting, providing insight, concerns and desires for the Program's future. The UDAC extends appreciation to the teams responsible for planning and executing the Ultra-Deepwater (UDW) Program: the DOE, National Energy Technology Laboratory (NETL) and Research Partnership to Secure Energy for America (RPSEA; or the Consortium). We encourage the teams to contribute an additional measure of cooperation as the Program makes adjustments following the tragic event of the *Deepwater Horizon*. In addition, the UDAC unanimously voted to create a new Subcommittee to assist with communication and direction with respect to risk assessment associated with offshore oil and gas activities.

3.0 SUBCOMMITTEE REPORTS

The UDAC maintained the formation of two standing subcommittees (R&D Program Portfolio and Program Process) to further review focus areas of the 2011 Draft Plan and offer suggestions to be considered with proposed change in the Plan direction. The following are highlights the Committee wishes to report.

3.1 R&D PORTFOLIO FINDINGS AND RECOMMENDATIONS

Overview

As stated in the 2011 Annual Plan for the Ultra-Deepwater (UDW) and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, the proposed Ultra-Deepwater Program Element concentrates on the following primary focus (2011 Annual Plan, September 2010, p. 11): *"… 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"*. The proposed areas for investigation include the following (paraphrased):

1. Gather and analyze data, develop and test models to identify and quantify environmental and safety risks associated with all aspects of ultra-deepwater drilling.

2. Focus on overburden formations and reservoir characterization, evaluation and surveillance to minimize drilling, completion, and production risks.

3. Gather and analyze data, develop and test models with the objective of reducing environmental and safety risks while extending tieback distances and eliminating surface host installations.

4. Improve environmental sustainability and safety of enhanced technology for direct intervention in wells in ultra-deep water.

5. Propose continuous improvement and innovation in the areas of environment and safety.

Subcommittee members are also cognizant of the following note from Secretary Chu appended to the statement of program areas (2011 Annual Plan, September 2010, p. 11): *"The Secretary is requesting recommendations from [Ultra-Deepwater Advisory Committee] UDAC on ways in which these or other R&D projects can assist in the identification of environmental and safety risks, and ways in which technology gaps can be identified and addressed."* Many of the same issues were raised by the Secretary during his visit to the UDAC meeting on 23 February 2011, and also appear in the Report to the President by the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling ("Deepwater; the Gulf Oil Disaster and the Future of Offshore Drilling," January 2011) - hereafter referred to as the Deepwater Report.

In view of the extraordinary events of 2010, it is clear that the future R&D portfolio will have a major focus on health, safety, and environmental issues. This refocusing activity will be common to all of the agencies, governmental and other, that are associated with the offshore petroleum industry. However, the emphasis will vary from agency to agency. The Deepwater Report reached the conclusion that there is a distinction between ensuring the safety of personnel and the safety of the processes that are being operated (Deepwater Report, p. 218). This is not a new distinction; the Deepwater Report also states that the Safety Board's report on the Texas City refinery accident of 2005 (p. 221) makes the same point. It seems clear that the Portfolio Subcommittee should address issues in the area of process safety as a priority.

In addition to obtaining the best result with limited funds, the Subcommittee has taken the view that an ounce of prevention is worth a pound of cure. In principle, an accident can be prevented entirely, whereas once it has occurred, the impacts can only be limited. The ability to prevent or to control an accident is greatly dependent upon the quality and timeliness of the information available to the decision makers. In complex systems, the disparate experiences of individuals often provide inadequate guidance and frequently lead to dangerous analogies. Therefore, research topics are recommended that provide a knowledge base for designs and operations which are as failure-free as possible.

The members of the Portfolio Subcommittee have strong views on many organizational matters, including:

- How the industry might adopt a more proactive attitude towards health and safety,
- How accidents should be reported and managed, and
- The respective roles of government and industry in regulating offshore activities.

It is believed that the offshore industry may learn from other high-risk industries, such as the military (conventional and nuclear), aviation, and nuclear power generation.

The Subcommittee agrees with the Deepwater Report that accident investigation methods be conducted by an authority analogous to the airline industry's National Transportation Safety Board and suggested implementation of the "Safety Case" approach. These topics have been dealt with at great length in the Deepwater Report, notably in Chapter 8 "Safety is not proprietary" and Chapter 9 "Develop options..."

The Subcommittee agrees with a Safety Case approach rather than by prescriptive regulation. The essence of the Safety Case approach is that the onus is placed on industry to identify risks and to demonstrate their capabilities to manage those risks. It is noted that a potential problem with prescriptive regulation is that it generates a mindset that if all the prescriptions have been obeyed, then nothing can go wrong, and this leads to complacency. The Safety Case approach, being open-ended, tends to lead to a desirable attitude of chronic uneasiness (as described for the nuclear Navy, p. 230). There should be a continual sense of safety awareness. The majority of blowouts occur when wells are not being drilled. On the rig, there is a heightened awareness of safety while drilling but chronic uneasiness may tend to diminish when drilling is halted or the well is completed.

This sense of continual safety awareness should be maintained throughout the entire drilling and completion activities.

The Subcommittee offers the following suggestions:

Finding 1: Determining the risk of failure in ultra-deepwater

The probability of the *Deepwater Horizon* event occurring may have been reduced if more reliable information had been available from the well and the region of the wellhead prior to the incident. The process would have benefited from a more thorough understanding of potential risks. During drilling, important information would have included the reporting of pressures, fluid types, flow rates and temperatures as the flow of reservoir fluids was developing. Effective interpretation of this data, possibly by an automated system with appropriate alarms, might have emphasized the danger of the situation to rig personnel in sufficient time for them to have taken action to avoid a catastrophic event.

Recommendations

Recommendation 1A:

Conduct projects aimed at placing additional measuring instruments in the well and/or at the wellhead to determine the nature of the well fluids, pressures, and their flow status in real time. This work should be combined with developing secure methods for transmitting the data to surface and providing timely interpretation. Special emphasis should be placed on identifying and resolving ambiguous or single source measurements by providing multiple sources of information, and presentation of information in a manner more easily transmitted, understood, and interpreted.

Recommendation 1B:

To understand the probability of failure in ultra-deepwater conditions, develop a project to characterize the hazard-related risks associated with performance and testing requirements and prioritize the risks based on industry standards and best practice well procedures (i.e. including negative pressure and other integrity tests, cement design and placement and verifying the quality of the job by logging or pressure tests).

Recommendation 1C:

Develop an approach (i.e. expert “smart” systems that assimilate different data types) to assess the likely behavior of formations before drilling starts, with a view to integrating well design, drilling, and completion activities. This approach would take, for example, formation analysis, well planning, and activities during drilling and completion in order to identify and provide an early alert of potential hazards.

This topic may also include the use of additional instrumentation to assess conditions ahead of the bit while drilling.

Recommendation 1D:

Conduct a study to understand the probability of failure modes of blow out preventers (BOPs) in UDW conditions (for example, high flow rates indicative of deepwater environments and pressures), based on industry standards and best-practice well procedures. From that identify tests, possibly to failure, for subsea equipment, including, among other things, BOP shear capability tests, time to actuate BOP rams and leakage tests. This activity may also include work to improve the design and monitoring of other subsea equipment, for example, riser shutdown valves and mooring system components.

Recommendation 1E:

Conduct a risk assessment from a regional perspective to understand consequences to the offshore industry of sudden catastrophic naturally occurring events (for example submarine landslides, earthquakes)

Finding 2: Controlling accident situations

Analysis of the incident indicated that from the initial blowout to the final capping of the well, control efforts were hampered by a lack of reliable information. This included difficulty in measuring flow from the well, knowing the status of the hardware (valve position) and measurement of pressures and other crucial data.

Recommendations

Recommendation 2A:

Support projects offering:

- Addition of and/or improvement to instrumentation at the wellhead (subsea and dry tree) and in the well to measure for example, temperatures and pressures, presence of hydrocarbons, BOP functions (valves or rams open or closed) accumulator pressure, and battery life and/or status.
- Interpretation capabilities (for example, expert systems) aimed at understanding well conditions related to potential hazards.
- BOP instrumentation that is replaceable by ROVs or AUVs supporting the entirety of well operations.

Recommendation 2B:

Support the development of autonomous underwater vehicles (AUVs) that can independently access seafloor information and transmit it to surface uninterrupted (24/7) whether the original surface equipment is present or not. Such equipment may be combined with devices to:

- Detect hydrocarbon leaks from the sea floor and other subsea equipment (for example, pipelines, separation facilities).
- Investigate whether subsea acoustic measurements may be able to detect the magnitude and location of hydrocarbon flows from the wellhead and surrounding sea floor.

Recommendation 2C:

Support projects that evaluate and quantify limitations of equipment so that leaking equipment can be modified or repaired at the sea floor, and/or to allow collection facilities to be attached to seabed equipment in the event of a leak.

Finding 3: Collecting and dealing with spilled hydrocarbons

The *Deepwater Horizon* accident revealed that, although exceptional efforts were exerted during and after the event to collect, disperse or otherwise deal with spilled hydrocarbons, there was little in place before the accident occurred to deal with a spill. The Deepwater Report (p.135) mentions that *"In 1969, following the Santa Barbara Channel spill, the Nixon administration had issued a report recommending, in part, that 'underwater methods to collect oil from subsea leaks should be developed.' For deepwater wells, however, such development had never occurred."*

Recommendations

Recommendation 3A:

Conduct studies of current subsea containment and capture technologies (hardware), including gap analyses and needs for future technologies with emphasis on subsea capture systems that are independent of surface facilities.

Recommendation 3B:

Develop a logic map (i.e., decision tree or flow chart) for determining adequate spill clean-up and collection methods for any given conditions, paying particular attention to the special conditions in deepwater (for example, risk of hydrate formation, weather conditions, underwater currents, water temperature and pressure, proximity to land).

Finding 4: Discovering attitudes towards safety issues in various peer groups

Because a number of behavioral factors associated with operations, maintenance, and training contributed to the incident, the Subcommittee finds that research aimed at discovering the fundamental attitudes of rig personnel and associated groups to health and safety issues. Discovering these attitudes is notoriously difficult, and may be critical to determine the acceptance of new safety regulations by the people affected. For example, one might ask how rig personnel react to being:

- Told to become "whistle-blowers";
- Encouraged to suggest (or to implement) changes that improve safety while reducing the speed of activities; or
- Told to report co-workers who are seen to be "cutting corners".

Recommendations

Recommendation 4A:

Conduct a study to evaluate potential applications of Expert Systems or other decision making procedures for:

- Well management,
- Accident detection, and
- Response based on best practice in other industries.

This study may include failure analysis (design, process and human) with a view to developing comprehensive risk assessment and reaction protocols, spanning a range of activities from reservoir management through well drilling, riser and vessel safety and station keeping with emphasis upon known approaches in operations research.

Comments: Several of the Subcommittee's recommendations call for the measurement of more data in a variety of environments. As the amount of data increases there is an increased likelihood of human misinterpretation, confusion and error. Expert Systems can assist in the assimilation of the data and reduce human error.

Recommendation 4B:

Conduct a review of published and unpublished information available which analyzes the attitudes and knowledge of personnel and other peer groups toward health, environment, safety, and operational issues through the entire drilling and completion process to determine if training is effective, and if safety procedures are carried out conscientiously.

Finding 5: Considering project strategy

Although it is clear that the 2011 Annual Plan must have a major new emphasis towards health and safety issues, the Subcommittee finds that the current portfolio of ongoing projects is valuable and thus should continue.

Recommendation 5A:

Specifically, the graduate programs in technology should be broadened to include additional scientific disciplines.

3.2 PROGRAM PROCESS FINDINGS AND RECOMMENDATIONS

Overview

The Subcommittee on Program Process is charged with examining and investigating the effectiveness and efficiency of the processes utilized by the program consortium in the solicitation, evaluation, selection and award of ultra-deepwater research and development projects pursuant to Subtitle J of EPAct 2005.

Specifically, the Subcommittee has been tasked with reporting to the Ultra-deepwater Advisory Committee (UDAC) the following matters:

- Scorecard(s) illustrating the process flow of research and development activities undertaken pursuant to the referenced subtitle;
- Identification of barriers and/or areas of improvement that would yield greater effectiveness and/or efficiencies of the program consortium;

- Recommendations of process improvements that would enhance the effectiveness and/or efficiency of the programs under the referenced subtitle;
- Benchmark comparisons with other research & development programs to address the perspective of relative program and/or program consortium performance; and
- Such other matters directed by the UDAC within the defined scope of this Subcommittee

It was decided that two of the Subcommittee's tasks; "*Scorecard illustrating the process flow of research and development activities undertaken pursuant to the referenced subtitle"* and "*Benchmark comparisons with other research and development programs…..*" were not to be addressed in this round of Subcommittee work. However, it was agreed that the Subcommittee would address "*Identification of barriers and/or areas of improvement that would yield greater effectiveness and/or efficiencies of the program consortium."* and "*recommendations of process improvements…"*. The Subcommittee concluded that the current program process and the directional change established by the 2011 Annual Plan of the Secretary of Energy would allow identification of findings and recommendations within the context of the existing program.

Therefore, the Subcommittee Chair Dr. Lesli J. Wood directed the Subcommittee to provide the following:

- Identification of barriers and/or areas of improvement that would yield greater effectiveness and/or efficiencies of the program consortium, and
- Recommendations of process improvements that would enhance the effectiveness and/or efficiency of the programs under the referenced subtitle.

The Subcommittee believes the existing program process is applicable for any directional changes the program may take as a result of the *Deepwater Horizon* incident. The Subcommittee provides the following findings and recommendations relative to the program process:

Finding 1: Concerning cycle time

While there have been significant improvements in the cycle time, which is defined as the time from approving the Annual Plan to the time when a contract has been awarded, the 2010 process is projected to take nearly 2 years. The long time involved in the process is a demotivating factor for groups coming forward with Research and Development (R&D) proposals and the different Technical Advisory Committees and Program Advisory Committee involved with respect to the RPSEA Program Consortium.

Recommendations

Recommendation 1A:

Achieve the current goal of a 12 month cycle time from Annual Plan approval to project award. Examine the program process and address issues with respect to slippage and propose methods to attain and maintain the schedule.

Recommendation 1B:

Award 5-10 projects each year that are more focused. The Subcommittee recommends reviewing the program to ensure fewer and more focused R&D projects are in line with the 2011 Annual Plan.

Minority opinion: For an identified deepwater development research, award more monetarily smaller projects at the beginning to identify the appropriate technology and then follow up with larger size projects for further detailed investigation. This would help more industry participation and offer the opportunity to review and find the most appropriate solution for that technology need.

Finding 2: Concerning general solicitation

The current solicitation process is not reaching a broad enough audience to assure that the program addresses ways of capturing lessons learned and best practices, and preparing guidelines.

Recommendations

Recommendation 2A:

The solicitation process should be expanded to increase the engagement of other groups not being addressed in the current program. For example:

- Society of Petroleum Engineers, American Petroleum Institute, National Academies and other professional organizations,
- Regulatory forums, and
- Marine well containment companies.

Recommendation 2B:

Establish an Environmental and Safety Analysis Forum to broaden the solicitation audience towards the goal of capturing lessons learned and best practices, and preparing guidelines. Consider inviting organizations with experience in hazard identification and risk analysis.

Finding 3: Concerning solicitation of environmental and safety issues

The current solicitation process is not reaching a broad enough audience to assure that the program addresses the development of an understanding of risk-based management and executive accountability for environmental and safety issues.

Recommendations

Recommendation 3A:

The solicitation process should be expanded to include:

- Risk management capability, and
- Environmental leadership and accountability management.

4.0 ULTRA-DEEPWATER ADVISORY COMMITTEE – 2011-2012

Dr. George A. Cooper* Professor University of California, Berkeley	Mr. Elmer P. Danenberger, III* Offshore Consultant	Mr. Daniel J. Daulton Director of Environmental Conformity and Marketing Baker Hughes Inc.
Dr. Quenton R. Dokken Executive Director Gulf of Mexico Foundation	Dr. Hartley H. Downs Technology Fellow Baker Hughes Inc.	Dr. Douglas J. Foster Senior Scientist ConocoPhillips
Mr. Lars Havardsholm Vice President, Field Development Statoil	Dr. Luc T. Ikelle* Robert R. Berg Professor Texas A&M University	Mr. James D. Litton* President and CEO Litton Consulting Group, Inc.
Mr. William C. New President and CEO New Industries, Inc.	Mr. D. Stephen Pye* Consultant	Dr. Nagan Srinivasan Executive Consultant Deepwater Structures, Inc.
Ms. Mary Jane Wilson President and CEO WZI, Inc.	Dr. Lesli J. Wood* Senior Research Scientist Bureau of Economic Geology University of Texas, Austin	

*Special Government Employee

5.0 SUBCOMMITTEE TOPICS AND MEMBERS

The Plan review and preparation of the final Committee Report involved the following:

R&D Program Portfolio

Subcommittee Roster

- **Dr. George A. Cooper, Chair**
- **Mr. Elmer P. Danenberger, III**
- **Dr. Quenton R. Dokken**
- **Dr. Hartley H. Downs**
- **Dr. Douglas J. Foster**
- **Mr. James D. Litton**
- **Mr. William C. New**

Program Process

Subcommittee Roster

- **Dr. Lesli J. Wood, Chair**
- **Mr. Daniel J. Daulton**
- **Mr. Lars Håvardsholm**
- **Dr. Luc T. Ikelle**
- **Mr. D. Stephen Pye**
- **Dr. Nagan Srinivasan**
- **Ms. Mary Jane Wilson**

Editing

Subcommittee Roster

- **Mr. Daniel J. Daulton, Chair**
- **Dr. Hartley H. Downs**
- **Dr. Douglas J. Foster**
- **Ms. Mary Jane Wilson**

Appendix D: Unconventional Resources Technology Advisory Committee Report

The following 18 pages encompass the final report from the Unconventional Resources Technology Advisory Committee charged with reviewing the 2011 Draft Annual Plan.

Unconventional Resources Technology Advisory Committee

Advisory Committee to The Secretary of Energy

October 22, 2010

The Honorable Dr. Steven Chu
Secretary of Energy
Washington, DC 20585

Dear Mr. Secretary:

On behalf of the Unconventional Resources Technology Advisory Committee (URTAC), it is my pleasure to submit our findings and recommendations based on our review of the Unconventional Resources Technology and Small Producers' portion of the *2011 Annual Plan* for the Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research Program.

The Committee finds that:

- The interest shown by the current Administration in the Department of Energy's (DOE) Section 999 Research and Development (R&D) programs is itself a major change in focus that is very welcome news to the Committee.
- The Committee recognizes that the DOE is proposing a major shift in focus to more substantively address safety and environmental concerns. However, we believe that a balance needs to be achieved between the intent of the Section 999 legislation under which the existing program has been carried out, and the change of emphasis being proposed by the DOE.
- The environmental concerns that have arisen because of the recent expansion of oil and gas activity into new onshore areas (such as the Marcellus) have given rise to issues that need to be addressed, researched, and resolved. We strongly agree that some of these issues are well suited to R&D award topics under the Section 999 program, but not to the exclusion of the existing program topics.
- Additional funding that is authorized under Section 999 should be requested by DOE. This would better enable the pursuit of additional research topics specifically focused on environmental and safety, and also allow an increase in emphasis on environment and safety within existing projects, without detracting from the core elements of the existing program.
- The Committee believes that the following areas deserve a higher priority in the research program: well isolation and integrity, water use and re-use of produced, flowback, and frac waters, and methods to reduce air quality impacts.
- The Committee applauds the DOE's development of a modern and accessible knowledge management database. A robust Technology Transfer program is critical to the success of the Unconventional Resources and Small Producer programs.

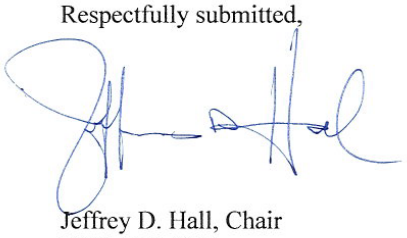
Unconventional Resources Technology Advisory Committee

Advisory Committee to The Secretary of Energy

These key findings are addressed in the report along with other observations and recommendations made by the Committee members. As experts and professionals in our areas of expertise, we believe that they are worthy of consideration and implementation.

The URTAC recommends proceeding with the continued implementation of the *2011 Annual Plan* consistent with the guidance outlined in our report.

Respectfully submitted,



Jeffrey D. Hall, Chair
(405) 552-4544

Unconventional Resources Technology Advisory Committee

Comments and Recommendations 2011 Annual Plan

OCTOBER 2010

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1.0 INTRODUCTION

The Unconventional Resources Technology Advisory Committee (URTAC) was formed in accordance with provisions of Section 999D(a) of the 2005 Energy Policy Act (EPACT).

The Committee consists of:

- A majority of members who are employees or representatives of Independent Producers of natural gas and other petroleum, including small producers;
- Individuals with extensive research experience, operational knowledge or unconventional natural gas and other petroleum resource exploration and production;
- Individuals broadly representative of the affected interests in unconventional natural gas and other petroleum resource exploration and production, including interests in environmental protection and safe operations;
- Individuals with expertise in the various geographic areas of potential supply of unconventional onshore natural gas and other petroleum in the United States.

The provisions of EPACT excluded from eligibility to participate in URTAC the following: Federal employees and board members, officers and employees of Research Partnership to Secure Energy for America (RPSEA).

The duties of the URTAC under EPACT Section 999 are to advise the Secretary of Energy on the development and implementation of programs related to unconventional natural gas and other petroleum resources and to review the draft annual research plan.

The Committee members were appointed by letters from the Secretary on September 2, 2010. Key milestones for the Committee included:

- Committee members received the initial Draft 2011Annual Plan on August 18, 2010.

- Committee members met on September 9th, 2009 in Sugar Land, Texas. The agenda included a briefing of the Role of Oil and Gas in the Administration's Energy Policy by Deputy Assistant Secretary Christopher Smith who presented a revised Draft 201 Annual Plan to the committee for consideration, status update and overview of the Oil and Gas Research Program by the NETL, and an overview of the Program's Consortium's 2011 Draft Annual Plan by RPSEA. Committee members provided comments on Deputy Assistant Secretary Smith's briefing and initial comments regarding the original plan received on August 18th, 2010. The Chair appointed sub-groups to work on sections of the plan.

- During the period from September 9th through October 13th, the appointed sub-group members conducted several meetings by teleconference and E-mail to develop and consolidate recommendations regarding the draft annual plan.

- The Committee met on October 13th and 14th, 2010 in New Orleans, Louisiana to receive sub-group reports and to draft the final recommendations of the Committee.

- The Committee met via teleconference on October 21, 2010 in Washington, D.C. to complete final approval of the Committee report in accordance with the deadline set by the Secretary and conveyed through the Designated Federal Officer.

EPACT Subtitle J "Section 999" sets the funding for the overall program at a level of $50-million-per-year over 8 years, provided from Federal lease royalties, rents, and bonuses paid by oil and gas companies. Of this, $37.5 million is awarded for the consortium research and development program administered by RPSEA and $12.5 million for the Complementary Program administered by NETL. The RPSEA program is broken into the Ultra-Deepwater ($14.493 million), the Unconventional Gas ($13.854 million), the Small Producer Program ($3.562 million) and funding for administration and oversight ($5.437 million).

The URTAC Committee focused on the Unconventional Gas and the Small Producer Programs of the Consortium Program and the applicable portions of the NETL Complementary Program.

2.0 EXECUTIVE SUMMARY AND RECOMMENDATION HIGHLIGHTS

The Committee reviewed the 2011 Annual Plan and identified major areas requiring further discussion. Sub-groups were formed to submit findings and recommendations for these areas. The sub-group reports were distributed to the entire Committee and each was discussed by the Committee as a whole. Following this discussion, the entire Committee agreed on and drafted the findings and recommendations included in this report.

The Committee wishes to note that steps have been taken by both NETL and RPSEA to implement many of the past recommendations of the URTAC, specifically in the areas of program, technology transfer, knowledge management database as well as metrics and benefit assessment.

For the 2011 Annual Plan, the Committee has the following comments:

- The interest shown by the current Administration in the Department of Energy's (DOE) Section 999 Research and Development (R&D) programs is itself a major change in focus that is very welcome news to the Committee.
- The Committee recognizes that the DOE is proposing a major shift in focus to more substantively address safety and environmental concerns. However, we believe that a balance needs to be achieved between the intent of the Section 999 legislation under which the existing program has been carried out, and the change of emphasis being proposed by the DOE.
- The environmental concerns that have arisen because of the recent expansion of oil and gas activity into new onshore areas (such as the Marcellus) have given rise to issues that need to be addressed, researched, and resolved. We strongly agree that some of these issues are well suited to R&D award topics under the Section 999 program, but not to the exclusion of the existing program topics.
- Additional funding that is authorized under Section 999 should be requested by DOE. This would better enable the pursuit of additional research topics specifically focused on environmental and safety, and also allow an increase in emphasis on environment and safety within existing projects, without detracting from the core elements of the existing program.
- The Committee believes that the following areas deserve a higher priority in the research program: well isolation and integrity, water use and re-use of produced, flowback, and frac waters, and methods to reduce air quality impacts.
- The Committee recognizes the need for a more modern and accessible knowledge management database and a robust Technology Transfer program as being critical to the success of the Unconventional Resources and Small Producer programs.
- The Secretary requested recommendations from URTAC regarding the relative importance of planned focus areas. The prioritization can be found in the Appendix.

3.0 TOPICAL REPORTS

The Advisory Committee developed their analysis of the 2011 Annual Plan through a series of meetings and sub-groups (as outlined in Section 5.0: Sub-Group Topics and Member Assignments). There are four areas of findings and recommendations:

- Policy
- Environmental and Regulatory
- Research
- Technology Transfer / Public Outreach

Treatment of Non-Consensus
In situations where members were divided on agreement with specific recommendations or statements in the report, the following categorization was used:

- ***Majority Agreement*** – 50% or greater of Committee members were in agreement with the statement.

- ***Minority Opinion*** – fewer than 50% of Committee members were in agreement with the statement.

In this report, there is one Minority Opinion.

3.1 POLICY FINDINGS AND RECOMMENDATIONS

The interest shown by the current Administration in the Department of Energy's (DOE) Section 999 Research and Development (R&D) programs is itself a major change in focus that is very welcome news for working to develop secure domestic energy supplies. The 2005 Energy Policy Act provided legislation for an eight year program as a means to provide stability for R&D programs by eliminating the threat of termination of funding that was inherent with the annual budgeting process.

With regards to the major change in program focus that is being proposed by the DOE in their 2011 Annual plan, we believe that a balance needs to be achieved between the intent of the Section 999 legislation under which the existing program has been carried out, and the change of emphasis being proposed by the DOE. We encourage the DOE to support their own recommendations with increased budgets and developing other areas of their programs (core and complimentary). We believe that the basic R&D programs now funded by Section 999 should be true to the legislation by retaining the breadth of the program as supported by the overarching objectives, albeit with an increase in environmental and safety focus.

This DOE program can provide through sound science the optimum balance between the need to support a crucial domestic energy industry, enhance the safety of its operation, protect the environment, and inform the regulatory process. The DOE's knowledge and unique perspective is of tremendous value to all stakeholders.

Finding #1

The DOE is requesting a "significant change in emphasis within the framework of the Overarching Objectives" (2011 Annual Plan, page 16). The DOE's 2011 Annual Plan proposes a major shift in focus to more substantively address the safety and environmental concerns.

The environmental concerns that have arisen because of the recent expansion of oil and gas activity into new onshore areas (such as the Marcellus) have given rise to issues that need to be addressed, researched, and resolved. We strongly agree that some of these are issues are well suited to R&D award topics under the Section 999 program, but not to the exclusion of the existing program topics.

Recommendations

The Committee fully supports the Overarching Objectives of the UCR program as stated in the 2011 Annual Plan on pages 15-16.

- *Increase Production and Recovery in an Environmentally Sound Manner:* Develop tools, techniques, and methods that substantially increase, in an environmentally sound manner, commercial production and ultimate recovery from established unconventional gas formations and accelerate development of existing and emerging unconventional gas plays.
- *Reduce Environmental Impact:* Develop tools, techniques, and methods that substantially decrease the environmental impact of unconventional gas

development with particular emphasis on water management and operations footprint.

- *Encourage Demonstrations of New Technology:* Integrate the results and deliverables of the existing portfolio of projects to encourage industry to demonstrate and apply new technologies to enhance safe and environmentally responsible production of the domestic unconventional gas resource base. Successful technology transfer is an important component of this objective.
- *Develop Technologies to Enable Environmentally Responsible Development of Emerging Gas Plays:* Develop techniques and methods for exploration and production from high priority emerging gas shales, coal, and tight sand fields, as well as frontier basins and formations, where these operations have been hindered by technical, economic, or environmental challenges.

All R&D projects and technology transfer efforts should continue to include the improvement of safety and the minimization of environmental impacts. This should be included as a criterion of the selection process and a metric of the success of the program.

- A greater share of the projects should continue to address environmental and safety concerns; however, in no way should these become the sole emphasis.
- R&D on environmental, health, safety, and regulatory topics that serve to address issues that are challenges to environmentally responsible oil and gas exploration, development, and production are of particular interest and should be pursued, whether under Section 999 or through other DOE programs. The objective of increasing domestic oil and gas reserves and production is the principal metric used to evaluate the program.

Finding #2

The support of the current Administration for the Department of Energy's (DOE) Section 999 Research and Development (R&D) programs is very welcome news to this committee. Continuity of funding is necessary to achieve maximum benefits from the research. The recommended expansion in the scope of the research will require more funding.

Recommendations

DOE should request additional funding that is authorized under Section 999. This would better enable the pursuit of additional research topics specifically focused on environmental and safety, and also allow an increase in emphasis on environment and safety within existing projects, without detracting from the core elements of the existing program. RPSEA states in the 2011 Draft Annual Plan that "roughly $58 million in qualifying projects that were not funded represents a resource of work that could be initiated rapidly to have a near-term impact on the nation's energy supply."

3.2 ENVIRONMENTAL AND REGULATORY FINDINGS AND RECOMMENDATIONS

We support the recognition that potential positive and negative environmental impacts must be identified, and appropriate plans and technologies must be in place to promote, prevent, or mitigate them.

Finding #1
The Program is well suited to identify the key issues that pose a threat to the environment, to contribute to the development of technologies to exploit these resources and to help develop and demonstrate new approaches to lessen the environmental impacts. Part of the identification work may be better suited for DOE's Complementary Program rather than through an industry-led consortium.

Many real and perceived environmental and safety concerns can be dealt with through appropriate regulation and enforcement. Sound science can inform practice and policy.

Recommendations
The environmental mission is broader than what can be accomplished by Section 999. DOE should provide funding for environmental research to NETL and other institutions to strengthen its program and help provide independent analysis. This effort should include research in all of the key geographic areas to reflect their unique environments.

RPSEA should put greater emphasis on identifying technologies that help balance the objective of improving unconventional resources production with the objective of reducing environmental impacts of production.

The most valuable role the Unconventional and Small Producer programs (and other DOE oil and gas research programs) is to provide good, sound science that can inform practice and policy.

- DOE should direct RPSEA to specify that proposals, where applicable, include a description of the potential environmental impacts of the apparatus or method that may result from the proposed research. Such impacts may be positive or negative or both.
- DOE benefits assessment of each completed project should be expanded to include environmental impacts.
- Research should be pursued that determines the benefits and limitations of current mitigation options and identifies those that may optimize co-benefits to the industry and environment.
- DOE should clarify the jurisdictional statement in the last paragraph on page 17 of the 2011 Annual Plan.

Finding #2
The DOE Plan places increased emphasis on environmental risk identification, prevention, and mitigation.

Recommendation

RPSEA should be directed to strive to include specific efforts to more fully define any risks associated with unconventional gas development and to ensure that appropriate technologies are available to mitigate those risks [modified from RPSEA Draft Annual Plan, Description of Planned Solicitations, page 61].

3.3 RESEARCH PROGRAM FINDINGS AND RECOMMENDATIONS

A major shift in focus, not accompanied by additional funds, will result in less research directed toward achieving the stated goal of EPAct, Title IX, Subtitle J, "The Secretary shall carry out the activities under section 999A, to maximize the value of natural gas and other petroleum resources of the United States, by increasing the supply of such resources, through reducing the cost and increasing the efficiency of exploration for and production of such resources, while improving safety and minimizing environmental impacts."

Finding #1
Research funded from this program has always included environmental and safety aspects. Not only have the projects funded included components of environmental and safety, others have been exclusively focused on these issues, such as:

- Environmentally Friendly Drilling Systems Program
- Pre-Treatment and Water Management of Frac Water Re-Use
- An Integrated Framework for the Treatment and Management of Produced Water

Recommendations
The Program should better communicate past project environmental and safety accomplishments.

Program research proposals should include statement of environmental and safety benefits.

Environmental and safety aspects should become a formal part of the selection committee criteria.

Finding #2
The Committee believes that the following areas deserve a higher priority in the research program:

- Well isolation and integrity (e.g. cementing, swellable packers, and evaluation of the effectiveness of the isolation)
- Water use and re-use of produced, flowback, and frac waters
- Alternate (non-flare) well testing methods to reduce cost, risk, and air quality impacts (liquefaction, compression, etc.)
- Air emissions

Other areas of importance are:

- Minimize surface impact
- Resources in frontier areas
- Other unconventional resources (oil-prone shale, tight sands and carbonates, and others)
- Production optimization and recovery enhancement utilizing methods to identify static and dynamic (over time) sweet spots

- Technologies which would encourage more use of stranded natural gas

The DOE 2011 Annual Plan places considerable emphasis on gas shale plays and neglects to consider other resources such as:

- Mature fields
- Oil producing shale
- Tight sands and carbonates, etc.
- Low BTU gas

Recommendation

There is a need for more research into the topics listed above.

TECHNOLOGY TRANSFER / PUBLIC OUTREACH FINDINGS AND RECOMMENDATIONS

The Unconventional Resources Technical Advisory Committee (URTAC) recommendations addressed the need for a more modern and accessible knowledge management database and a robust Technology Transfer program as being critical to the success of the Unconventional Resources and Small Producer programs.

Finding #1

The Petroleum Technology Transfer Council (PTTC) has been working within the producing regions of the country. While the PTTC has heretofore focused on a regional approach, the need to disseminate information at the national level is proving to be more challenging. RPSEA has held several stand alone symposiums dealing with the presentation of the various research projects and has had some reviews of the individual research projects.

Recommendations

RPSEA needs to accomplish their technology transfer requirements through groups such as PTTC. Technology transfer events should be held in diverse geographical areas, including areas with emerging oil and gas activity, and target a more diverse audience of stakeholders. RPSEA and PTTC should endeavor to hold more technology transfer events in conjunction with other major technical conferences.

Technology transfer should continue to the end of the Program for each project.

DOE, through its Complementary Program with PTTC or other groups, should:

- Seek to complement existing private sector/academic training in general oilfield safety, regulatory, and environmental requirements.
- Provide to the general public a clearing house of information on various oil and gas issues. This could be used to provide information on continuing research and important technology changes that may be of interest to regulators and other stakeholders.

DOE should assign “Outreach Coordinators” to work with oil and gas producers and state agencies to help inform the regulatory process.

Finding #2

In the 2007 URTAC Committee’s report, a Web based system was identified as needed to disseminate research and development activities, lessons learned and knowledge management around Unconventional Resources and Small Producer Programs (Section 999) to those communities. As a result, the knowledge repository was created (www.netl.doe.gov/KMD) by NETL. This repository is a significant resource to all stakeholders (oil and gas, environmental, regulatory, and others).

Recommendations

The Knowledge Management Database needs to be made to be more user friendly to allow a quick logon, preferably with a synopsis as to the content of the research, and associated websites to determine what other material might be out there.

DOE should require a disclaimer to be part of the presented results of all funded research. In addition, researchers should strive to report results in peer reviewed forums.

COMMITTEE MEMBERS

Title	Last Name	First Name	Employer	City	State
Mr.	Arthur	J. Daniel	ALL Consulting, LLC	Tulsa	OK
Dr.	Botkin	Daniel B.	Center for the Study of the Environment	New York	NY
Mr.	Bromfield	Kenneth	Dow Hydrocarbons and Resources, LLC	Houston	TX
Dr.	Brown	Nancy J.	Lawrence Berkeley National Laboratory	Berkeley	CA
Mr.	Camp	Wayne K.	Anadarko Petroleum Corporation	Woodlands	TX
Ms.	Cavens	Jessica J.	EnCana Oil & Gas (USA)	Denver	CO
Mr.	Daugherty	William S.	NGAS Resources, Inc	Lexington	KY
Mr.	Dwyer	James P.	Baker Hughes	Houston	TX
Mr.	Hall	J. Chris	Drilling & Production Co.	Torrance	CA
Mr.	Hall	Jeffrey D.	Devon Energy Corporation	Oklahoma City	OK
Dr.	Hardage	Bob	University of Texas at Austin	Austin	TX
Mr.	Harju	John A.	Energy & Environmental Research Center	Grand Forks	ND
Mr.	Kleinberg	Robert L.	Schlumberger-Doll Research	Cambridge	MA
Mr..	Lewis	Fletcher S.	Rainmaker Oil & Gas	Oklahoma City	OK
Ms.	Mall	Amy	Natural Resources Defense Council	Boulder	CO
Dr.	Martin	John P.	New York State Energy Research and Development Authority	Albany	NY
Mr.	Mason	Gregory	The Energy Cooperative	Newark	OH
Dr.	Mohaghegh	Shahab D.	West Virginia University	Morgantown	WV
Mr.	Nilson	Gary J.	Pioneer Natural Resources USA, Inc,	Denver	CO
Mr.	Oglesby	Kenneth D.	Acorn Resources, Inc.	Tulsa	OK
Mr.	Rodgers	Brady D.	New Frontier Energy, Inc.	Denver	CO
Mr.	Sparks	Don L.	Discovery Operating, Inc.	Midland	TX
Mr.	Whitney	Sam W.	Shell E&P Company	Houston	TX

5.0 SUB-GROUP TOPICS AND MEMBER ASSIGNMENTS

At the September 9th, 2010 meeting in Sugar Land, Texas the following Subgroups and Schedule were established for developing the Subgroup analyses and reports. At the Committee meeting in New Orleans, Louisiana on October 13th and 14th, the "2011 Program" was reviewed and incorporated into this final report.

Schedule
9/9 – Subgroups establish and leaders defined
9/13-10/7 – Subgroup conference calls and E-mail correspondence
10/7- Subgroup reports to Chair
10/11- Subgroup reports distributed to Committee
10/13-10/14– Meeting in New Orleans
10/21- Teleconference and formal vote on final URTAC Report

Six Sub-Group Areas of Analysis and Member Assignments:

Executive Summary, Editing:
Lead – J. Hall
Members - C. Hall, Dwyer, Mason, Whitney

Research Program:
Lead – Dwyer, Mohaghegh
Members – Sparks, Oglesby, Lewis, Camp, Harju, Nilson, Mall, Brown, Rodgers

Policy:
Lead – C. Hall
Members – Whitney, Oglesby, Daugherty, Arthur, Mason, Brown

Technology Transfer and Public Outreach:
Lead – Lewis
Members – C. Hall, J. Hall, Martin, Mason, Dwyer, Nilson, Rodgers

Environmental and Regulatory:
Lead – Arthur
Members- Martin, Kleinberg, Brown, Mall, Mason, Hardage, Dwyer, Cavens, Bromfield

6.0 APPENDIX A

The Secretary requested recommendations from URTAC regarding the relative importance of planned focus areas.

By an overwhelming majority, the following items were of the highest priority.

In the Unconventional Program: proposals to develop new technologies necessary to enable more efficient and environmentally benign development of unconventional natural gas resources.

In the Small Producer Program: proposals to develop novel methods that provide positive environmental benefits while extending the economic life of mature fields.

Corrections

- Water demands for shale gas wells may exceed 2-3 million gallons. Water use associated with some wells has exceeded 10 million gallons.
- Flowback is a process and should be referred to as such. Water returning from the well is produced water, which may include spent fracturing fluids and natural formation water.
- Under air quality, note that intentionally vented emissions (stranded gas) are also a concern, particularly those with large Global Warming Potential.
- Page 14, bullet point 2 implies that cementing and casing standards are non-existent and/or are not followed, neither of which is true. The last statement of the bullet should more accurately read "The public concern is that current standards for cementing and casing wells, as well as monitoring and enforcement of these standards by the states may need to be reviewed for adequacy to ensure that drinking water supplies are protected".
- Page 16, 2011 Solicitations: recommend changing “any onshore” to “any onshore unconventional” at 3rd and 4th bullets is too broad for unconventional reservoir research scope.
- Page 18, first sentence should read federal ***and*** state regulatory agencies
- Page 6, 2nd paragraph, remove the word ***responsible***

7.0 APPENDIX B

Minority Opinion

Amy Mall and Dan Arthur strongly support the Department of Energy's proposal to increase substantially the program's emphasis on identifying and minimizing environmental impacts within current funding levels, consistent with the clear direction from the Energy Policy Act of 2005 that research, development, demonstration (RD&D) and commercial application of technologies carried out under this program include safe operations and environmental mitigation, along with exploration and production. Additional RD&D and commercial application of technologies focused on environment and safety are essential given the country's reliance on fossil fuels as we transition to a cleaner energy future. Any funding beyond current levels should be equally focused on environmental mitigation and safety issues.