U.S. DEPARTMENT OF ENERGY

2013 Annual Plan

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

Report to Congress
June 2013

United States Department of Energy
Washington, DC 20585

Message from the Secretary

The Nation needs to deploy American assets, innovation, and technology so that it can safely and responsibly develop more energy here at home and be a leader in the global energy economy.

To this end, the Department of Energy (DOE) continues its work toward safe and responsible development of fossil fuels. This means giving American families and communities high confidence that air and water quality, and public health and safety will not be compromised.

The Energy Policy Act of 2005 (EPAct) Subtitle J research on ultra-deepwater and unconventional resources is coordinated with DOE's ongoing natural gas research and development program within the Department's Office of Fossil Energy. Onshore, DOE's research on natural gas is part of a collaborative interagency effort with the Environmental Protection Agency (EPA) and the Department of the Interior (DOI). The three agencies are developing a framework for federal research that focuses on high priority recommendations of the Secretary of Energy Advisory Board (SEAB) Natural Gas Subcommittee to safely and prudently develop the Nation's unconventional shale gas and tight oil resources. Each agency will focus on specific core research competencies.

Offshore, DOE continues to work toward mitigating the risks and challenges associated with ultra-deepwater drilling and production operations. This includes deepening the collaboration and coordination already established with the DOI Bureau of Safety and Environmental Enforcement, and acknowledging the recommendations and advice DOI has received from its Ocean Energy Safety Advisory Committee.

The above initiatives, analyses, and recommendations underpin the *2013 Annual Plan*, including recommendations received from the DOE Ultra-Deepwater Advisory Committee, and the DOE Unconventional Resources Technology Advisory Committee.

DOE is committed to developing the science and technology that will allow the Nation to use its abundant fossil energy resources in a way that balances the energy needs for sustaining a robust economy with continued environmental responsibility. As we move forward with this research, DOE will pursue its mission with the same commitment to excellence and innovation.

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 Ron Wyden**
  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. Brad Crowell, Acting Assistant Secretary for the Office of Congressional and Intergovernmental Affairs, at (202) 586-5450.

Sincerely,

Ernest J. Moniz

Executive Summary

This *2013 Annual Plan* is the seventh research plan for the *Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research Program* since the launch of the program in 2007.

This plan reflects the program's focus on safety and environmental sustainability that was initiated in the 2011 plan, and is consistent with the President's Office of Management and Budget directive for research that has significant potential public benefits.[1]

Onshore, research on Unconventional Resources focuses on protecting groundwater and air quality, understanding rock and fluid interactions, and integrated environmental protection, including water treatment technologies and water management. For small producers, the program focuses on extending the life of mature fields in an environmentally sustainable way.

Offshore, research on Ultra-Deepwater emphasizes improved understanding of systems risk, reducing risk through the acquisition of real-time information, and reducing risk through the development of advanced technologies.

The research activities described in this plan 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. The expertise of RPSEA's members in all areas of the exploration and production value chain ensures that the Department of Energy's research program leverages relevant emerging technologies and processes, and that project results will have a direct impact on practices in the field.

[1] Secretary of Energy Advisory Board, Shale Gas Production Subcommittee, Second Ninety Day Report, November 18, 2011, page 19, Letter from Jacob J. Lew to Dr. John Deutch, November 8, 2011.

2013 ANNUAL PLAN

ULTRA-DEEPWATER AND UNCONVENTIONAL NATURAL GAS AND OTHER PETROLEUM RESOURCES RESEARCH AND DEVELOPMENT PROGRAM

Table of Contents

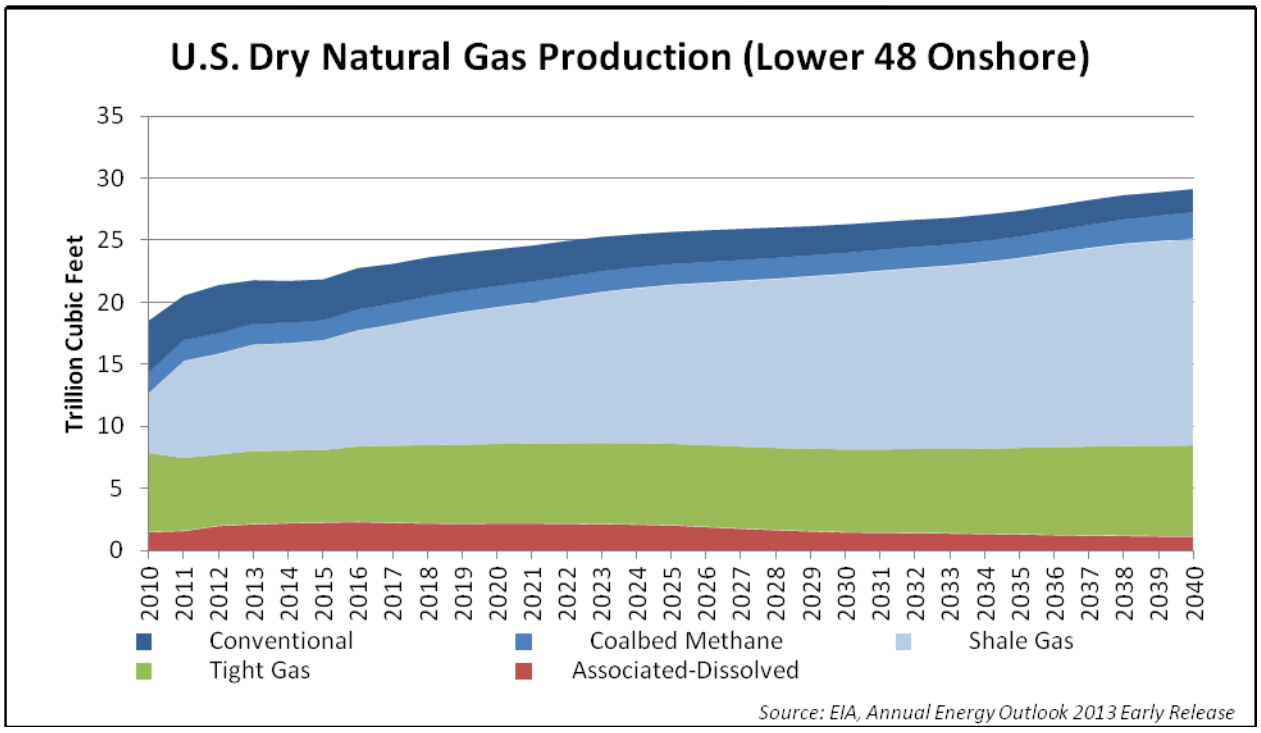
I. Goals and Objectives

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.
--U.S. Department of Energy Strategic Plan May 2011

By focusing on core competencies and capabilities, the Department of Energy (DOE) continues to ensure that the Federal Government understands and can address the risks associated with development of unconventional natural gas and oil onshore, as well as ultra-deepwater resources.

Natural gas from shale formations continues to be an important part of U.S. energy supply

According to the Secretary of Energy Advisory Board (SEAB), natural gas is a cornerstone of the U.S. economy, providing a quarter of the country's total energy.[2] The Energy Information Administration (EIA) recently forecast that shale gas production will continue to increase strongly through 2040, growing about 240 percent from 2010 to 2040.[3] While total domestic dry natural gas production is projected to increase from 21.3 trillion cubic feet in 2010 to 33.1 trillion cubic feet in 2040, shale gas production is projected to grow to 16.7 trillion cubic feet in 2040, when it makes up 50 percent of total U.S. production—up considerably from the 23 percent share in 2010.



[2] SEAB, Shale Gas Production Subcommittee 90-Day Report, August 18, 2011, page 1.
[3] EIA Annual Energy Outlook 2013 Early Release Reference case. Natural gas production data in the AEO is dry unless otherwise stated.

EIA reports that increasing natural gas production over the forecast reflects "…continued success in tapping the nation's extensive shale gas resource."[4] Further, EIA projects that, despite low natural gas prices, drilling activity will continue in part as a result of high crude oil prices, which significantly improve the economics of natural gas plays that have relatively high liquids content. Also according to EIA, improved drilling efficiencies will contribute to growing production volumes, which result in a greater number of wells being drilled more quickly, with fewer rigs and higher initial production rates.

Measures can be taken to reduce the environmental impact and enhance the safety of shale gas production

The advent of shale gas development also brings a host of safety and environmental issues, including: 1) demand for water for use in fracturing; 2) protection of drinking water aquifers; 3) evaluation of the safety of chemicals used in hydraulic fracturing; 4) environmental impacts resulting from the treatment and/or disposal of produced or fracturing flowback water; 5) air quality impacts; and 6) community safety issues.

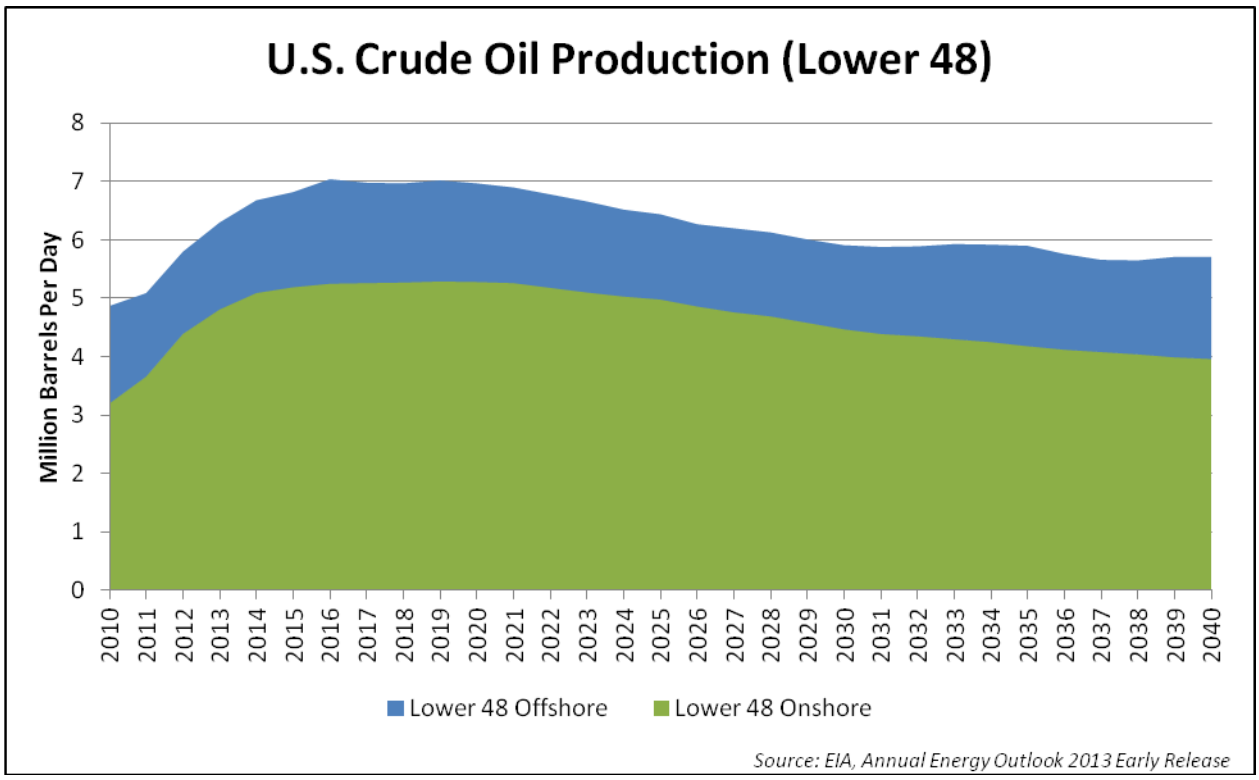
To address these issues, the SEAB presented recommendations to improve the safety and environmental performance of shale gas production.[5] In response, the President issued an executive order which led to the establishment of a memorandum of agreement on research collaboration between the DOE, the Department of the Interior (DOI), and the Environmental Protection Agency (EPA) based on core competencies.[6] For its part, DOE brings research experience and capabilities in the development of technologies and best practices to reduce the environmental impact and enhance the safety of shale gas production.

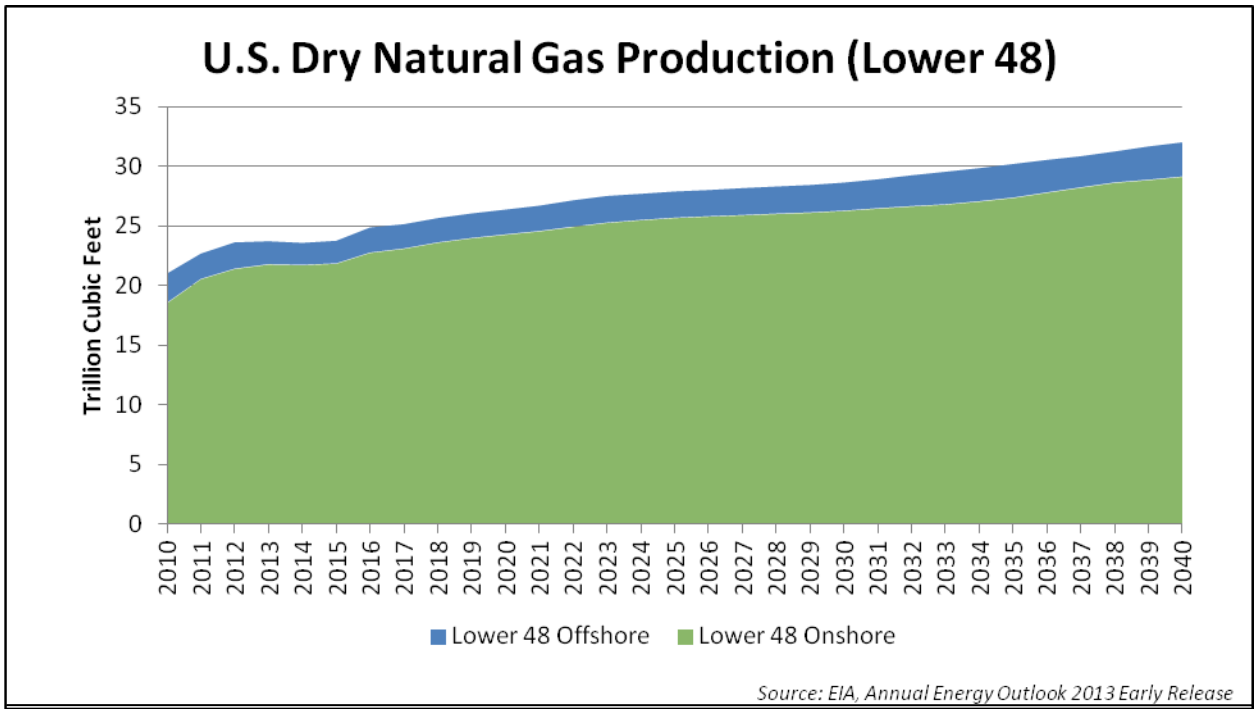
Ultra-deepwater production is an important contributor to U.S. oil and gas production

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. In the U.S., the Gulf of Mexico (GOM) is an important contributor to domestic oil and natural gas supply. Growing demand means that the deepwater GOM will remain a key contributor to America's supply of oil for the foreseeable future.

The EIA Annual Energy Outlook for 2013 (*AEO2013)* projects that continued development of deepwater crude oil resources in the GOM remains an important component of domestic crude production.[7] In the GOM, offshore crude oil production is projected to be relatively flat over time fluctuating generally between 1.3 million and 1.7 million barrels per day. Offshore natural gas production in the GOM fluctuates between 1.8 trillion and 2.6 trillion cubic feet per year.

[4] Energy Information Administration Annual Energy Outlook 2013 Early Release Overview
[5] SEAB, *Shale Gas Production Subcommittee 90-Day Report*, August 18, 2011, pages 1-5.
[6] http://unconventional.energy.gov
[7] Energy Information Administration Annual Energy Outlook 2013 Early Release Overview


U.S. Crude Oil Production (Lower 48)
Million Barrels Per Day
0
1
2
3
4
5
6
7
8
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
Lower 48 Offshore
Lower 48 Onshore
Source: EIA, Annual Energy Outlook 2013 Early Release


U.S. Dry Natural Gas Production (Lower 48)
Trillion Cubic Feet
0
5
10
15
20
25
30
35
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
Lower 48 Offshore
Lower 48 Onshore
Source: EIA, Annual Energy Outlook 2013 Early Release

Technological advances related to preventing and mitigating environmental impacts are needed

Industry has had impressive success innovating new technologies to find, develop, and commercialize oil and gas in ultra-deepwater; additional efforts continue to be pursued to provide reassurance that shoreline communities are protected, offshore workers are safe, and the integrity of the environment is maintained.

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

Given the strategic importance of ultra-deepwater production to our Nation's oil supply, the research topics to be pursued in accordance with the *2013 Annual Plan* focus on spill prevention. This is accomplished in part through improved characterization of the geologic environment, acquisition of real-time data downhole, and understanding of the human-machine interface.

DOE continues to coordinate with and complement the research conducted by the DOI Bureau of Safety and Environmental Enforcement (BSEE), the National Oceanic and Atmospheric Administration (NOAA), and the other members of the Interagency Coordination Committee for Oil Pollution Research (ICCOPR). DOE leads the Spill Prevention Subcommittee of the DOI Ocean Energy Safety Advisory Committee and includes relevant research in its portfolio.

II. 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.

(2) 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).

III. Background

Title IX, Subtitle J of EPAct directs that $50 million[8] 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). It also requires that the offshore and onshore research activities be administered pursuant to an annual plan.

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

The National Energy Technology Laboratory (NETL) is responsible for implementation of the Program, including oversight of the Program Consortium contract.

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 cost-shared research activities pursuant to Section 999B(c) of EPAct.

RPSEA has a broad membership base that includes representatives from all levels and sectors of 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. The private companies, universities, and other organizations that are awarded contracts through this program provide cost-share contributions of at least 20 percent.

[8] As a result of sequestration, amounts available for obligation from Fiscal Year 2013 funds are permanently reduced by $2.55 million. Funding levels in this report represent pre-sequestration amounts.

IV. Research Activities

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

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

Unconventional Resources Program

Program Goal
The goal of the Unconventional Resources Program (UCR) is to unlock the vast resources of natural gas trapped within shale deposits across the nation while addressing safety and protection of the environment.

The recommendations of the SEAB, as presented in its August 18, 2011 report, *Shale Gas Production Subcommittee 90-Day Report*, describe research topics that could reduce safety risk and environmental impacts for shale gas production. Research topics include: fugitive emissions management, groundwater protection, waste stream reduction and management, and produced water flowback treatment and recycling.

The Department's natural gas R&D program is coordinating its research efforts with the EPA and the DOI's U.S. Geological Survey, as envisioned by the SEAB. Together, they are developing a coordinated, multi-agency research program to address the highest priority challenges associated with safely and prudently developing unconventional shale gas and shale oil resources.[9]

Implementation Plan
The Program Consortium will administer the cost-shared UCR portfolio, and will coordinate with its network of private sector experts to recommend solicitations for additional R&D projects that warrant the investment of public funds.[10]

[9] www.unconventional.energy.gov
[10] Appendix B: Research Partnership to Secure Energy for America (RPSEA), *2012-2014 Draft Annual Plan*, November 2011, page 31.

Solicitations
The planned solicitation topics for the portfolio address protection of water resources and air quality, and increased understanding of the dynamics of the hydraulic fracturing process. Specific topics will be determined within the context of results and interim findings of completed and ongoing research, and may include:

- The effectiveness of current methods of ensuring wellbore integrity through the life of the well and beyond by incorporating measured field data.
- Quantifying and mitigating the risks associated with propagation of induced fracture while optimizing hydraulic fracture design.
- The risks and impacts of induced seismic activity associated with, but not limited to, [salt] water disposal and basic research on the relationship of fluid injection and induced seismicity.
- Characterizing unconventional resources including shale oil, residual oil, and associated strata, including shallow groundwater systems.
- Developing novel geophysical techniques that better detect natural fractures and subtle faults, and that help define spatial positions, geometrical shapes, and volumetric sizes of stratigraphic intervals.
- Research sampling protocols and measurement guidelines and/or field data to assess the overall air quality impacts, including greenhouse gas lifecycle.
- Comparing and contrasting key rock and fluid properties across basins to optimize development strategies.
- Developing technologies to mitigate operation risks and environmental impacts.

Anticipated Awards
About $13.7 million has been allocated for research awards. Approximately four to ten awards are anticipated to be awarded as part of the 2013 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. All awards will be subject to the Secretary of Energy's final approval.

Administrative Activities
The Program Consortium will continue active management of the cost-shared R&D portfolio, planning and development of future R&D, and program level technology transfer workshops. The administrative milestones for the three 2013 research portfolios are listed in Section IV.

The next solicitation will remain open for a minimum of 60 days. The review and selection process will take several 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 2013 include:

- Issue and complete at least one solicitation.
- Engage technical advisory committees to review the solicitation to ensure that it reflects sufficient breadth and depth of industry experience.[11]
- Select and award four to ten projects for the portfolio.

Summary of 2007- 2012 Activities

Appendix A is comprised of tables that list research projects for all prior years. Additional data included in the tables include lead performer, end dates for active projects, anticipated duration for projects pending award, projects' anticipated costs, and source year of funding. The 2012 solicitations for proposals are anticipated to be released late 2012/early 2013.

The table below summarizes the number of solicitations, selections, and project awards for 2007 through 2012 as of November 20, 2012.

UCR Program Solicitations, Selections and Awards

Funding Year	Solicitations	Selections	Awards
2007	1	19	19
2008	1	9	9
2009	1	11	10
2010	1	8	8
2011	1	15	5
2012	Pending	Pending	Pending

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.

Information regarding the research activities of the NETL Complementary Research Program on unconventional resources can be found at https://edx.netl.doe.gov/ucr.

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 and associated mitigation methods keep pace with the technologies that industry has developed to tap reserves in increasingly challenging conditions.[12]

[11] Research Partnership to Secure Energy for America (RPSEA), *2012-2014 Draft Annual Plan*, November 2011, page 31.

UDW will assess and develop technologies and best practices to mitigate the risks in offshore production activities related to controls, safeguards, and environmental impacts during drilling and production operations.[13]

DOE continues to coordinate with and complement the research conducted by BSEE, NOAA, and the other agency members of the ICCOPR. Research topics are expected to include: development of improved well control and wild well intervention techniques; evaluation of appropriate safeguards for blowout preventers, cementing and casing; evaluation of instrumentation and monitoring; improvement of flow assurance; expediting the completion of relief wells, and other topics associated with ultra-deepwater operations.

Implementation Plan

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

Solicitations

For the 2012 portfolio, the process of informing stakeholders about pending solicitations was expanded to increase the engagement of other groups such as the Society of Petroleum Engineers, American Petroleum Institute, National Academies, plus other professional organizations, environmental groups, regulatory organizations, and marine well containment companies.[14]

The list of planned solicitations for the next UDW research portfolio is presented below. In its preparation of the actual UDW solicitations, the Department will be influenced and informed in large part by the Ultra Deepwater Advisory Committee (UDAC), by ongoing risk analysis conducted by the Los Alamos National laboratory, and by advice to the DOI from its OESC and its subcommittees on oil spill prevention. Quantification and assessment of risk will be an integral part of the entire research program.

The planned solicitation topics for the portfolio quantify the risk associated with drilling through the rock and fluids present in high pressure/high temperature reservoirs, and the challenges of wellbore integrity and well control. Specific topics may include:

- Reservoir characterization, including bounding strata to ensure hydrocarbon containment within the geologic and engineered system.
- Research sensors; instrumentation; command electronics; and advanced data interpretation technologies and alert systems to improve decision-making capabilities.
- Studies of human behavior as related to the high risk conditions of ultra-deepwater drilling and production operations with emphasis on the “human-machine” interface.

---

[12] *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.

[13] “*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.

[14] *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.

- Advanced well and vessel design to reduce risks of operations in areas of harsh storms.
- Hardware and novel drilling and completion techniques that prevent loss of well control.

Anticipated Awards
Approximately $15 million has been allocated for research awards. Cost-sharing beyond the required minimum of 20 percent will be sought. Not all areas of solicitations may include actual awards because only the highest quality proposals received will be considered for award. All awards are subject to the Secretary of Energy's final approval.

Administrative Activities
The Program Consortium will continue active administration of the R&D portfolio, planning and development of future R&D, and holding program level technology transfer workshops. The administrative milestones for the 2013 research portfolios are listed in Section IV.

The next solicitation is expected to be released during Spring 2013 and will remain open for a minimum of 60 days. The review and selection process will take several 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 one RFP for the 2013 portfolio based on the 2007-2012 portfolios.
- Select and award three to five large projects for the 2013 portfolio.
- Establish research priorities based on results of 2007-2013 portfolios and inputs from the Program Consortium and advice from the UDAC and other important Federal advisory bodies.
- Update the RPSEA *2012-2014 Draft Annual Plan*, if needed.

Summary of 2007-2012 Activities
Appendix A is comprised of tables that list research projects for all prior years. The projects are organized into six areas that address specific needs identified in Appendix B.[15] Additional data included in the tables are: lead performer, end date for active projects, anticipated project duration for projects pending award, project cost, and source year of funding. It is anticipated that the solicitations for proposals for the portfolio will be released March through May 2013, dependent upon available funding.

The table below summarizes the number of solicitations, selections, and awards for 2007-2012 made as of November 20, 2012. Abstracts and project information for each of the research 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.

[15] Research Partnership to Secure Energy for America (RPSEA), 2012-2014 Draft Annual Plan, November 2011.

UDW Program Solicitations, Selections and Awards

Funding Year	Solicitations	Selections	Awards
2007	13	17	16
2008	11	14	14
2009	5	11	11
2010	7	19	14
2011	2	3	Pending
2012	Pending	Pending	

Information regarding the research activities of the NETL Complementary Research Program for ultra-deepwater can be found at https://edx.netl.doe.gov/udw.

Small Producer Program

Program Goal

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

The goal of the Small Producer Program (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*.[16]

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.[17]

Specific goals of SP are:

[16] 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.

[17] SEC. 999B(d)(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.

- Reduce Environmental Impacts from Small Producer Operations
- Mitigate Environmental Impacts in Mature Fields
- Improve Recovery
- Extend Economic Life of Mature Fields Through Environmentally Safe Efficiency.

Implementation Plan
The SP is being implemented by developing and administering an annual solicitation for research in areas that address the objectives outlined above. The following section outlines the major steps in the implementation plan.

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*.[18] For the purposes of the solicitation, a small producer consortium shall consist of two or more entities participating in a proposal through a 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.

Solicitations
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 will help to:

- *Carry out scientific and technical research, demonstrate technologies, and identify practices and guidelines to optimize operational environmental performance.*

Anticipated Awards
About $3.2 million has been allocated for SP. Approximately two to six awards are anticipated to be awarded. All awards are subject to the Secretary of Energy's final approval.

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

The next Small Producer solicitation will remain open for a minimum of 60 days. The review and selection process will take several months, and the award process will take approximately three months. The Program Consortium will coordinate closely with each awardee to develop a successful technology transfer plan.

[18] SEC. 999B(d)(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.

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

- Issuance of at least one solicitation;
- Integration of input from the technical advisory group to ensure the solicitation reflects sufficient breadth and depth of industry experience;
- Selection and award of two to six projects; and
- Establishment of R&D priorities based on results of prior year program solicitations and other inputs from stakeholders, including the Program Consortium's advisory committees and advice from the Secretary of Energy's URTAC.

Summary of 2007-2012 Activities

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

The table below summarizes the number of solicitations, selections, and awards for 2007 through 2012 as of November 20, 2012.

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	2
2011	1	9	8
2012	Pending	Pending	

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.

V. Administrative Activities

Solicitation Process

Eligibility

Pursuant to Section 999E 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 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 of United States-owned entities.

The Program Consortium is not eligible to apply for an award under this program.

Organizational/Personal Conflict of Interest

The approved Program Consortium 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, RPSEA submitted an OCI Plan 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."

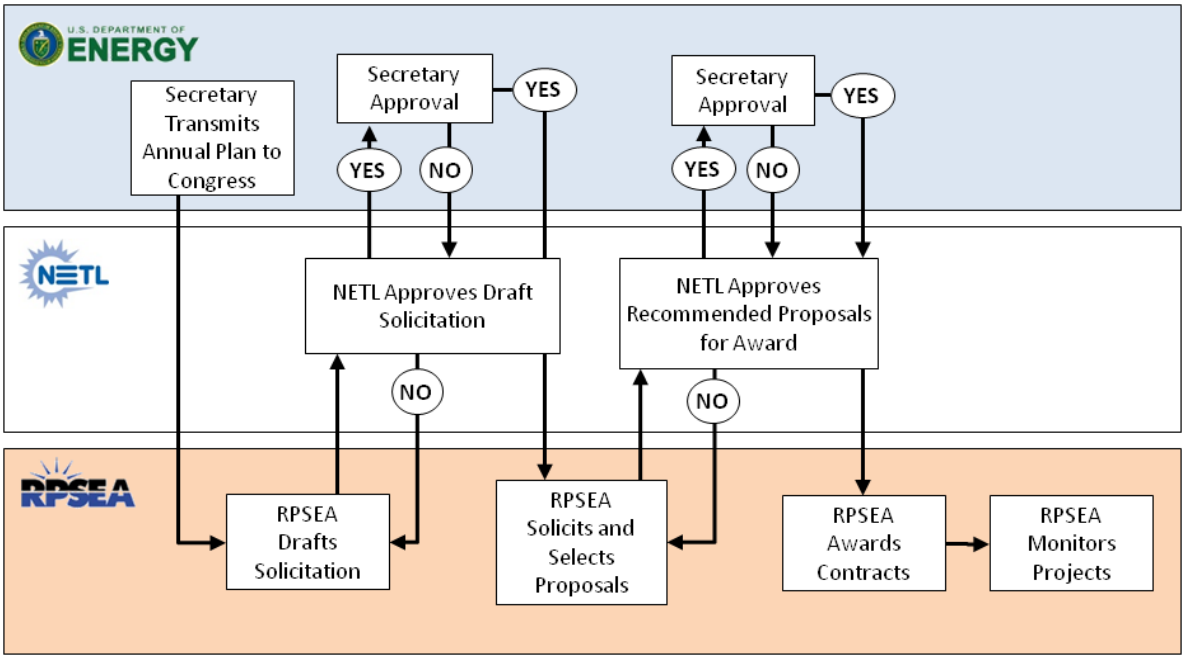
In addition, the Contract between DOE and RPSEA includes the following OCI clauses: H.22 Organizational Conflict of Interest (Nov 2005); H.23 Organizational Conflict of Interest (OCI) Annual Disclosure; and H.24 Limitation of Future Contracting and Employment. These contract clauses and the approved 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 below. 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) provide technical reviews of proposals, while the RPSEA Program Advisory Committees (PACs) select projects for recommendation for award to DOE. The Secretary of Energy is responsible for the final review and approval of recommended projects.

Project Solicitation Approval Process



Selection Criteria

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

- Technical merit and applicable production, reserve, and environmental impacts (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
- Demonstration of public benefit
- 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 applicant may be required to meet with the technical review committee to present its proposal and to answer any outstanding questions.

Schedule and Timing

The schedule for the solicitations to be included in the portfolio will be determined after 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 the table below.

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 2013 Awards													
Manage 2007- 2012 Awards													
Report Program Deliverables													
Conduct Technology Transfer Workshops & Activities													
Establish 2013 R&D Priorities & Annual Plan													

Proposal Specifications

The structure and required elements of proposals submitted in response to each solicitation, 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* and *Federal Acquisition Regulations*. Relevant clauses will be 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.

Funding Estimates

It is anticipated that $14.9 million will be available for UDW with approximately five to ten awards and $13.7 million for UCR with approximately four to ten awards.

The typical award is expected to have a term of one to three years, although shorter or longer awards may be considered if warranted by the nature of the proposed project. All research 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 $3.2 million will be available for SP in FY 2013. Approximately two to six awards are anticipated during FY 2013. The typical award is expected to have a term 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 target identified in the 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 producers, universities, Non-Government Organizations (NGOs), etc.)
- Petroleum Technology Transfer Council (PTTC)

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
- Funding-alert organizations that send e-mails once a week about funding opportunities to members in their specific areas of expertise
- Various professional, industry, state, and national organizations with established communications networks such as the 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 of EPAct as requirements for awards. This information must be addressed in the solicitations and applications, as 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.
- ***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).

- ***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.
- ***Technology Transfer –*** 2.5 percent of the amount of each award must be designated for technology transfer and outreach activities.
- ***Cost Sharing Reduction for Independent Producers –*** In applying the cost sharing requirements under section 988 of EPAct to awards under the *Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research Program*, the Secretary may reduce or eliminate the non-Federal requirement if the Secretary determines that the reduction is necessary and appropriate considering the technological risks involved in the project.
- ***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.

Project Management

The Program Consortium has developed and implemented formal policies/procedures for the administration 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 the following topics:

- 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

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

1. Engage project performers through collaborative agreements, actively disseminating the results of their research efforts through regular meetings (e.g., conferences, industry meetings, workshops, seminars, and forums).
2. Maintain the DOE website as a centralized repository 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.[19]

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.

The *Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research Program* will utilize a combination of various technology transfer mechanisms. The table matrix below 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 featured articles highlighting individual projects and overall Program activities. As progress on individual projects accelerates, all of the various technology transfer mechanisms will be engaged to deliver results and data products identified in the table below.

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.[20] 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 has engaged 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.

[19] http://www.netl.doe.gov/kmd.
[20] http://www.netl.doe.gov/kmd.

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. As 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 the understanding that for the desired impact to be achieved, an integrated approach to technology transfer is needed.

At the project level, technology transfer activities are listed below:

- 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

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

- 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)
- 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. The primary reference is a Calendar of Events on the RPSEA website (http://www.rpsea.org/en/calendarevents/monthly.asp).

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	Completed	$820,000	2008
DW2502: Modeling and Simulation of Managed Pressure Drilling for Improved Design, Risk Assessment, Training and Operations	Stratamagnetic Software, LLC	Completed	$360,000	2008
DW3500-10: Gyroscope Guidance Sensor for Ultra-Deepwater Applications	Laserlith Corporation	September 2013	$489,346	2009
DW4501-01: Smart Cementing Materials and Drilling Muds for Real Time Monitoring of Deepwater Wellbore Enhancement	University of Houston	August 2015	$2,580,401	2010
DW4502-01: Deepwater Reverse-Circulation Primary Cementing	CSI Technologies, LLC	June 2014	$798,507	2010
		Subtotal:	**$5,048,254**	
Initiative 2: Completion Cost Reduction				
DW4504-01: Intelligent Casing-Intelligent Formation Telemetry (ICIFT) System	The Board of Regents of the University of Oklahoma	July 2013	$474,935	2010
		Subtotal:	**$474,935**	
Initiative 3: Intervention (Downhole Services)				
DW1502: Coil Tubing Drilling and Intervention System Using Cost Effective Vessels	Nautilus International, LLC	Completed	$820,000	2008
DW2301: Deepwater Riserless Intervention System (RIS)	DTC International, LLC	December 2013	$3,382,017	2008
DW3500-07: Deepwater Subsea Test Tree and Intervention Riser System	DTC International, Inc.	December 2013	$1,551,239	2009
DW4505-01: Coil Tubing Drilling and Intervention System Using Cost Effective Vessel	Nautilus International, LLC	July 2014	$1,306,739	2010
		Subtotal:	**$7,059,995**	
		Need 1 Total:	***$12,583,184***	
Need 2: Appraisal and Development Geoscience and Reservoir Engineering				
Initiative 1: Reservoir Characterization and Appraisal				

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
DW2001: Synthetic Benchmark Models of Complex Salt	SEAM	June 2013	$2,633,364	2007
DW2701: Resources to Reserves Development and Acceleration through Appraisal	University of Texas at Austin	September 2013	$280,644	2008
		Subtotal:	**$2,994,321**	
Initiative 2: Improved Recovery				
DW1701: Improved Recovery	Knowledge Reservoir	Completed	$1,599,712	2007
DW3500-01: Intelligent Production System for UDW with Short Hop Wireless Power & Wireless Data Transfer for Lateral Production Control & Optimization	Tubel LLC	Completed	$1,103,000	2009
DW3700-02: A 1,000 Level Drill Pipe Deployed Fiber Optic 3C Receiver Array for Deep Boreholes	Paulsson, Inc.	February 2014	$1,994,329	2009
		Subtotal:	**$4,697,041**	
		Need 2 Total:	***$7,611,049***	
Need 3: Significantly Extend Satellite Well Tieback /Surface Host Elimination				
Initiative 1: Subsea Processing & Boosting				
DW1301: Improvements to Deepwater Subsea Measurements	Letton-Hall Group	Completed	$3,600,126	2007
DW1901: Subsea Processing System Integration Engineering	GE Global Research	Completed	$1,200,000	2007
DW 4304-01: More Improvements to Deepwater Subsea Measurement	Letton-Hall Group	July 2015	$3,245,910	2010
		Subtotal:	**$8,046,036**	
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 2013	$4,999,967	2008
DW3300-10: Development of Carbon Nanotube Composite Cable for Ultra Deepwater Oil and Gas Fields	Los Alamos National Laboratory	April 2014	$2,000,000	2009
DW4302-01: Ultra-High Conductivity Umbilicals: Polymer Nanotube Umbilicals (PNUs)	NanoRidge Materials	August 2015	$2,558,550	2010
DW4306-01: All Electric Subsea Autonomous High Integrity Pressure Protection System (HIPPS) Architecture	GE Global Research	February 2015	$760,000	2010
		Subtotal:	**$11,246,517**	

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
Initiative 3: Stabilized Flow				
DW1201: Wax Control	University of Utah	Completed	$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	July 2014	$502,961	2008
DW3300-02: Displacement & Mixing in Subsea Jumpers Experimental Data and CFD Simulations	The University of Tulsa	Completed	$254,952	2009
DW4202-01: Hydrate Modeling & Flow Loop Experiments for Water Continuous & Dispersed Systems	Colorado School of Mines	August 2014	$701,354	2010
DW4204-01: Corrosion and Scale at Extreme Temperature and Pressure	Brine Chemistry Solutions, LLC	August 2015	$3,651,068	2010
		Subtotal:	**$5,510,335**	
		Need 3 Total:	***$24,802,888***	
Need 4: Dry Trees and Risers in 10,000 Feet Water Depth				
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
DW4404-03: Low Cost Flexible Production System for Remote Ultra-Deepwater Gulf of Mexico Field Development	Doris	October 2013	$1,197,827	2010
DW4405-02: Ultra-deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico, Phase 2	Det Norske Veritas	December 2013	$2,134,395	2010
DW4406-01: Effects of Fiber Rope - Seabed Contact on Subsequent Rope Integrity	Stress Engineering	August 2013	$2,240,421	2010
DW4407-01: Deepwater Direct Offloading Systems, Phase 1	Remora Technology	August 2013	$843,471	2010
		Subtotal:	**$7,506,842**	
Initiative 2: Risers				
DW1401: Carbon Fiber Wrapped High Pressure Drilling and Production Riser Qualification Program	Lincoln Composites	June 2013	$2,071,507	2007
DW1403: Fatigue Performance of High Strength Riser Materials	Southwest Research Institute	Completed	$800,000	2007
DW3500-02: Fatigue Testing Of Shrink-Fit Riser Connection For High Pressure Ultra Deepwater Risers	Subsea Riser Products	Completed	$348,563	2009

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
DW4401-02: Ultra-Deepwater Riser Concepts for High Motion Vessels	Stress Engineering	August 2015	$1,200,000	2010
DW4402-01: Qualification of Flexible Fiber-Reinforced Pipe for 10,000-Foot Water Depths	GE Global Research	August 2016	$7,113,436	2010
DW4402-02: Qualification of Flexible Fiber-Reinforced Pipe for 10,000-Foot Water Depths	DeepFlex	October 2016	$10,803,462	2010
		Subtotal:	**$22,336,968**	
		Need 4 Total:	***$29,843,810***	
Need 5: Continuous Improvement and Innovation				
Initiative 1: Improve Operating and Inspection Processes				
DW2101: New Safety Barrier Testing Methods	Southwest Research Institute	Completed	$128,000	2008
DW3300-06: High Resolution 3D Laser Imaging for Inspection, Maintenance, Repair, and Operations	3D at Depth, LLC	August 2014	$2,214,828	2009
DW3300-08: Sensors & Processing for Pipe, Riser, Structure, & Equipment Inspection to Provide Detailed Measurements, Corrosion Detection, Leak	Blueview Technologies, Inc.	June 2013	$468,463	2009
		Subtotal:	**$2,811,291**	
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
DW1603-D: Graduate Student Design Project. Robotic MFL Sensor for Monitoring and Inspection of Deepwater Risers	Rice University	Completed	$120,000	2007
DW2902-02: Technologies of the Future for Pipeline Monitoring and Inspection	The University of Tulsa	Completed	$120,000	2008
DW2902-03:Wireless Subsea Communications Systems	GE Global Research	Completed	$120,000	2008
DW2902-04: Replacing Chemical Biocides with Targeted Bacteriophages in Deepwater Pipelines and Reservoirs	Phage Biocontrol, LLC	Completed	$120,000	2008

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
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.	Completed	$119,716	2008
DW2902-07: Fiber Containing Sweep Fluids for Ultra Deepwater Drilling Applications	The University of Oklahoma	Completed	$119,971	2008
		Subtotal:	**$1,160,528**	
		Need 5 Total:	***$3,971,819***	
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)	Completed	$544,085	2007
DW2801: Gulf 3-D Operational Current Model Pilot Project	Portland State University	March 2014	$1,248,000	2008
DW4801-01: Synthetic Hurricane Risk Model for the Gulf of Mexico	Applied Research Associates	18 months	$875,915	2010
DW4802-01: Effect of Climate Variability and Change in Hurricane Activity in the North Atlantic	University Corporation for Atmospheric Research	July 2015	$1,440,000	2010
		Subtotal:	**$4,108,000**	
Initiative 2: HS&E Concerns with Emerging New Technologies				
DW3300-05: Autonomous Inspection of Subsea Facilities	Lockheed Martin	Completed	$1,302,113	2009
DW3100-01: UDW Seabed Discharge of Produced Water and/or Solids	Fluor Enterprises, Inc.	Completed	$448,956	2009
DW4903-02: Autonomous Underwater Inspection Using a 3D Laser	Lockheed Martin	April 2014	$1,642,446	2010
		Subtotal:	**$3,393,515**	
		Need 6 Total:	***$7,501,515***	
	Total for 2007 - 2010		***$86,314,265***	

UCR Project Portfolio

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
2007 Funding Year				
07122-07 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.

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
07122-09 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 Completed	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
07122-12 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
07122-14 Comprehensive Investigation of the Biogeochemical Factors Enhancing Microbially Generated Methane in Coal Beds	Colorado School of Mines	$864,333 Completed	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
07122-15 Reservoir Connectivity and Stimulated Gas Flow in Tight Sands	Colorado School of Mines	$2,894,256 Completed	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

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
07122-16 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
07122-17 Geological Foundation for Production of Natural Gas from Diverse Shale Formations	Geologic Survey of Alabama	$497,459 Completed	Geologic characterization of diverse shales in Alabama	
07122-22 Petrophysical Studies of Unconventional Gas Reservoirs Using High-Resolution Rock Imaging	Lawrence Berkeley National Laboratory	$1,071,105 Completed	Development of recovery strategies mitigating condensate precipitation based on high resolution rock imaging	Schlumberger; BP; Chevron
07122-23 A Self-Teaching Expert System for the Analysis, Design and Prediction of Gas Production from Shales	Lawrence Berkeley National Laboratory	$1,774,840 Completed	User friendly software package for gas shale production prediction	Texas A&M University; University of Houston; University of California Berkeley; Anadarko; Southwestern Energy
07122-27 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
07122-29 Gas Condensate Productivity in Tight Gas Sands	Stanford University	$518,227 Completed	Production protocols to minimize formation damage due to liquids precipitation near the wellbore	

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
07122-33 Advanced Hydraulic Fracturing Technology for Unconventional Tight Gas Reservoirs	Texas A&M University	$1,045,551 Completed	Design methodology for hydraulic fracturing considering new conductivity model	Carbo Ceramics; Schlumberger; Halliburton Energy Services; BJ Services
07122-35 Optimizing Development Strategies to Increase Reserves in Unconventional Gas Reservoirs	Texas A&M University	$314,606 Completed	Reservoir and decision model incorporating uncertainties	Unconventional Gas Resources Canada Operating Inc.; Pioneer Natural Resources
07122-36 Novel Fluids for Gas Productivity Enhancement in Tight Formations	The University of Tulsa	$219,920 Completed	Model for the mitigation of gel damage due to hydraulic fracturing in the near wellbore region	Williams Exploration & Production
07122-38 Improvement of Fracturing for Gas Shales	The University of Texas at Austin	$484,406 Completed	Design and field test of lightweight proppant materials in the Barnett shale	Daneshy Consultants; BJ Services
07122-41 Improved Reservoir Access through Refracture Treatments in Tight Gas Sands and Gas Shales	The University of Texas at Austin	$949,318 June 2013	Strategy for refracture of tight gas and gas shale wells. Define window of refracture opportunity	Noble Energy; BJ Services; Anadarko; Jones Energy; Pinnacle Technologies
07122-43 Optimization of Infill Well Locations in Wamsutter Field	The University of Tulsa	$443,563 Completed	Simulation technique for high-grading downsized spacing locations in a tight gas reservoir	Texas A&M University; Devon Energy
07122-44 Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures	The University of Utah	$1,068,863 Completed	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

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
07122-45 Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities	Utah Geologic Survey	$428,491 Completed	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
2008 Funding Year				
08122-05 Barnett and Appalachian Shale Water Management and Reuse Technologies	Gas Technology Institute	$2,500,000 Completed	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
08122-15 Novel Gas Isotope Interpretation Tools to Optimize Gas Shale Production	California Institute of Technology	$1,190,000 Completed	Novel diagnostic tools for predicting, monitoring and optimizing shale gas production	Devon Energy Corporation; BJ Services Company; GeoIsoChem Inc.

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
08122-35 The Environmentally Friendly Drilling Systems Program	Houston Advanced Research Center	$2,199,895 Completed	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
08122-36 Pretreatment and Water Management for Frac Water Reuse and Salt Production	GE Global Research	$1,105,000 Completed	Technology that enables recycle of fracturing flowback water, and production of a salable salt by-product	STW Resources, Inc.
08122-40 Stratigraphic Controls on Higher-Than-Average Permeability Zones in Tight-Gas Sands in the Piceance Basin	Colorado School of Mines	$111,216 Completed	Evaluation of the stratigraphic controls on the distribution and quality of tight-gas reservoirs in the Piceance Basin	
08122-45 Coupled Flow-Geomechanical-Geophysical-Geochemical (F3G) Analysis of Tight Gas Production	Lawrence Berkeley National Laboratory	$2,900,000 Sep 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	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
08122-48 Sustaining Fracture Area and Conductivity of Gas Shale Reservoirs for Enhancing Long-Term Production and Recovery	Texas A & M University	$1,615,000 May 2013	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.
08122-53 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 Aug 2013	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
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	Bureau of Economic Geology, The University of Texas at Austin	$1,020,000 Completed	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				
09122-01 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
09122-02 Characterizing Stimulation Domains, for Improved Well Completions in Gas Shales	Higgs-Palmer Technologies	$437,176 Sep 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	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
09122-04 Marcellus Gas Shale Project	Gas Technology Institute	$3,215,157 Completed	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
09122-06 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
09122-07 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
09122-11 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.
09122-12 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 2013	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.

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
09122-29 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
09122-32 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	$3,120,363 Sep 2014	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
09122-41 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
2010 Funding Year				

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
10122-06 The Technology Integration Program: An Extension of the Environmentally Friendly Drilling Systems Program	Houston Advanced Research Center	$5,999,710 July 2015	The TIP will establish a network of regional centers that will perform field tests, technology transfer and outreach activities. Field tests of identified technologies will be performed and documented. The integrated technologies are expected to significantly accelerate the safe and environmentally responsible development of gas shales across the USA. Technology Transfer-Outreach-Education materials include web sites, reports from conferences, brochures, and publications	Texas A&M University, Texas A&M University – Kingsville, Texas AgriLife Extension Service, Sam Houston State University, Utah State University, Tom Williams, Epic Software, Petris Technology, Oak Ridge National Laboratory, University of Arkansas, University of Colorado, Land Steward Consultants, Black Brush Oil and Gas, Scott Environmental Services, Newpark Mats and Services, Natures Composites, MI SWACO, University of Texas Bureau of Economic Geology, AVI LLC (Rice University), Ames Energy Advisors, Fountain Quail, 212 Resources, Dow Chemical Company, Water Resources Company, Consumer Energy Alliance, Goodrich Petroleum Company, The Nature Conservancy, Campbell Applied Physics, Rancho San Pedro, Petrohawk.
10122-07 NORM Mitigation and Clean Water Recovery from Marcellus Frac Water	GE Global Research	$1,507,673 Jan 2014	Development and validation at the pilot scale, of two technologies to economically recover 90-95% of Marcellus frac water as clean water and a salable salt	GE Water & Process Technologies, Endicott Interconnect Technologies, Inc.
10122-19: Lowering Drilling Cost, Improving Operational Safety, and Reducing Environmental Impact through Zonal Isolation Improvements for Horizontal Wells Drilled in the Marcellus and Haynesville Shales	CSI Technologies	$3,125,252 Apr 2014	A comprehensive study of the cementing process applied in the Marcellus Shale fields and an integrated process to optimize zonal isolation, reduce job problems, minimize remedial cementing requirements, and reduce rig time spent waiting on cement.	University of Houston Chemical Engineering Department

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
10122-20: Development of Non-Contaminating Cryogenic Fracturing Technology for Shale and Tight Gas Reservoirs	Colorado School of Mines	$1,990,568 July 2015	Test and develop an innovative technology for enhanced gas recovery (EGR) from low-permeability shale gas and tight gas reservoirs. In particular, the proposed research is focused on developing a novel cryogenic fracturing technology for significant reduction of flow resistance near wells and increase mobile gas volume in unconventional gas reservoirs. The success of this technology could dramatically reduce water use for shale fracturing.	CARBO Ceramics, Pioneer Natural Resources USA, Inc., Lawrence Berkeley National Laboratory (LBNL)
10122-39: Novel Engineered Osmosis Technology: A Comprehensive Approach to the Treatment and Reuse of Produced Water and Drilling Wastewater	Colorado School of Mines	$1,323,805 June 2014	Novel membranes and membrane systems, new methods to enhance and improve osmotic and other water treatment processes, and computer programs to facilitate the implementation of these new systems	Hydration Technology Innovations, LLC, Bear Creek Services (BCS) Pinnacle Operating Company, Inc., Stewart Environmental Consultants, Inc., SM Energy Company, PENN Virginia Oil and Gas, L.P., Emerging Products Technical Consulting, LLC, and more

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
10122-42 A Geomechanical Analysis of Gas Shale Fracturing and Its Containment	Texas A&M University	$650,357 Jan 2014	Study(i) to understand the role of rock texture, fabric, and deformation regime on the nature and extent of induced fractures, (ii) to develop better understanding of the impact of rock property and interfaces/discontinuities characteristics on containing fractures in gas shale reservoirs, and (iii) to numerically study fracture complexity and contained stimulated volume while considering rock heterogeneity and discontinuity based on experimental observations.	Shell Oil, Matador, APEXHiPoint, and Schlumberger-TerraTek
10122-43 Diagnosis of Multiple Fracture Stimulation in Horizontal Wells by Downhole Temperature Measurement for Unconventional Oil and Gas Wells	Texas A&M University	$740,742 Sep 2014	A new methodology for hydraulic fracturing diagnosis using downhole temperature and pressure date to identify fracture locations and types (longitudinal versus transverse), estimate fracture geometries and evaluate fractured well performance	Hess, Shell USA
10122-47 Predicting Higher-Than-Average Permeability Zones In Tight-Gas Sands, Piceance Basin: An Integrated Structural And Stratigraphic Analysis	Colorado School of Mines	$781,707 Sep 2014	An improved, fully integrated understanding of subsurface geologic controls on tight-gas sand resources will help predict critical “sweet spots” in the Piceance basin. Optimum well placement will result in a decrease in the number of wells necessary to develop the resource.	Bill Barrett Corporation and Williams E&P
2011 Funding Year				

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
11122-07 Conductivity of Complex Fracturing in Unconventional Shale Reservoirs	Texas A&M, Texas Engineering Experiment Station	$883,508 24 months	The effectiveness of 100 mesh proppant, both by itself and mixed with larger proppant will be measured. Actual fracture conductivity that is created in shale will be determined and published; as There are no published studies on this topic.	Southwestern Energy CoreLab
11122-20 Advanced Hydraulic Fracturing	Gas Technology Institute	$6,200,964 Dec 2014	1) Guideline for environmentally safe and economically optimal fracture stimulation of shale and tight sand reservoirs, 2) Evaluation of the relationship between changes in pumping rate and the size properties of the stimulated zone. 3) Methods and techniques for high resolution microseismic data analysis, 4) Design diagram for the next generation microseismic data acquisition, 5) Shale-specific production decline analysis software for hydraulically fractured shales and other unconventional resources, 6) A complete research quality dataset, 7) Final Report.	University of California, Berkeley Lawrence Berkeley National Laboratory Louisiana State University Octave Reservoir Technologies East Management LLC ATK Technologies
11122-27 Relationships between Induced Seismicity and Fluid Injection: Development of Strategies to Manage Fluid Disposal in Shale Hydrocarbon Plays	The University of Texas at Austin	$963,664 Mar 2015	An increased understanding of injection-induced seismicity will be determined. A reliable means for predicting when seismic activity might occur will be provided. Recommendations for managing the injection process such that objectionable seismic activity is prevented.	University of Texas Department of Petroleum and Geosystems Engineering
11122-31 Development of Plasma Technology for the Management of Frac/Produced Water	Drexel University	$1,574,685 Apr 2015	The validity of a novel plasma-induced water softening process will be Demonstrated and reported. A plasma-assisted self-cleaning filtration process for efficiently removing total dissolved will be developed. A coupled vapor-distillation process will be evaluated and reported.	Energy Onvector LLC Range Resources Layne Intevras Chevron Global Water Technologies

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
11122-42 Development of Methods to Prohibit and Remediate Loss of Annular Isolation in Shale Gas Wells: Prevention and Remediation of Sustained Casing Pressure and other Isolation Breaches	CSI Technologies	$4,166,881 24 months	A comprehensive report of improved technologies for inhibiting the loss of annular isolation and remediating techniques. Focus will include horizontal wells and address causes of sustained casing pressure.	University of Houston The Measurement Group Southwest Energy

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
11122-45 Reducing the Environmental Impact of Gas Shale Development: Advanced Analytical Methods for Air and Stray Gas Emissions and Produced Brine Characterization	GSI Environmental Inc.	$3,456,965 36 months	Scientifically-based protocols for sampling, analysis, and interpretation of data during monitoring and investigation of potential environmental impacts related to gas shale development will be delivered. Areas of investigation include: Emissions of volatile air contaminants from produced water impoundments, Impacts of methane and other gases on groundwater resources, and Improper treatment, disposal, or re-use of produced water due to insufficient analytical characterization.	Accutest Laboratories Cabot Oil & Gas Corp. Fred Baldassare, P.G., Echelon GE Analytical Instruments) Hach Company HOLT CAT M-I SWACO-Environmental Solutions Produced Water Absorbents (PWA) Range Resources Schlumberger Universal Geoscience Consulting Inc. (UGC) Alamo Area Council of Governments (AACOG) EFD Advanced Analytical Services Roundtable (EFD-AAS) Groundwater Protection Council (GWPC) Guadalupe-Blanco River Authority (GBRA) New York State Department of Environmental Conservation (NYS DEC) New York State Research Development Authority Ohio Department of Natural Resources (ODNR) Pennsylvania Department of Env. Protection (PaDEP) Texas Railroad Commission Texas Commission on Environmental Quality Houston Advanced Research Center (HARC) R. Paul Philp, University of Oklahoma (OU) Shikha Sharma, Ph.D., West Virginia University TAMU Agri-Life Extension Service (South Texas) TAMU School of Rural Public Health (SRPH)

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
11122-53 Advancing a Web-based Tool for Unconventional Natural Gas Development with Focus on Flowback and Produced Water Characterization, Treatment and Beneficial Use	Colorado School of Mines	$286,366 36 months	An enhancement to the existing online produced water management tool will be developed including: Enhanced functionality and user choices, enlarged comprehensive water quality database to include compositions of fracturing fluids, flow back, produced water, and baseline groundwater and surface water compositions for a variety of shale gas and tight gas plays.	Pioneer Natural Resources Emerging Products Technical Consulting LLC Tetra Tech, Inc Halliburton
11122-55 Development of GIS-Based Tool for Optimized Fluid Management in Shale Operations	Colorado State University	$1,106,049 Mar 2015	A GIS-based Optimized Fluids Management (OFM) tool will be developed and delivered. The tool will: Access and analyze industry, regulatory, public, and research databases, Utilize a computational engine to provide equilibrium chemistry predictions and treatment process designs for a given set of water quality data.	Noble Energy, Inc.
11122-56 Understanding and Managing Environmental Roadblocks to Shale Gas Development: An Analysis of Shallow Gas, NORMs, and Trace Metals (Texas)	The University of Texas at Austin, Bureau of Economic Geology	$1,291,318 24 months	A set of analytical tools to improve understanding of the sources and transport mechanisms for potential groundwater contaminants will be developed and delivered. Included will be natural gas, NORM and trace metals in Texas shale gas plays. A best management practices for fingerprinting contaminant sources and identifying mobilization mechanisms will be delivered.	University of Michigan

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
11122-57 Advanced Treatment of Shale Gas Frac Water to Produce NPDES Quality Water	Southern Research Institute	$1,838,831 24 months	a treatment process for flowback water that: combines magnetic ballast clarification (MBC) for removal of total suspended solids, metals, and naturally occurring radioactive material, and vortex-generating and nano filtration membranes for removal of suspended and dissolved solids will be feasibility investigated and reported.	M2 Water Treatment, Inc. BKT Viking International Resources
11122-60 Cost-Effective Treatment of Flowback and Produced Waters via an Integrated Precipitative Supercritical Process	Ohio University	$1,936,630 24 months	The performance of an integrated precipitative supercritical (IPSC) process for treating fracturing flowback and produced water incorporating solids filtering, ultra-violet light treatment, chemical precipitation, and an advanced supercritical water reactor for removal of ionic salts will be evaluated, and delivered.	Aquionics Parker Kilbarger Drilling Inc. Altier Bros. Inc.
11122-63 Petrophysics and Tight Rock Characterization for the Application of Improved Stimulation and Production Technology in Shale	Oklahoma State University	$1,529,166 24 months	Deliverables: 1) proposing new analytical methods to increase the reliability of analytical results 2) establishing protocols for laboratory testing and evaluation of stimulation fluids 3) developing a best practices manual for the evaluation of petrology, petrophysics, and fluid sensitivity in shale gas reservoirs	Chesapeake Energy Corporation G4 Resources Schlumberger Geological Survey of Alabama

Project	Awardee	Program Funding/ Complete Date	Deliverable	Other Participants
11122-71 Water Handling and Enhanced Productivity from Gas Shales	University of Southern California	$1,741,215 24 months	Deliverable = report; research will utilize a combination of laboratory tests, modeling, and field-scale activities, develop an improved understanding of the interaction between Marcellus shale matrix and water-based fracturing fluids in order to: optimize fracturing efficiency, and minimize need for fresh water.	Colorado School of Mines Stim-Lab: A Core Laboratories Company (SLB) Media and Process Technology, Inc. (M&P) Energy Corporation of America
11122-73 Development of Subsurface Brine Disposal Framework in the Northern Appalachian Basin	Battelle Memorial Institute	$1,834,021 Mar 2015	Deliverables = a framework for managing produced fluid disposal in the Northern Appalachian Basin that explicitly accounts for geology, reservoir dynamics, geomechanical issues, and subsurface effects of brine disposal. A second deliverable will be an assessment of the current water data bases and related websites across the U.S.	Kentucky Geological Survey, University of Kentucky NSI Technologies, LLC Ohio Oil Gathering Corporation Pennsylvania Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey West Virginia Geological and Economic Survey

SP Project Portfolio

Projects	Awardee	RPSEA Funding/ Completion Date	Deliverable	Other Participants
2007 Funding Year				
07123-01 Field Site Testing of Low Impact Oil Field Access Roads: Reducing the Footprint in Desert Ecosystems	Texas A&M University	$284,839 Dec 2013	Identify materials and processes that will lessen the environmental impact of oilfield operations	Rio Vista Bluff Ranch; Halliburton
07123-02 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
07123-03 Near Miscible CO_2 Application to Improved Oil Recovery for Small Producers	The University of Kansas	$274,171 Completed	Define the potential for CO_2 recovery or sequestration in near-miscible reservoirs	Carmen Schmitt
07123-04 Enhancing Oil Recovery from Mature Reservoirs Using Radial-Jetted Laterals and High-Volume Progressive Cavity Pumps	The University of Kansas	$248,385 Completed	Application of available technology to increase oil recovery while effectively disposing of water	Kansas Geological Survey; American Energies Corporation
07123-05 Cost-Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers	New Mexico Institute of Mining and Technology	$420,543 Completed	A process to purify produced water at the wellhead	Robert L. Bayless, Producer LLC; Harvard Petroleum Company
07123-06 Seismic Stimulation to Enhance Oil Recovery	Lawrence Berkeley National Laboratory	$723,373 July 2014	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
07123-07 Reducing Impacts of New Pit Rules on Small Producers	New Mexico Institute of Mining and Technology	$509,185 Completed	Access to online compliance data and automating permitting process	Independent Petroleum Association of New Mexico; New Mexico Oil Conservation Division
2008 Funding Year				
08123-02 Field Demonstration of Alkaline Surfactant Polymer Floods in Mature Oil Reservoirs Brookshire Dome, Texas	Layline Petroleum 1, LLC	$597,834 Completed	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
08123-07 Mini-Waterflood: A New Cost Effective Approach to Extend the Economic Life of Small, Mature Oil Reservoirs	New Mexico Institute of Mining and Technology	$224,624 Completed	Demonstrate the feasibility of waterflooding small oil reservoirs that are not conducive to a fully-developed, patterned waterflood.	Armstrong Energy Corporation; Keltic Wall Services
08123-10 Electrical Power Generation from Produced Water: Field Demonstration of Ways to Reduce Operating Costs of Small Producers	Gulf Coast Green Energy	$229, 796 Completed	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
08123-12 Evaluation and Modeling of Stratigraphic Control on the Distribution of Hydrothermal Dolomite Reservoir Away from Major Fault Planes	Western Michigan University	$393,369 Completed	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
08123-16 Development Strategies for Maximizing East Texas Oil Field Production	Bureau of Economic Geology, The University of Texas at Austin,	$700,000 June 2013	Exploration of short to midterm strategies for maximizing recovery from East Texas Oil Field.	Danmark Energy LP; John Linder Operating Co. LLC

Projects	Awardee	RPSEA Funding/ Completion Date	Deliverable	Other Participants
08123-19 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 Completed	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
2009 Funding Year				
09123-03: Field Testing and Diagnostics of Radial-Jet Well-Stimulation for Enhanced Oil Recovery from Marginal Reserves	New Mexico Institute of Mining and Technology	$656,537 Mar 2014	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
09123-09: Enhanced Oil 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
09123-11: 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
09123-14: Green Oil™ CO_2-Enhanced Oil Recovery For America's Small Oil Producers	Pioneer Astronautics, Inc.	$564,606 Aug 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

Projects	Awardee	RPSEA Funding/ Completion Date	Deliverable	Other Participants
09123-18: 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 Mar 2014	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.
09123-20: Creating Fractures Past Damage More Effectively With Less Environmental Damage	DaniMer Scientific, LLC	$350,000 Completed	Development of a more environmentally-friendly fracture fluid and technique for mature reservoirs.	CSI Technologies LLC; Texas A&M University
2010 Funding Year				
10123-03: Game Changing Technology of Polymeric-Surfactants for Tertiary Oil Recovery in the Illinois Basin	Power, Environmental, Energy Research Institute (PEER Institute)	$624,000 Mar 2014	Engineering calculations and an economic analysis that provide a basis for field implementation of a PS injection project in an oil field located in the Illinois Basin, yielding additional recovery from the existing resource.	American Energy Reserves
10123-17: Identifying and Developing Technology for Enabling Small Producers to Pursue the Residual Oil Zone (ROZ) Fairways of the Permian Basin, San Andres	The University of Texas of the Permian Basin	$838,340 Sep 2014	Delineation of the ROZ "fairways" in the Permian Basin of Texas and New Mexico and development of technology for finding the higher quality portions of the ROZ resource recoverable with CO_2 EOR.	Timberline Oil and Gas , Legado Resources, ER Operating, Tabula Rosa, and KinderMorgan, and The Enhanced Oil Recovery Institute, Petroleum Technology Transfer Council, Midland College's Petroleum Professional Development Center, and The Applied Petroleum Technology Academy, Midland
2011 Funding Year				

Projects	Awardee	RPSEA Funding/ Completion Date	Deliverable	Other Participants
11123-03: Cost-Effective Treatment of Produced Water Using Co-Produced Energy Sources Phase II: Field Scale Demonstration and Commercialization	New Mexico Institute of Mining and Technology	$677,736 Nov 2014	Scale up of a produced-water treatment process prototype that utilizes a humidification-dehumidification process and solar energy for a higher capacity.	Harvard Petroleum Corporation LLC
11123-08: Basin-Scale Produced Water Management Tools and Options – GIS based models and statistical analysis of shale gas/tight sand reservoirs and their produced water streams, Uinta Basin, Utah	Utah Geological Survey	$539,985 Oct 2014	Creation of Uinta Basin-wide, digital, produced-water management tools that integrate produced water character, water disposal/reuse alternatives, water transport requirements, and groundwater sensitivity factors to allow for quicker and more efficient regulatory and management decisions related to unconventional gas development.	Anadarko Petroleum; El Paso E&P; EOG Resources; QEP Resources; XTO Energy
11123-09: Upstream Ultrasonic Processing for Small Producers: Preventative Maintenance for Paraffin Management in Production Tubing Using Non-Invasive Ultrasonic Technology	Pacific Northwest National Laboratory	$752,500 24 months	Development and demonstration of an environmentally responsible and cost-effective ultrasonic alternative to hot oil treatments and resistive heating for preventing paraffin deposition in production tubing.	Falcon Exploration; Baker Hughes

Projects	Awardee	RPSEA Funding/ Completion Date	Deliverable	Other Participants
11123-14: Study and Pilot Test of Preformed Particle Gel Conformance Control Combined with Surfactant Treatment	Missouri University of Science and Technology	$863,453 Nov 2014	Demonstration of how a preformed particle gel (PPG) and a surfactant can be combined into one enhanced oil recovery process where the PPG element will preferentially enter fractures to reduce their permeability, while the surfactant will be squeezed into non-swept zones to reduce interfacial tension, alter wettability, and improve recovery.	Blue Top Energy, LLC; Colt Energy, LLC; TMD Energy; Baker Hughes
11123-15: Hybrid Rotor Compression for Multiphase and Liquids-Rich Wellhead Production Applications	OsComp Systems Inc.	$1,727,682 Jul 2014	Development and demonstration of a hybrid rotor compression technology that can be used as a multiphase compression solution for wet gas applications in small producer environments.	Red River Compression; Mertz Energy
11123-23: Field Demonstration of Eco-Friendly Creation of Propped Hydraulic Fractures	DaniMer Scientific, LLC	$1,618,968 Feb 2014	Development of a hydraulic fracturing treatment method that employs a biodegradable polymer for transporting proppant, requires less horsepower, is simpler to execute, has a smaller footprint, and requires less water.	CSI Technologies, LLC; Texas A&M University; EnerPol; Petroleum Technology Transfer Council; Ampak Oil Company

Projects	Awardee	RPSEA Funding/ Completion Date	Deliverable	Other Participants
11123-24: Reduction of Uncertainty in Surfactant-Flooding Pilot Design using Multiple Single Well Tests, Fingerprinting, and Modeling	The University of Oklahoma	$1,058,074 Jan 2015	Advance the technology of surfactant/polymer (SP) flooding, in particular for Oklahoma's Pennsylvanian-aged sandstone reservoirs and similar geological formations in other states that contain high total dissolved solids brines, through laboratory and field tests.	Mid-Con Energy Operating, Mid-Con Energy III, LLC
11123-28: Field Demonstration of Chemical Flooding of the Trembley Oilfield, Reno County, Kansas	Kansas University Center for Research	$1,524,714 Oct 2014	Design, test, and implementation of a chemical flood for the Trembley Field, in Reno County, KS, to demonstrate to the small-producer community the applicability of similar chemical flooding methods in other mature fields.	Berexco, Inc.; Huntsman Petrochemical LLC: SNF Holding
11123-32: Water Management in Mature Oil Fields using Advanced Particle Gels	The University of Texas at Austin	$903,746 Jan 2015	Advancement of the understanding of particle gel processes via lab experiments and development of a numerical simulation tool to optimize particle gel treatments designed to increase oil recovery and reduce water production.	Legacy Reserves; Hilcorp Energy Company

Appendix B: RPSEA 2013 Draft Annual Plan

The following page comprise the RPSEA 2012-2014 Draft Annual Plan submitted pursuant to EPAct Title IX, Subtitle J, Section 999B(e)(2)(A).

RPSEA 2012-2014 Draft Annual Plan

November 2011

www.rpsea.org

1650 Highway 6, Suite 325
Sugar Land, TX 77478

Table of Contents

Executive Summary

This document is the Research Partnership to Secure Energy for America (RPSEA) 2012-2014 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 2011, and in their development gathered extensive input through industry workshops, road mapping sessions, and expert opinion, including input from two Federal Advisory Committees (FACA). This DAP covers the period from 2012 through 2014 in order to consider factors that will be necessary to bring the program to a close by the current September 30, 2014 sunset date while still building a foundation for work that could be conducted beyond that date should the program be extended.

The 2012-2014 DAP is an evolutionary document which builds upon the foundation of the successful program developed as a result of the 2007 through 2011 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. Technology developed through this program is opening the door for safer development of ultra-deepwater resources, environmentally sensitive development of the tremendous shale gas resource within the U.S. and the responsible production of additional hydrocarbons from the mature fields that are operated by small producers throughout the nation. The chapters of this plan that describe each of the program elements include descriptions of specific projects that illustrate some of successful technology development efforts funded through the program. Highlights include the development of ultra-high conductivity umbilicals and other technologies that will reduce the number of surface facilities required for ultra-deepwater development, an award-winning program to decrease the environmental impact of onshore drilling and production operations, and projects to help small producers recover the thermal energy in produced fluids to lower energy requirements and purify produced water streams.

The success of any research and development program is appropriately judged by the extent to which the results are applied and commercialized. While the results from some of the earliest projects are just now reaching the preliminary application stage, the results of the program are very apparent at any of the professional conferences at which research relevant to the oil and gas industry is discussed. Over 230 reports, presentations and publications document the work conducted through the program, which is leading the way toward safe and responsible development of our nation's most prolific, if technically challenging, energy resources.

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 to ensure that the risks associated with the development of ultra-deepwater and unconventional resources are fully understood, and that the means are available to fully mitigate those risks with respect to both prevention and recovery. The 2011 approved Annual Plan submitted to Congress had a strong focus on safety and environmental sustainability, and this DAP maintains that focus while identifying some of the technology development needs that will be required for safe and responsible development of the targeted resources.

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 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. Each of the three RPSEA program portfolios, ultra-deepwater, unconventional resources, and small producer, has developed according to plan. The 2012 DAP continues that evolution to build upon the foundation of previous work to develop a portfolio that addresses evolving technology requirements.

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 through the advisory committees 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 and universities 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 years of the program, the RPSEA solicitation process has been able to generate qualified proposals for several times the amount of funding available, and the percentage of submitted proposals that are funded has continually decreased. 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., on the support for training the next generation of the workforce through funding U.S. universities, and on 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.

2012 - 2014 Planning

The development of technology that will enable safe development of resources in the ultra-deepwater Gulf of Mexico has been the cornerstone of **the Ultra-deepwater Program** since its inception. Not only will the application of this technology create U.S. jobs and add to the secure domestic energy resource base, but technology exports will benefit U.S. companies and universities as global ultra-deepwater resources are developed.

For 2012, the program will concentrate on nine safety and environmental sustainability topics including:

- Improved well control technologies and techniques
- Improved well design and construction
- Improved subsea ultra-deepwater measurement and monitoring instrumentation
- Improvements in flow assurance predictions
- Increased understanding of complex fluid phase behaviors that occur under conditions of extreme pressure and temperature
- Assessments and quantification of risks of environmental impacts from deepwater oil and gas exploration, drilling, and production activity on newly developed technologies
- Research on sensors, instrumentation, command electronics, and advanced data interpretation technologies
- Improved reservoir characterization and recovery methods
- Continued research and technology development and demonstration of certain previously identified concepts and needs.

This added emphasis on environmental and safety issues will be addressed through needs identified as a result of extensive analysis of the Deepwater Horizon incident by government, science, and industry organizations. The above topics will be tied to the following six UDW Mission Needs, which were originally developed by the UDW Program consortia members:

- 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 domestic unconventional gas resource has the potential to dramatically alter the energy picture in the U.S., but the technology being developed by the **Unconventional Resources Program** is critical to fully realize that potential. As attention turns toward shale gas resources around the world, the technologies developed through this program and applied to environmentally responsible development of domestic resources will keep U.S. companies and universities in the forefront of global unconventional resource development.

For 2007 through 2010 the program focused on three theme areas that targeted 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). For 2011, the focus on unconventional natural gas was 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 included specific efforts to more fully define the risks associated with unconventional gas development and ensure that appropriate technologies are available to mitigate those risks. This DAP builds on the safety and environmental sustainability themes of the 2011 Annual Plan submitted to Congress and identifies specific technology areas critical for the safe and responsible development of the substantial unconventional gas resources of the United States. Specific objectives are listed below:

- Minimize surface disruption associated with shale gas development. This includes not only well site construction, but includes air emissions, noise, visual impact and impact on surface water resources
- Ensure isolation of producing formations and wellbores from shallower formations, particularly near-surface aquifers
- Maximize the efficiency of hydraulic fracturing operations to ensure that the minimum amount of fluid is used to completely stimulate the reservoir zone and the need for refracture treatments is minimized
- Predict and mitigate induced seismicity associated with unconventional gas development, including hydraulic fracturing and injection well disposal
- Develop means for managing the fluid use associated with shale gas development. This includes understanding and minimizing the impact on regional water resources, the development of "green" drilling and fracturing fluids that minimize contamination concerns, the development of improved treatment and re-use options and the

- Demonstrate and integrate promising technologies to facilitate early utilization and commercialization

The mature assets that form the focus of the **Small Producer Program** represent resources for which the needed development infrastructure is already in place. Responsibly increasing production and recovery from these resources leverages the economic and environmental investment in that infrastructure and provides opportunities for the thousands of small energy producers located throughout the U.S.

For 2007 through 2011 the program targeted advancing technologies for mature fields, which primarily covers the technology challenges of managing water production, improving recovery, and reducing costs. Small producers operating mature fields 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. This DAP continues the theme of ensuring that the maximum production is obtained from the existing infrastructure associated with mature fields, while placing a particular emphasis on technologies that will decrease the environmental impact of Small Producer operations. Specific objectives for the 2012–2014 program years are listed below:

- Reduce cost and improve efficacy of well interventions and drilling
- Extend economic life of mature fields through environmentally safe efficiency improvements
- Mitigate environmental impacts in mature fields
- Reduce operating costs through more effective and efficient compliance with operating regulations

Chapter 1 Overview

Program Goals and Objectives

All RPSEA activities contemplated in this DAP are focused toward meeting the 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 describe the approach being used from 2012 through 2014 to ensure that the funds allocated in the program's final years are effectively deployed to meet this goal. Should the program be extended beyond the current sunset date, the activities described in the plan will form a solid basis for additional work toward the goal of maximizing the value of natural gas and other petroleum resources of the United States.

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 and unconventional natural gas.

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 to ensure that reserves and production from mature oil and gas fields are maximized while ensuring the least possible environmental impact.

In the draft of their report "Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources", released on September 15, 2011, the National Petroleum Council (NPC) has stated that "In a competitive global business environment, where companies have the ability to move capital around the world, a dependable and affordable supply of natural gas and oil is important for creating economic growth, investment, and jobs in the United States." It is the goal of the program described in this Plan to ensure that the technologies necessary to provide that "dependable and affordable supply" in a safe and environmentally responsible fashion are available to domestic producers, while developing the skilled workforce that will maintain the United States in a global leadership position with regard to critical energy technology.

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 2005 to 2009, annual worldwide ultra-deepwater (defined as 1,500 meters or more water depth) hydrocarbon discoveries accounted for roughly half of all discoveries—onshore and offshore (Figure 1.1).

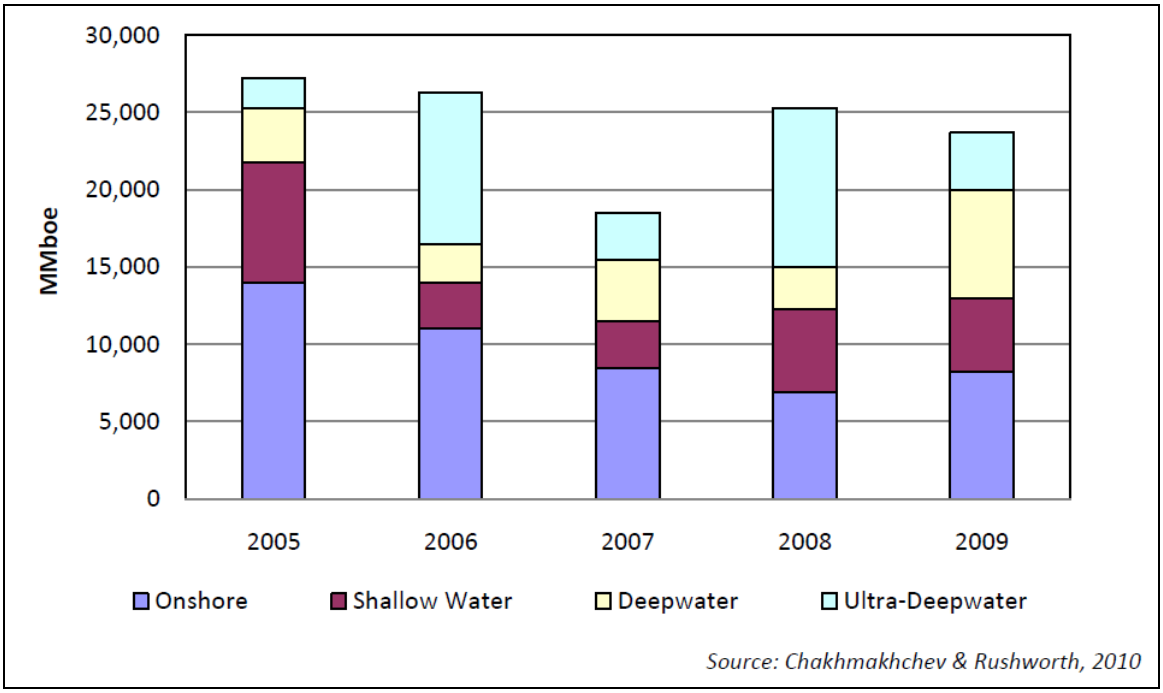


Figure 1.1: 2005 – 2009 Annual Ultra-deepwater Hydrocarbon Discoveries

In the U.S. overall offshore Gulf of Mexico (GOM) production accounted for 30 percent of U.S. crude oil production in 2009. 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 three 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 one 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. This plot shows the contribution that the deepwater GOM is projected to make to domestic energy production over the next decade.

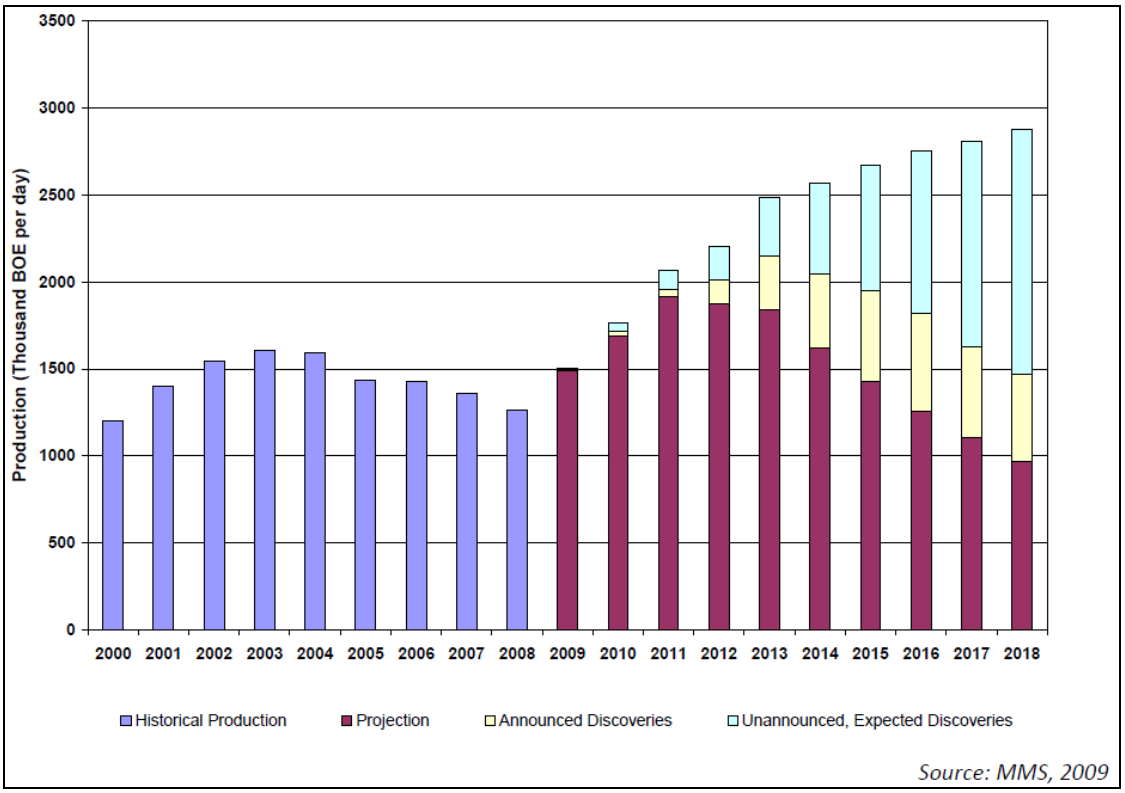


Figure 1.2: 2000 – 2018 Annual Deepwater Hydrocarbon Discoveries and Projections

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.

Technological advances related to preventing and mitigating environmental impacts.

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. The National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling report to the President highlighted the degree to which technological advances in the prevention and mitigation of environmental impacts have not kept pace with advances that have focused on commercializing oil and natural gas offshore. The report recommended that this research program be refocused on safety. 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. operating companies and technology developers maintain a focus on technologies that can help minimize environmental impacts cost effectively. Domestic oil production will continue to play an important role in our Nation's energy security, and oil and gas operations must be performed 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. 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.

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). 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.

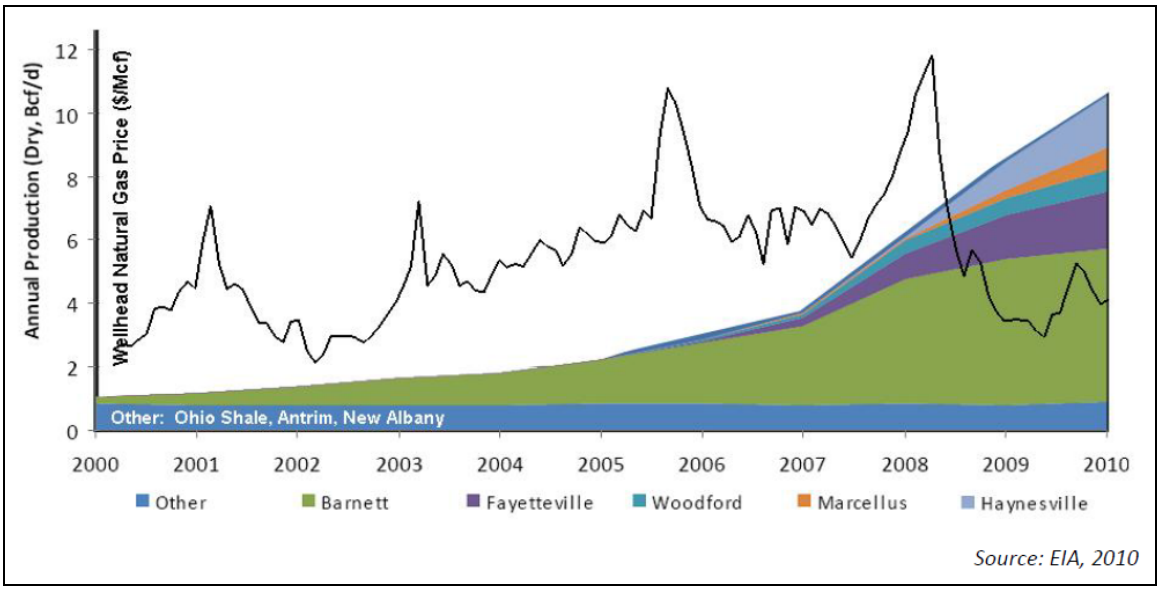


Figure 1.3: 2000 – 2010 Annual Shale Gas Production Rates and Natural Gas Prices

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 ground water aquifers during hydraulic fracturing
- evaluation of the safety of chemicals used in hydraulic fracturing
- evaluation of the potential for seismic activity associated with hydraulic fracturing or injection in disposal wells
- environmental impacts resulting from the treatment and/or disposal of produced or fracturing flowback water and other liquid or solid wastes
- air quality impacts resulting from increased drilling, natural gas production, and truck transportation activity
- impact of access roads and well sites
- community issues surrounding high pressure fracturing operations in populated areas, including safety, noise, dust, traffic, stress on existing infrastructure, etc.

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. It will also require the

accurate, timely and objective dissemination of this information. The movement of the program toward the integration of technical results and the demonstration of their application in actual development situations will be critical in accelerating the adoption of improved technical solutions and assuring the public and other stakeholders of the efficacy of these solutions.

The research conducted in accordance with this DAP will complement the efforts of other agencies and organizations to ensure that these issues are addressed and the potential positive impact of the shale gas resource is fully realized. RPSEA's active technology transfer network involving members, contractors and outreach activities can contribute to increasing public confidence in safe and responsible shale gas development.

Safety and Environmental Awareness

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 industry and government efforts under way to understand and evaluate the risks associated with ultra-deepwater operations. RPSEA members are active in these efforts. RPSEA members have also been active in similar efforts associated with the development of shale gas and hydraulic fracturing. These include serving on the Secretary of Energy Advisory Board Shale Gas Subcommittee and contributing to the NPC report to the Secretary, "Prudent Development – Realizing the Potential of North America's Abundant Natural Gas and Oil Resources". The sections of this DAP describing each program element are informed by relevant elements of these studies and 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

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 engagement of 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 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. As such, RPSEA:

- Works with universities and other researchers to ensure that new technical advances are directed and applied toward the key challenges associated with ultra-deepwater and unconventional resource development in the U.S.
- Works with industry to enhance technology transfer and deployment, demonstrating technology utilization as technologies are developed
- Coordinates outreach efforts to ensure that the results of successful trials and experiments are made widely available
- 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 end user 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". 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. This is a tenet that industry must embrace in order to maintain a license to operate with the required access to our resources. 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. This Annual Plan reflects the additional effort that will be directed toward addressing and 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. The status of RPSEA as a public-benefit

organization with active engagement of industry, universities and other stakeholders provides a unique opportunity for making a significant near-term impact on the safety and reducing the potential environmental impact of oil and gas development operations.

RPSEA's research portfolio has been designed to be balanced in order to include projects that focus on near-, mid-, and longer-term metrics; as successful and promising projects progress, RPSEA is committed to assuring these promising technologies are applied and commercialized. 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
- Focus, as the portfolio matures, on a relatively fewer number of larger and/or higher potential impact 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 expertise and technologies outside of the natural gas and oil industry that may have application to help achieve the mission of the Program
- Assure safety and environmental protection goals are addressed and documented – this also assures new technologies will achieve faster regulatory approval
- 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 through increased supplies leading to lower and more affordable commodity prices. Innovative and cost-effective technologies will be required to realize the promise of large emerging energy supplies. 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 1.4. This strategic triangle developed by the Strategic Advisory Committee (SAC) conveys Program timeframes against the spectrum of technology development levels, from basic to applied technologies. 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 2012, the RPSEA program has moved upward in the triangle depicted in Figure 1.4. 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. At the same time, some projects in new areas will be initiated to address critical needs that have developed since the inception of the program. This DAP will outline the work to be accomplished through the program sunset date in 2014, and will form the basis for updates to the DOE plan in 2013 and 2014. Should the sunset date be changed to align with the ten year program duration specified in EPACT, subsequent revisions of this plan will detail the approach planned to build on the results of work accomplished through 2014. The results of the program detailed in this DAP should form a solid basis for future technology development well beyond the current sunset date. Planning now for the effective use of 2013-2014 program year funds will allow the program to maximize its impact through the 2014 sunset 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.

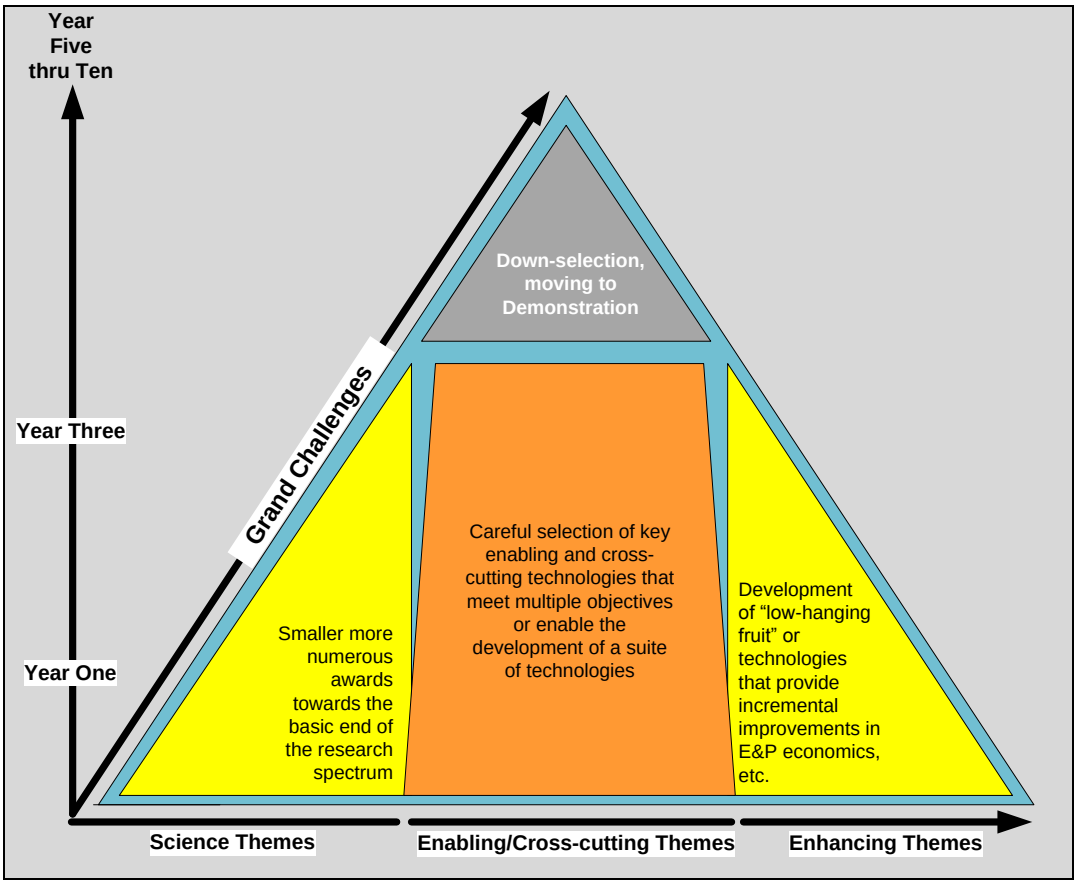


Figure 1.4: SAC Research Portfolio Guidance

Draft Annual Plan Organization

Following the structure of the strategic triangle in Figure 1.4, this DAP builds upon the foundation laid by the 2007 through 2011 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 2011 Annual Plans as follows:

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

Intertwined with the success of past years' projects will be a strong bias towards the safety and environmental impacts of future endeavors. Both improved safety and reduced environmental impact will be the key focus of this DAP. Risk identification, assessment, and mitigation will be included in the methodologies used to achieve these goals.

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 Board of Directors (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

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 the NETL Office of Research and Development (ORD).

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. First and foremost are jobs. Three recent studies highlight this: An API commissioned study by PricewaterhouseCoopers showed that the oil and gas industry contributed 9.2 million jobs to the U.S. economy, with over 2.5 million in the upstream oil and gas sector. While manufacturing and other industries have been losing jobs, the upstream oil and gas industry has been adding jobs in spite of the Gulf of Mexico moratorium. An IHS study for the Independent Petroleum Association of America (IPAA) stated that workers for U.S. independents were paid $148 billion in compensation and paid $30 billion in federal, state and local taxes; coupled with independent companies corporate and severance taxes, the total contribution was $67.7 billion in taxes paid in 2010. A 2011 Wood Mackenzie report stated that the U.S. should add over 1 million new upstream jobs by 2018 and pay an additional $800 billion in taxes.

In addition, new federal royalty and tax 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 of about 2.4% to the gross national product and add to domestic energy security. Technically challenging resources cannot be fully exploited to their full public economic and security benefit potential without the necessary technology.

In the letter to the Secretary of Energy included with the draft report "Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources", released by the National Petroleum Council on September 15, 2011, the following four conclusions are drawn:

"First, the potential supply of North American natural gas is far bigger than previously thought. It is now understood that the natural gas resource base is enormous and that its development, if carried out in acceptable ways, is potentially transformative for the American economy, energy security, and the environment, including reduction of carbon and other emissions. These resources could meet high projections of demand.

Second – and surprising to many – North America's oil resources are also much larger than previously thought. These oil resources offer substantial supply for decades and could help the United States reduce, though not eliminate its reliance on imported oil.

Third, natural gas and oil resources will be needed even as energy efficiency reduces demand and lower carbon alternatives become more economically available on a large scale. Moreover, the natural gas and oil industry is vital to the U.S. economy, generating millions of jobs, widely stimulating economic activity, and providing significant revenues to governments.

Fourth, realizing the benefits of natural gas and oil depends on environmentally responsible development. The nation can realize the benefits of these larger resources by ensuring they are developed and delivered in a safe, responsible, and environmentally acceptable manner in all circumstances."

The program outlined in this plan is specifically directed toward developing the technology that will attract additional industry investment in the development of these large but economically marginal resources. The impact of public research funding in attracting industry development investment has been clearly established. Back in 1982, the U.S. Department of Energy in collaboration with the Gas Research Institute (GRI, now the Gas Technology Institute), led the world's first effort to develop unconventional gas resources with a research program targeting coalbed methane. GRI managed a collaboration of experts from industry and academia that evolved throughout the 1980's and generated the advancements enabling 12% of U.S. gas supplies today coming from coalbed methane (CBM). This R&D funding occurred in advance of industry's heavy involvement and so set the stage for the developments to come. For example, the Coalbed Methane R&D program provided $30 million in funding from 1978 to 1982 with production starting just a couple years after this. The Shale Gas R&D program provided $137 million from 1978 to 1992 and again production started just a couple years later. Figure 2.1 illustrates the relationship between the early R&D investment by DOE and CBM and shale gas production in the U.S. This program will enable R&D to continue to reduce the cost and environmental footprint of development of these resources to insure this development is sustainable for the long-term.

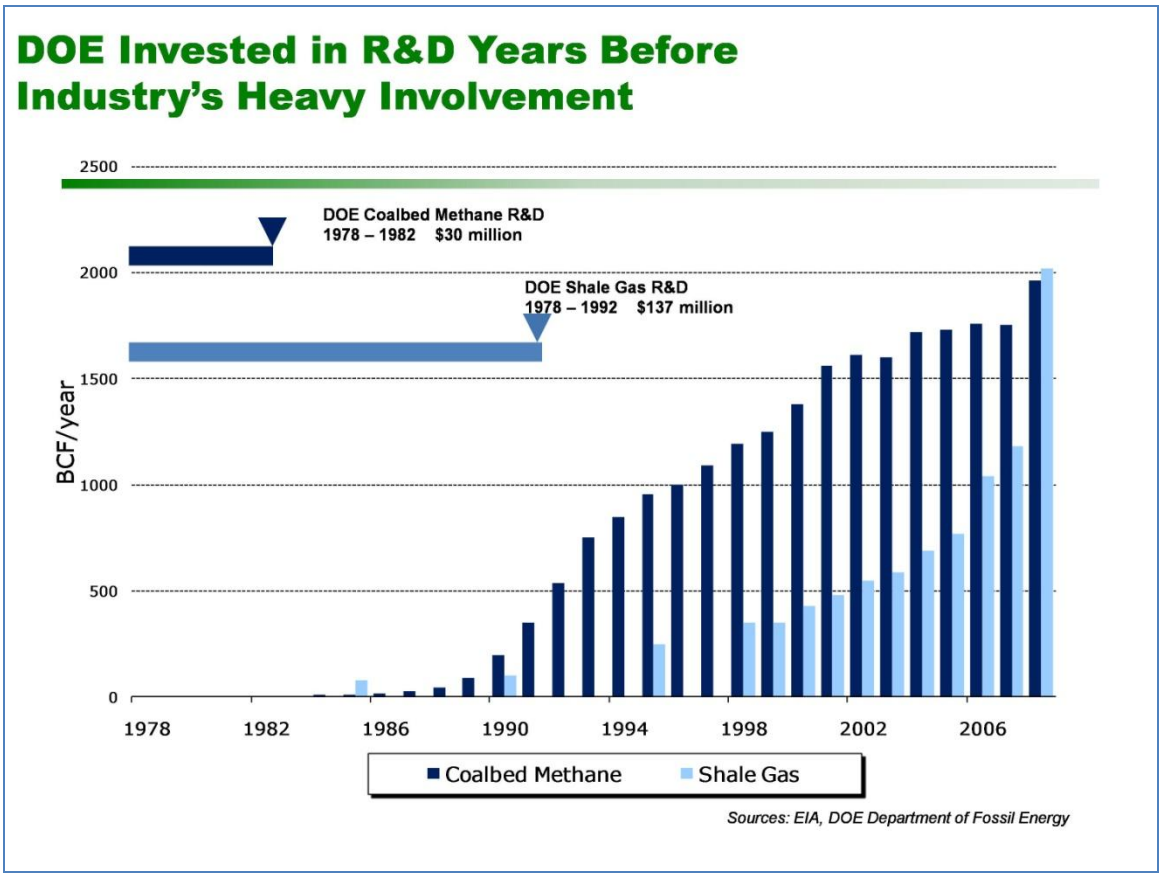


Figure 2.1: Past DOE Investment in Unconventional Gas R&D

In addition to CBM and gas shale research, DOE funded a tight gas research program (*Western Tight Gas Sand Program*). DOE expenditures in the Western Tight Gas Sand program from 1978 to 1999 amount to $185 million. The program peaked in 1981 at $21 million. The program included both basic and applied research with a strong field-based component. Field-based research was conducted in the Piceance Basin of Western Colorado at a multi-research well location called the MWX research site. Much of the tight gas sand production in the Western U.S. today is attributable to the fundamental findings established at the MWX site with regard to tight gas flow through a low permeability porous media.

The technologies generated from these investments are now deployed throughout the U.S. and available to other countries now looking to develop their resources. The result of the development and implementation of these technologies is that the U.S. energy picture has been transformed. In 2002, there were 47 liquefied natural gas (LNG) terminals in permitting in preparation for looming shortages. Six short years later, the view had changed dramatically. Many of these facilities are idle or considering conversion to LNG export facilities. Unconventional gas developed from several resources across the country now represents 46% of U.S. production. Shale is the fastest growing fraction and several basins hold additional potential for drilling beyond those already being developed. Every time the level of technically recoverable resource has been reassessed, advances in technology and understanding of

resource potential has increased the amount to the degree that the U.S. has the potential to be self-sufficient with 100 or even 200 years of technically recoverable resources identified. Shale gas alone is projected to make up 45% of U.S. supply by 2030.

The shale gas revolution in the U.S. was driven by independent producers working in cooperation with the federal government with support of universities and support organizations like GRI and RPSEA. The role of technology developments that started this revolution is not done. Continuing to reduce the cost and environmental footprint of production will enhance the sustainability of these gains.

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 170 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 toward 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 and vetting of R&D projects to be awarded and the review of project results. **Collectively, this network has accounted for approximately 37,200**

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 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 small and large 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 relationships 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 2.2. RPSEA is the consortium competitively selected by the Department of Energy (DOE) to administer three program elements of Section 999. Information on RPSEA and its members can be found at this link, RPSEA Members.

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

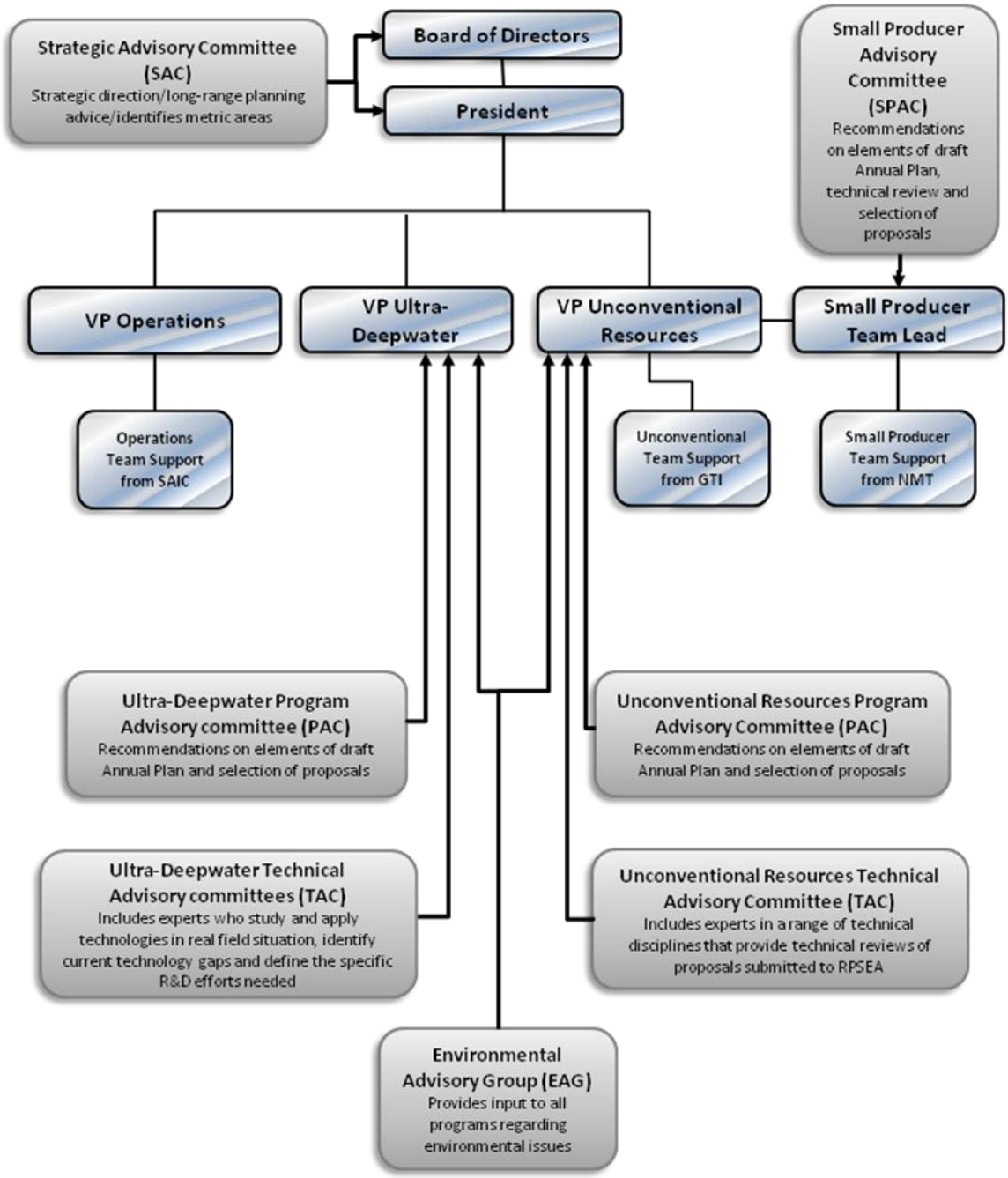


Figure 2.2: Organization of RPSEA and Advisory Committee Relationships

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 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 awareness 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. Upon request, the EAG conducts workshops and 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.

Program Advisory (PAC) and Technical Advisory (TAC) Committees - The roles of the PACs and TACs within each program are further defined in Chapters 4 through 6, 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 Advisory Committee (SPAC) - The Small Producer Program receives guidance from the SPAC consisting of industry and academic representatives that are closely tied to the national small producer community. The SPAC 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 SPAC annually.

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

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. In view of the approaching sunset date for the program (September 30, 2014), this draft Annual Plan will cover the 2012 through 2014 program years.

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.

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

- RPSEA member forums, conferences, and workshops held in various regions of the country. These events have drawn thousands of individual participants representing multiple organizations with interests in technologies to enhance safe and environmentally responsible domestic natural gas and oil production.
- The UDW TAC meetings that are an integral part of the management of the UDW program element.
- 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 SPAC for general guidance and project selection, the various TACs and the SPAC 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

Chapter 3 RPSEA Accomplishments

The primary accomplishment of the RPSEA program lies in the technical results of the projects funded through the program, which are impacting the safe and responsible development of emerging resources throughout the U.S. These results are highlighted in the chapters covering each of the program elements, Ultra-deepwater (Chapter 4), Unconventional Resources (Chapter 5) and Small Producer (Chapter 6). This chapter discusses some of the key organizational accomplishments that have enabled a successful technical program.

A key organizational accomplishment is the engagement of technical experts across the spectrum of disciplines and stakeholder organizations to form an active research program developing new technology that meets the goals of the overall program. RPSEA has made significant organizational progress, as noted by the accomplishments listed below, toward these high-level goals.

- Commenced a restructuring of RPSEA management and an internalization of the Section 999 Program management subcontractors into RPSEA
- Developed a federally compliant set of policies and procedures (including management and operating plans) specifically for administering Section 999 of EPAct
- 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
- Developed successful partnerships that give potential Small Business suppliers the opportunity to meet and present their capabilities and qualifications to RPSEA's procurement staff and technical management team
- Launched a new, content-rich website to support strategic communications, technology transfer, and the solicitation process
- Established a comprehensive advisory committee and working project group network
- Provided drilling management and oil spill response technologies testimony to the House Subcommittee on Energy and the Environment
- Entered into a contract with the Petroleum Technology Transfer Council (PTTC) to provide a multi-pronged package of technology transfer services that, through synergy, will deliver results beyond that of any single technology transfer service for the dissemination of knowledge
- Developed a cost-effective technology transfer opportunity for booth poster presentations at conferences where principle investigators can display their project development success
- Built support among oil and gas research and industry constituencies
- Increased membership within the different oil and gas community stakeholder groups. RPSEA currently has over 170 members.

- Co-hosted seven project workshops with principle investigators of RPSEA funded projects to disseminate project results in an effective and efficient manner
- Promoted links to other associations and members by utilizing the RPSEA website as a "network of networks"
- Utilized and cooperated with the successful Petroleum Technology Transfer Council (PTTC) organization to assist in technology transfer activities.
- Met with the Geological Society of America, American Association of Petroleum Geologists and the Society of Petroleum Engineers to discuss working together to develop and maintain student interest in an engineering, geology or geophysics vocation
- Conducted 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 2011 Draft Annual Plans, which were the bases for the approved Program Annual Plans transmitted to Congress.
- Developed and issued research solicitations for Program years 2007 through 2010
    - Received and reviewed 387 research proposals, made 99 project selections and successfully negotiated and awarded 96 contracts (this does not include project selections for the Unconventional Resources and Small Producer Programs for 2010 nor the UDW proposals received or selected for 2010)
- Established a Fellowship/Scholarship Program with private funding of $255,000 for eight member universities, providing much needed support for 48 students
- Established a RPSEA summer internship
- Hosted multiple membership meetings
- Hosted five Program technology conferences across the United States which were attended by approximately 650 people where researchers presented project progress, technical challenges and technology benefits to participants in an interactive meeting environment
- Held 29 nationwide member technology input forums
- Established RPSEA Lunch and Learn talks at member organizations
- Participated/exhibited and/or sponsored/supported 170 oil & gas industry functions (functions are individually listed below in the Technology Transfer and Outreach section)
- 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 Offshore Technology Conference (OTC) Supporting Organization during 2010
- Sponsored the Young Professionals in Energy (YPE) website

- Sponsored the development of the Oil & Gas Innovation Center and the 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.

Completed Research Awards

While all projects have not been selected for 2010, to date 110 projects have been choosen for funding consideration. As of November 1, 2011, RPSEA has successfully managed 23 of these projects to completion. Information regarding the technical accomplishments associated with these projects is included with the program element discussions in Chapters 4-6. Table 3.1 lists these projects along with the subcontractor's name.

Project Title	Subcontractor	Project Number
Wax Control in the Presence of Hydrates	The University of Utah	07121-1201
Ultra-High Conductivity Umbilicals Program	NanoRidge Materials, Inc.	07121-1302
Ultra-Deepwater Dry Tree System for Drilling and Production	FloaTEC, LLC	07121-1402a
Ultra-Deepwater Dry Tree System for Drilling and Production	Houston Offshore Engineering	07121-1402b
Coil Tubing Drilling and Intervention System Using Cost Effective Vessel	Nautilus International, LLC	07121-1502-01
Flow Phenomena in Jumpers-Relation to Hydrate Plugging Risk	The University of Tulsa	07121-1603a
Hydrates Characterization & Dissociation Strategies	The University of Tulsa	07121-1603b
Design Investigation of Extreme High Pressure, High Temperature, (xHPHT), Subsurface Safety Valves (SSSV)	William Marsh Rice University	07121-1603c
Development of a Research Report and Characterization Database of Deepwater and Ultra-Deepwater Assets in the Gulf of Mexico, including Technical Focus Direction, Incentives, Needs Assessment Analysis and Concepts Identification for Improved Recovery Tech	Knowledge Reservoir, LLC	07121-1701
Effect of Global Warming on Hurricane Activity	National Center for Atmospheric Research	07121-1801

Project Title	Subcontractor	Project Number
Subsea Systems Engineering Integration	GE Global Research Center	07121-1901
Deep Sea Hybrid Power Systems: Ultra-Deep Water	Houston Advanced Research Center	07121-1902
Novel Concepts for Unconventional Gas		

An Integrated Framework for the Treatment and Management of Produced Water	Colorado School of Mines	07122-12
New Albany Gas Shale	Gas Technology Institute	07122-16
Geological Foundation for Production of Natural Gas from Diverse Shale Formations	Geological Survey of Alabama	07122-17
Enhancing Appalachian Coalbed Methane Extraction by Microwave-Induced Fractures	The Pennsylvania State University	07122-27
Optimization Of Infill Well Locations In Wamsutter Field	The University of Tulsa	07122-43
Preformed Particle Gels For Mitigating Water Production And Extending the Life of Mature Oil Wells and Further Improve Particle Gel Technology	Missouri University of Science and Technology	07123-02
Near Miscible CO_2 Application to Improve Oil Recovery for Small Producers	University of Kansas	07123-03
Early Reservoir Appraisal Utilizing a Well Testing System	Nautilus International, LLC	08121-2501-02
Modeling and Simulation of Managed Pressure Drilling for Improved Design, Risk Assessment, Training and Operations	Stratamagnetic Software, LLC	08121-2502-01
Mini-Waterflood: A New Cost Effective Approach to Extend the Economic Life of Small, Mature Oil Reservoirs	New Mexico Institute of Mining and Technology	08123-07

Table 3.1: Completed Research Awards

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 almost tripled since January 2007, growing from 66 members to the current membership of 177 members as of September 30, 2011 (Figure 3.1). These members represent 24 states, the District of Columbia, and the Provinces of Newfoundland and Alberta, Canada. 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.

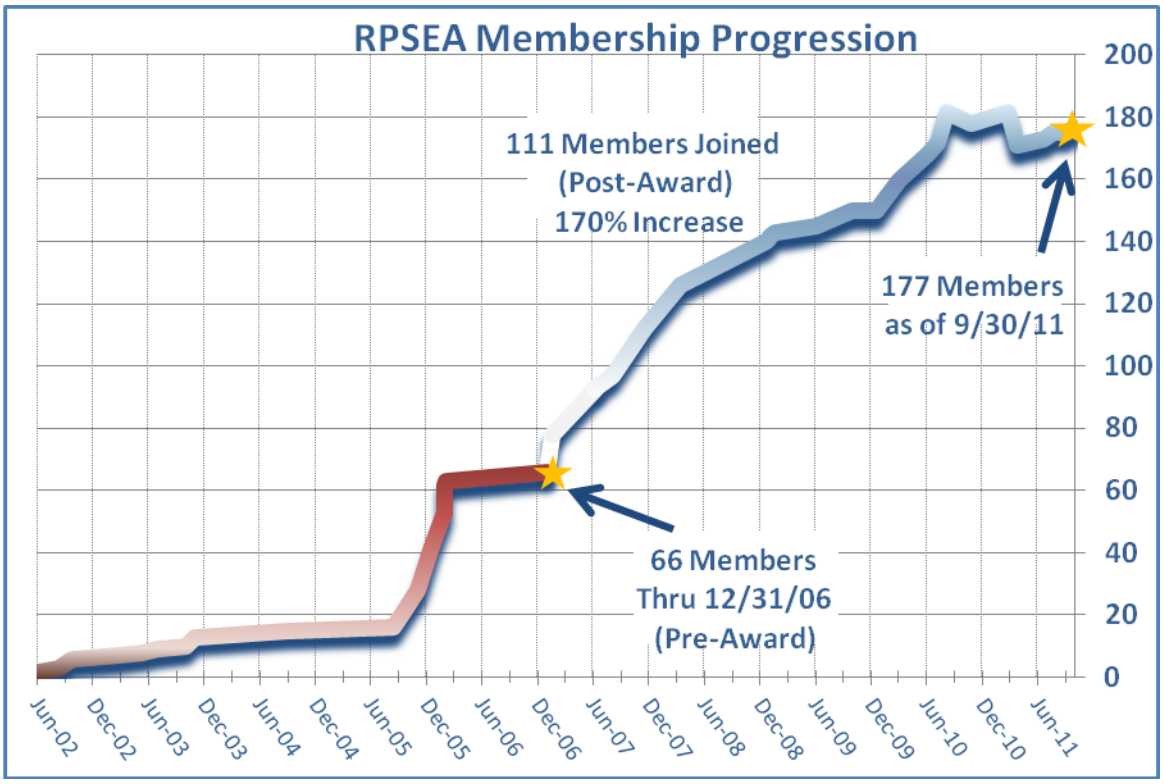


Figure 3.1: RPSEA Membership Progression

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:

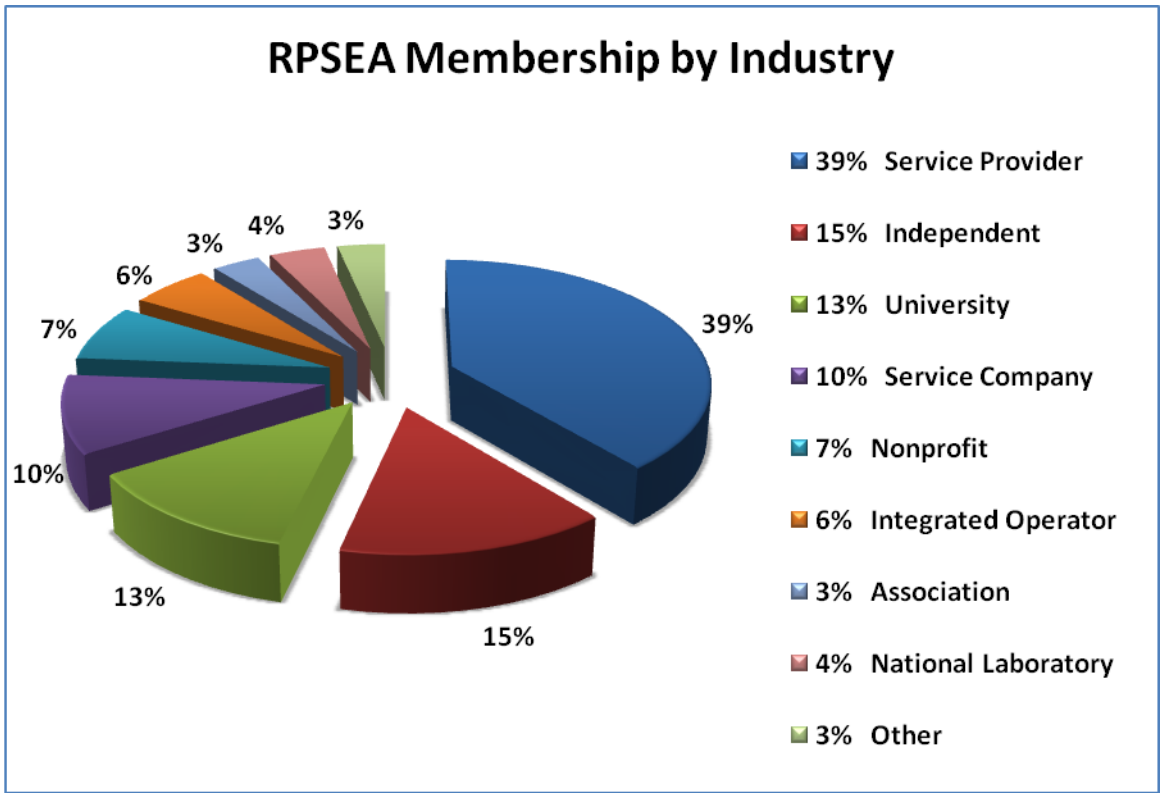


Figure 3.2: RPSEA Membership by Industry

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 SPAC have been the workhorse committees. In the overall process there have been 202 meetings with 4,212 participants who have volunteered approximately 37,200 hours of time and effort. As an example, the Ultra-Deepwater (UDW) PAC and TACs, combined, have met 117 times with 2,438 participants involving over 7,500 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 & Workshops

RPSEA, in conjunction with other organizations or alone with our member institutions, has broadly reached out to involve the oil and gas community through an outreach program of technology forums to address specific challenges and technology needs for resource themes. These forums have been held 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. This unique aspect of RPSEA allows the forum participants to prioritize those ideas that they feel should be addressed. In addition to the forums, RPSEA, during 2011, began to co-host workshops to disseminate results of RPSEA funded projects. To date seven workshops have been held. These workshops are an effective, low-cost means of reaching out to the oil and gas community to ensure that there is awareness of the new technological advances being developed by RPSEA funded projects. All totaled, 36 forums and workshops have been held in which 1,954 people have participated. This participation amounts to over 15,600 hours of participant commitment and does not include the time, effort, and monetary support from the host organization that has been substantial in all cases.

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

Member Forums & Workshops	Host	Date
Ultra-Deepwater		
Improvements to Deepwater Measurement Workshop	Letton Hall Group	6/20/2011
Composite Reinforced Ultra-Deep Drilling Riser Technology Transfer Workshop	Stress Engineering and Lincoln Composites	5/5/2011
Research and Technology Needs for Deepwater Development – Addressing Oil Recovery and Effective Cleanup of Oil Spills Forum	Houston Advanced Research Center	7/22/2010
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	1/11/2007

Member Forums & Workshops	Host	Date
	Technology	
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		
Accessible Software Developed for Application to Unconventional Resources Workshop	Lawrence Berkeley National Lab at the University of Houston	6/30/2011
Piceance Basin, Mamm Creek Field Project Review Workshop	Colorado School of Mines at Williams Exploration	4/21/2011
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		
Shale-Gas and Tight-Gas-Sand Reservoirs of Utah Core Workshop	Utah Geological Survey	7/13/2011 – 7/14/2011
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
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		

Member Forums & Workshops	Host	Date
Focusing on Environmental Issues Associated with Unconventional Natural Gas Operations Workshop	Houston Advanced Research Center	8/18/2011
Lo[illegible]	West Virginia University	7/26/2011
Natural Gas, The Path to Clean Energy Forum	Texas A&M University	11/18/2010
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 3.2: RPSEA Forums and Project Workshops

In addition to the theme-based member forums listed above, the UDW also 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

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 by RPSEA. To this end, RPSEA seeks to participate or exhibit at multiple industry functions to engage with industry stakeholders and to disseminate information on RPSEA. RPSEA has participated, exhibited, sponsored, or otherwise supported 170 industry functions:

American Association of Drilling Engineers Annual Conference 2011

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 2011

American Association of Petroleum Geologists (AAPG) Eastern Section Gas Shales Workshop 2011

American Association of Petroleum Geologists (AAPG) Eastern Section Meeting 2011

American Association of Petroleum Geologists (AAPG) Rocky Mountain Section Meeting 2010 and 2011

American Institute of Chemical Engineers (South Texas Section) 2008

American Rock Mechanics Association Workshop 2007 and 2011

Annual Convention of the Gulf Coast Association of Geological Societies 2007

Annual Gas Shale Summit 2008

Aspen Science Center Critical Path Energy Summit 2010

Barnett Shale Produced Water Conference 2007

BOEMRE Information Transfer Meeting 2011

BOEMRE Offshore Energy Safety Advisory Committee 2011

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 20011

CO_2 Flooding Conference 2007 through 20010

DeepGulf Conference 2010

Deep Offshore Technology (DOT) and Demo2000 Conference 2007

Developing Unconventional Gas (DUG) 2007through 2011

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

Environmentally Friendly Drilling System – Europe 2010

Florida Independent Petroleum Producers Association (FLIPPA) Annual Meeting 2007

Gas Shales Summit 2008 and 2010

Geological Society of America (GSA) Annual Conference 2009 and 2010

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 Gas Processors Association 2010

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 Association of Drilling Contractors (IADC) Health, Safety, Environment & Training Conference 2011

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

Interstate Oil and Gas Compact Commission (IOGCC) Woodford Summit 2011

Louisiana Oil and Gas Association (LOGA) 2009

Marine Technical Society 2008

Massachusetts Institute of Technology Natural Gas Advisory Committee 2008 through 2010

Massachusetts Institute of Technology CO_2 Enhanced Oil Recovery Symposium 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) 2007 through 2011

Offshore Technology Conference (OTC) 2007 through 2011

Oklahoma Clean Energy Commission 2010

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

Oklahoma State University Energy Conference 2010

Pennwell Unconventional Gas Conference 2009 and 2011

Re-energize America Conference 2010

Residual Oil Workshop 2009

Rice Alliance Business Plan Competition 2008 and 2009

Rice Alliance Energy and Clean Technology Venture Forum 2007 through 20010

Rice Nanotechnology Venture Forum 2008 and 2009

Rice University Congressional Field Hearing 2008

Rocky Mountain Energy Epicenter Technology Conference 2008 through 2011

Science Engineering Fair of Houston 2008 through 2010

Society of Exploration Geophysicists (SEG) Annual Meeting 2007 through 20011

Society of Petroleum Engineers (SPE) Workshop on Delivering and Using Emerging Technology in the E&P Business 2009

Society of Petroleum Engineers (SPE) Colloquium on Petroleum Engineering Education 2010

Society of Petroleum Engineers (SPE) Hydraulic Fracturing Conference 2011

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) National Academy of Engineering Gulf of Mexico Ultra-Deepwater Drilling & Completions Regulations Summit 2011

Society of Petroleum Engineers (SPE) Annual Technical Conference Exhibition 2007 through 20010

Society of Petroleum Engineers (SPE) Deepwater Completions & Operations Symposium 2011

Society of Petroleum Engineers (SPE) Digital Energy Conference 2009

Society of Petroleum Engineers (SPE) North American Unconventional Gas Conference 2011

Society of Petroleum Engineers (SPE) Eastern Regional Meeting 2011

Society of Petroleum Engineers (SPE) Gulf Coast Section General Meeting 2011

Society of Petroleum Engineers (SPE) Tight Sands Workshop 2009Society of Petroleum Engineers (SPE) E&P Health, Safety, Security & Environmental Conference 2011

Southern Methodist University Geothermal Conference 2009 and 2011

Subsea Tieback Forum 2010 and 2011

Sustainable Opportunities Summit 2010

SW Petroleum Show 2008

Texas Alliance Expo and Annual Meeting 2008 through 2011

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

Unconventional Resources Conference 2011

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

U.S. – Mexico Border Energy Forum 2009

Washington Post Energy Conference 2007

West Slope Colorado Oil & Gas Association (WSCOGA) Annual Meeting 2010

World Energy Technology Summit 2010

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

Fellowship/Scholarship Program

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, RPSEA has awarded 48 scholarships to date to the following 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.

Schlumberger $210,000					
2007-08		**2008-09**		**2009-10**	
West Virginia University - $30,000 over 3 years - $10,000 per year					
Ryan Tyree	$5,000	Ryan Tyree	$5,000	Mohammed Ashfaq	$5,000
Matthew Imrich	$5,000	Ross Schweitzer	$5,000	Ahmed Yusuf	$5,000
Texas A&M University - $30,000 over 3 years - $10,000 per year					
Yunan Wei	$5,000	Yunan Wei	$5,000	Yunan Wei	$5,000
Sara Old	$5,000	Sanghoon Lee	$5,000	Kun Cheng	$5,000
Colorado School of Mines - $30,000 over 3 years - $10,000 per year					
David Wilson, Sr.	$5,000	Colin Melvin, Sr.	$5,000	John (Essau) Worthy-Blackwell	$5,000
Stephanie Kristen Swaim	$5,000	Sarah Devriese	$5,000	Catherine (Katie) Cox	$5,000
The University of Texas at Austin - $30,000 over 3 years - $10,000 per year					
Geo-Science					
Kersten Wallace	$5,000	Matthew Prudhomme	$5,000	Kersten Wallace	$5,000
Petroleum Engineering					
Donovan Kilmartin	$5,000	Kyle Tipley	$5,000	Walter B. Fair, Jr.	$5,000
Louisiana State University - $30,000 over 3 years - $10,000 per year					
Benjamin Mark Bates	$5,000	Lauren Nicole Fogarty	$5,000	Peyton Keith Tippett	$5,000
Courtney Elizabeth Sample	$5,000	Joseph Jules Sabrier IV	$5,000	Noah Scott McGill	$5,000
The University of Oklahoma - $30,000 over 3 years - $10,000 per year					
Oyetunde Oyewole Oyewo	$5,000	Olugbemiga Segun Adjoke	$5,000	Alisan Templet Sweet	$5,000
Gregory Dean	$2,500	Quinn Flock	$5,500	Ashley Zumwalt	$5,000
		Emily Dixon	$2,000		
Stanford University - $30,000 over 3 years - $10,000 per year					

Gboyega Aveni	$5,000	Zhouyuan Zhu	$5,000	Adeyemi Arogunmati	$5,000
Jing Peng	$5,000	Roshan Sumbaly	$5,000	Yifan Zhou	$5,000
	$67,500		**$72,500**		**$70,000**

2007-08		2008-09		2009-10		2010-11	
New Mexico Institute of Mining and Technology - $30,000 over 3 years - $10,000 per year							
Rich Clark	$5,000	Benjamin Dickinson	$5,000	William Barton Murphy	$5,000	Eric Angelos	$5,000
Jesus Barraza	$5,000	Garrett Wilson	$5,000	Todd Parks	$5,000	Kenneth Malone	$5,000
						Kyle Pettigrew	$5,000
	$10,000		**$10,000**		**$10,000**		**$15,000**

Table 3.3: Fellowship/Scholarship Awards

Chapter 4 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."*

Further, the 2011 Annual Plan states that the Ultra-Deepwater Program Element shall concentrate on the following primary focus area:

"… to fill-in identified technology and/or knowledge gaps related specifically to ultra-deepwater safety, environmental impact assessment, and environmental impact mitigation which are not currently addressed by the portfolio of projects and outstanding solicitations resulting from past Annual Plans".

A. Program 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
- Accomplishing these tasks in a safe and environmentally friendly manner.

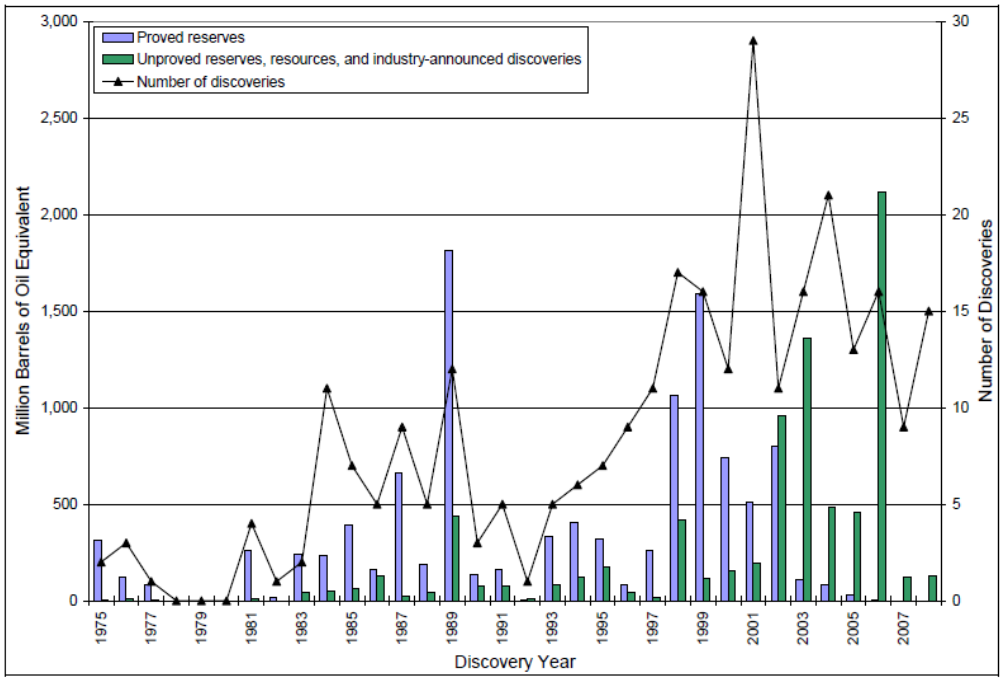
As of this writing, investigations are still underway collecting and reviewing factors surrounding the 2010 Deepwater Horizon incident. As one of the largest nonprofit group of experts with over 170 member organizations, RPSEA is closely monitoring the results as they are released and targeting high value research and development needs as identified 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

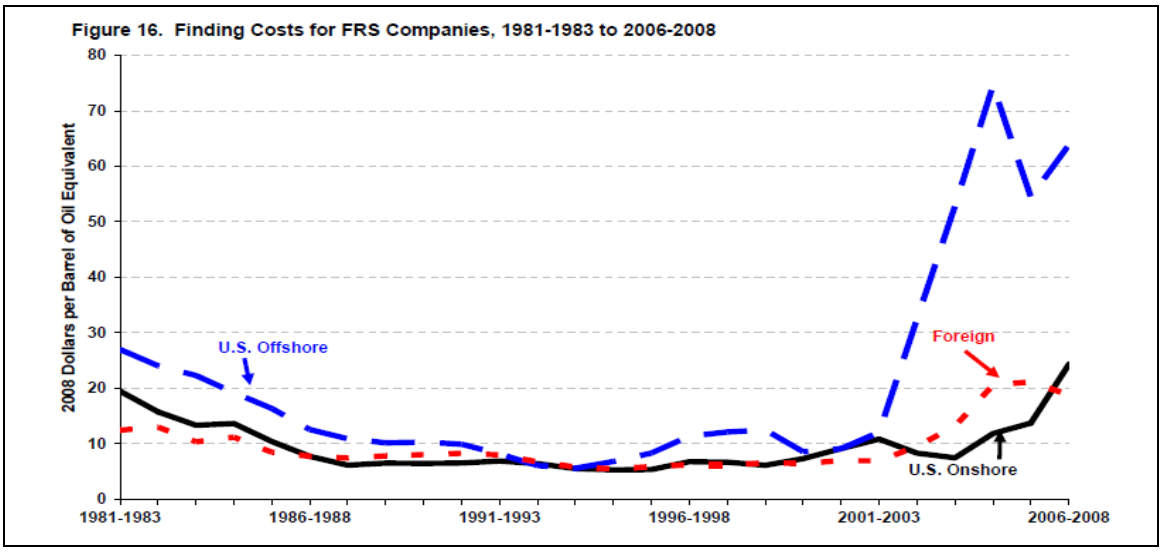
The significant importance of this mission is illustrated by Figure 4.1, which shows the difficulty the oil and gas industry has had since 2002 converting discovered resources into proven reserves (producing developments). Proven reserves add value to royalty revenues, consumers, and the oil and gas 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 4.1: Proven Reserves Add Value

Further evidence supporting UDW's goal to reduce cost can be found in Figures 4.2, 4.3, and 4.4 from the U.S. Department of Energy's Energy Information Administration (EIA). The data in Figure 4.2 vividly depict the much higher cost associated with UDW. To 'move' the resources depicted in the resource category in Figure 4.1 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

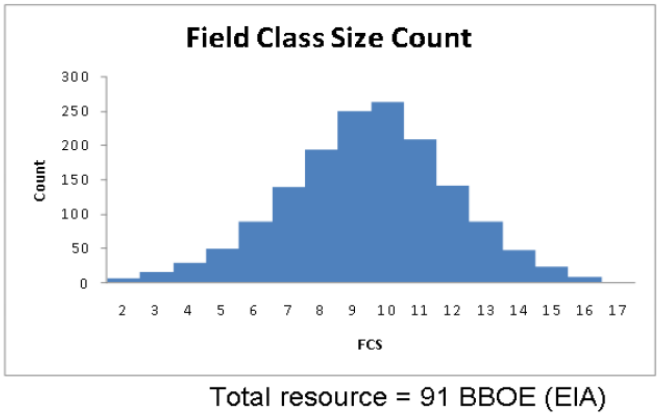
Figure 4.2: Need to Develop Technology to Control Finding Costs

Figure 4.3 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 discoveries that will be developed are likely to be these smaller fields, developed with extended subsea tiebacks, utilizing a 'hub and spoke' methodology with multiple small fields tied to single surface hosts. Because each of these fields has different characteristics (pressure, temperature, fluids, flow rates, etc.) and life cycles, this complex system within the overall GOM facilities and pipelines complex will be unique to each small field. The interaction, safety mechanisms, and overall mix relating to each hub is akin to management of a traffic circle, only that many of the working parts and "nodes" will be below the surface of the water, and even at the individual wells' reservoirs.

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



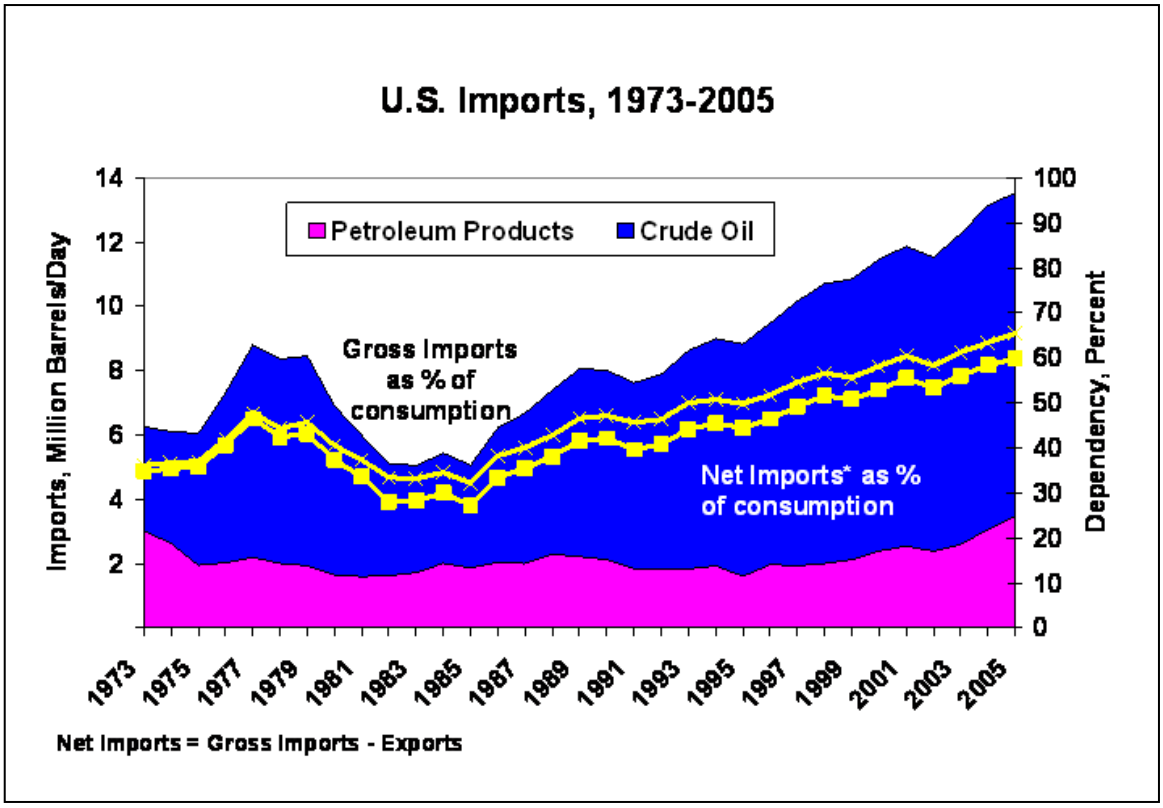
Total resource = 91 BBOE (EIA)

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 4.3: Undiscovered Resource Base by Field Class Size

Figure 4.4 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 develop and produce resources 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 4.4: Imports and GOM UDW Production

The goal of Ultra-Deepwater Program (UDW) is to develop environmentally sensitive, cost-effective technologies to identify and develop resources in increasingly challenging conditions and ensure that the understanding of the risks associated with ultra-deepwater operations keeps pace with the technologies that industry has developed. UDW will assess and mitigate the risk in offshore production activities related to controls, safeguards, and environmental impact mitigation procedures in place during drilling, completion, and production operations. Research topics may 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.

This goal was altered following the 2010 Deepwater Horizon blowout and oil spill in the GOM. While the mission remains the same, the UDW Program will redouble its efforts to ensure that hydrocarbons are safely extracted in an environmentally sound manner. As noted above, the Program will focus the identification, analysis, mitigation of risks associated with development of UDW techniques and tools to responsibly drill for and produce oil and gas in this environment. In short, the original mission to develop the tools to reduce dependence on foreign sources via the GOM ultra-deepwater will be intertwined with the safety and environmental sustainability requirements to ensure that future work can be performed soundly with positive results. By doing so, the research and development performed under the UDW Program will lead to greater public understanding and acceptance of future industry endeavors to unlock and tap these precious reserves.

B. Implementation Plan

Advisory Committee Roles in the UDW Program Element

The UDW Program solicits input and volunteer efforts through several avenues. A chief strength of the Program lies in its unique use and engagement of over 950 subject matter experts and other interested parties. These volunteers meet with RPSEA periodically to review project progression, develop ideas for additional project work, and share their knowledge with one another. 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 of idea generation, vetting, and project selection formally facilitates the direct input of universities, regulatory bodies, service companies, manufacturers, national laboratories, and other key stakeholder groups. The 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 Program Advisory Committee (PAC) and Technical Advisory Committees (TACs) in advisory roles. The PAC consists of upper level technical managers within operating companies, service and manufacturing industry, and safety and environmental firms, as well as experienced academic researchers 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 because:

- The operators will be the organizations called upon to actually deploy and operate the new technologies developed under the program
- The service, supply, and manufacturing industry representatives provide a unique perspective concerning development issues related to novel technologies
- The safety and environmental concerns are fully aware of new developments and specific technological gaps and needs within their areas of expertise

- Academic researchers provide an additional link between fundamental and applied research that can shed light on newer, promising, beyond the horizon technologies.

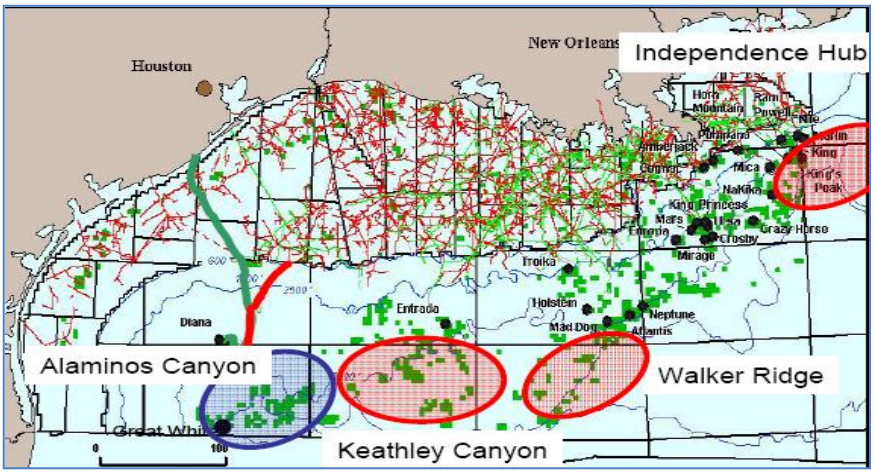
Supporting the PAC are six TACs, each of which is focused on a particular ultra-deepwater technology area (see Table 4.1). In the past year the number of TACs has been reduced to account for the restructuring and refocus of the UDW Program toward more of an environmental and safety area of interest, as well as to increase collaboration and cross-pollination of certain functional knowledge areas. 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 and Metocean	Floating Facilities and Systems Engineering
Flow Assurance	Geosciences and Reservoir Engineering	Subsea Facilities

Table 4.1: 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 4.5). Collectively, these areas of activity represent a very large resource base as portrayed earlier in Figure 4.1. The initial 2007 and 2008 project selections and portfolio program 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 4.5: 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.

The 2009 and 2010 selections continued that goal – to address challenges associated with specific field types. The Program expanded the R&D efforts to carry projects addressing the most important gaps closer to implementation and commerciality stages. It was during the 2010 UDW Program project selection stage that the Deepwater Horizon blowout and spill occurred. Consequently, in the months that followed, a renewed emphasis was placed on safety and environmental sustainability (S&ES). As a result, the 2010 UDW solicitation process was altered to ensure that S&ES and risk mitigation were addressed wherever possible. The 2010 UDW Program solicitations were therefore highly focused on S&ES issues.

Likewise, the 2011 UDW Program focused on risk assessment and prevention, safety and the environmental aspects of UDW through drilling, completions, operations, reservoir, and met-ocean functionalities. It has become abundantly clear from the 2010 catastrophe that there should be no separation between the quest to address these technical challenges and the need to include all aspects of safety and all potential effects on the environment as an integral part of scientific discovery through this, and any other Program.

The 2012 UDW Program will follow the same path – that of risk assessment and reduction associated with the UDW industry work. UDW projects are chosen based on their potential to address and satisfy the most important UDW needs and therefore meet the goal of converting UDW resources to proven reserves in an environmentally safe and sound manner as shown in Figure 4.6, which ties to the Mission Statement.

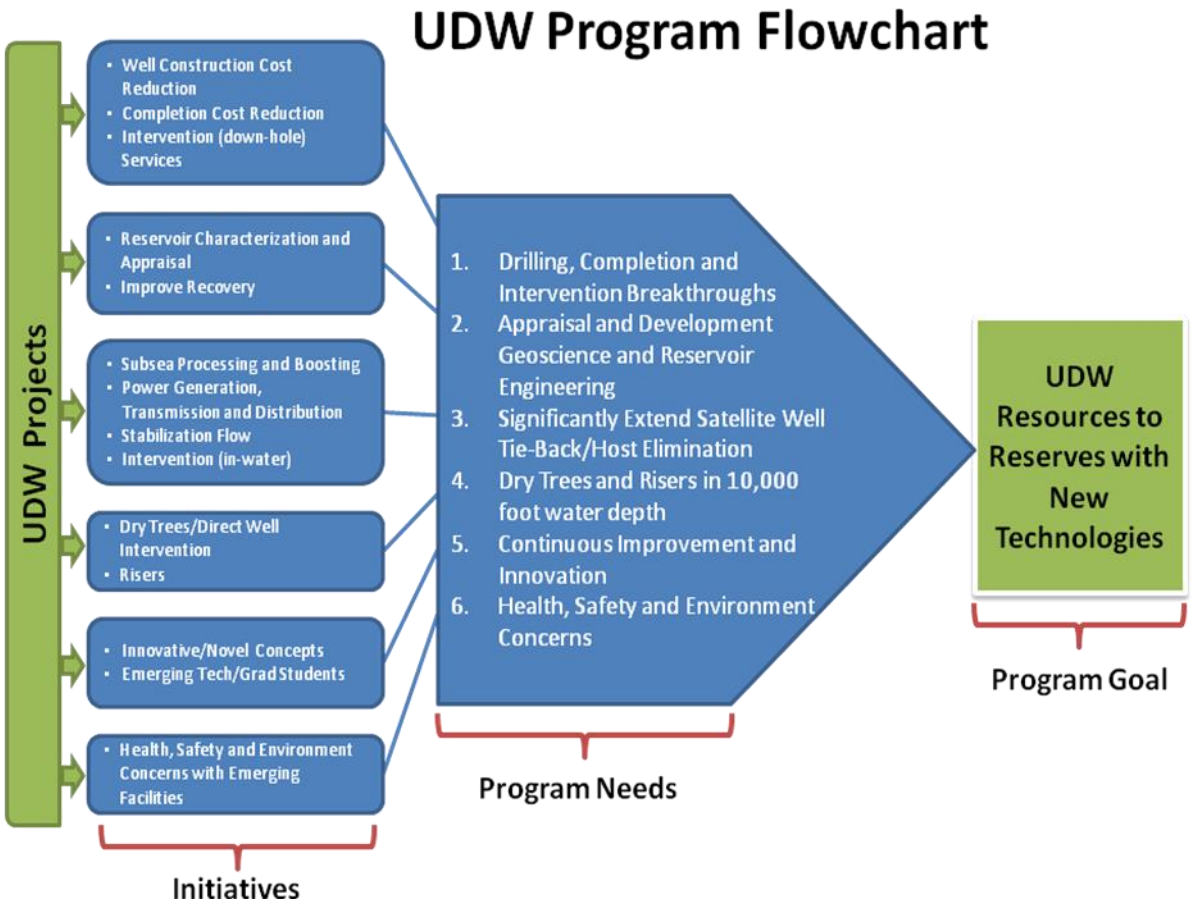


Figure 4.6: UDW Program Flowchart

2012 – 2014 Solicitations

Upon transmittal of the ***2012 Annual Plan*** to Congress, RPSEA will develop and submit the 2012 requests for proposals (RFPs) to the Secretary for approval. There are two aspects of the Program that may cause this to be altered.

- The first aspect is concerned with the Program sunset date of September 30, 2014. Currently, all funds must be allocated and spent by the sunset date. The timing of the 2012 Annual Plan release will determine the amount of time available to submit RFPs to the Secretary, issue RFPs once approved, receive and review proposals, negotiate contracts, and perform the projects' research. There may simply not be enough time to perform meaningful projects before the sunset date.
- The second aspect is concerned with the process that the UDW Program has employed to ensure that funds are spent wisely by this sunset date. Both the 2010 and 2011 Programs utilized a stage-gate approach, wherein additional research work beyond the initial phase for some projects is contingent upon successful phase completion, and it utilizes future year funding as available for the follow-on phases. This process allows longer term projects to

potentially secure research using latter fiscal year funds. To that extent, available funds for a 2012 Program may be reduced, and they will almost certainly be limited in 2013 and beyond.

For the 2012 portfolio, the process of informing stakeholders about pending solicitations will once again include the engagement of other groups such as Society of Petroleum Engineers, American Association of Drilling Engineers, American Society of Mechanical Engineers – Petroleum Division, American Association of Petroleum Geologists, Society of Exploration Geophysicists, American Petroleum Institute, National Academies, DeepStar, other professional organizations, environmental groups, regulatory organizations, and marine well containment companies to increase engagement.

The list of planned solicitations for the 2012 UDW research portfolio is presented below. RPSEA will take into account the work of the UDAC Subcommittee on Risk Assessment and The DOI Ocean Energy Safety Advisory Committee (OESC). Quantification and assessment of risk will be an integral part of the research program.

The planned topics for the solicitations leading to the 2012 portfolio may include:

1. ***Improved well control technologies and techniques to reduce risk.***

   If determined that such work is not being undertaken by others, including the private sector, RPSEA may conduct research on techniques for controlling or regaining control of wells in ultra-deepwater (water depths greater than 5000 feet), to include:

   - Risk quantification and evaluation of the suitability of existing technologies to address possible emergency conditions that might be encountered in a range of conditions in UDW reservoirs
   - Independent risk assessment evaluation of technologies developed or in the process of being developed by ongoing private sector well containment consortia under expected UDW reservoir conditions
   - Development of new tools or techniques to assist in regaining control of wells in UDW

2. ***Improved well design and construction to reduce risks for ultra-deepwater wells.***

   RPSEA may sponsor research to include evaluation, risk assessment, and potential development of the following, as long as work is not already being performed by others:

   - Novel casing design or repair alternatives for UDW wells
   - Alternatives that comprise competent cement barriers to flow
   - Investigate, characterize, and describe the physical and chemical behavior of typical cements that are used in UDW completions and verify the performance characteristics of these cement formulations during setting and post-setting, with an emphasis on potential failure pathway identification.

3. Improved subsea ultra-deepwater measurement and monitoring instrumentation.

As long as research in this area is not being performed by other entities, RPSEA may perform work that may include the following:

- Identify and characterize the need for and role of remote sensing and surveillance equipment and vehicles under various operating scenarios that include failure scenarios, including technology specifications leading to the development of autonomous underwater vehicles (AUVs) or other technologies that can independently access seafloor information and transmit it to the surface uninterrupted, twenty-four hours per day, seven days a week, whether or not the original surface equipment is present.
- Identify and characterize the optimum capabilities of high resolution imaging technologies that can be used to observe subsea installations via long range, high resolution range-finders, detectors and sensors that lead to the development of devices that can be packaged onto an AUV.

4. Improvement of flow assurance, expediting the completion of well control efforts, and reducing the risk of environmental impacts from potential hydrate plugging related ruptures during producing operations.

RPSEA may conduct research in one or more of the following example areas, if similar work is not being conducted by others:

- Develop detailed descriptions and models of ultra-deepwater conditions that can result in hydrate formation and blockage phenomena during production operations
- Improve the ability to predict hydrate behavior based on advanced modeling of hydrate plug formation and dissociation in natural gas dominated systems
- Continue to modify and validate existing models as needed by carrying out flow loop and other experiments to support model validations
- Use the improved models to predict behavior of two-, three-, and four-phased systems under a wide range of extreme UDW pressure, temperature, and equipment architecture conditions

5. Increased understanding of complex fluid phase behaviors that occur under conditions of extreme pressure and temperature, and develop advanced models of hydrocarbon behavior.

As long as work in these fields is not being performed already, RPSEA may sponsor research in any of the following:

- 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° F)
- Study variations in behavior when these fluids include brine, hydrogen sulfide, and/or carbon dioxide
- Conduct experimental and theoretical studies to predict the behavior of petroleum fluids under UDW pressure and temperature, including extreme high pressure – high temperature (xHPHT), conditions

- Develop and validate advanced models for extreme high pressure – high temperature (xHPHT) well and reservoir conditions for complex fluid mixtures

6. Assess and quantify the risks of environmental impacts from deepwater oil and gas exploration, drilling, and production activity, to include modeling and evaluation of industry systems, based on newly developed technologies.

To support the development of a logical framework to determine adequate spill clean-up and collection methods or clean-up response prioritization, RPSEA may sponsor projects that include:

- Performing a risk assessment from a regional perspective to understand the impact resulting from sudden catastrophic naturally occurring events (e.g., submarine landslides, earthquakes) on currently ongoing oil and gas operations
- Refining models to assist in prediction of storms, storm surges, directionality, speed, and other weather-related named storm variables
- Evaluating and conceptualizing development of expert systems or other decision making procedures during emergency conditions caused by naturally occurring events

7. Research on sensors, instrumentation, command electronics, and advanced data interpretation technologies.

RPSEA will first ensure that research is not being performed in the following areas before possibly undertaking any projects:

- Develop improved failsafe systems, and controls for UDW subsea production equipment
- Address risks associated with installation and operations of long flowline tie-backs and develop tools and equipment to reduce or mitigate such risks
- Develop long flowline tie-backs that incorporate a high integrity pressure protection system (HIPPS) with isolation valves that are capable of operation with a failsafe position and with multiple sensors that can be employed with the hardware to make shutdown decisions from topside locations.
- Verify 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

8. Improved reservoir characterization, simulation, and recovery methods which result in lower dependence on new field developments and new wells, thus reducing the physical and environmental footprint, as well as dependency on foreign sources of oil.

Provided that research is not already being conducted in these areas, RPSEA may sponsor research to address the following:

- Improved subsurface imaging through seismic reduces the need for appraising and characterization through drilling of wells
- The development of low environmental impact, testing techniques for characterization
- Improved reserve recovery methods and technologies that are specific to the ultra-deepwater Gulf of Mexico reservoirs

9. Continued research and technology development and demonstration of certain previously identified concepts and needs.

RPSEA will review its existing, ongoing portfolio and may sponsor certain additional phased work that contains significant safety or environmental sustainability or improvement components. RPSEA will also verify that work is not already being performed before recommending additional research in these areas. These previously identified needs may include:

- Development of safe, reliable dry tree floating facilities systems capable of drilling and producing in up to 10,000-foot water depths
- Full qualification of specialized drilling and/or production risers and riser materials for UDW to improve environmental integrity and safety
- Novel and reliable well completion and intervention systems and tools that reduce the need for personnel, equipment, and/or time on station
- Improved corrosion control technologies for subsurface and/or subsea equipment to prolong equipment life and reduce the possibility of spills
- Improvements in providing power and step-changes in developing power efficiencies for subsea and subsurface, resulting in more reliable transmission, controls and measurement

The above topics will be tied to the following six Needs, which were originally developed by the UDW Program consortia members, and which also tie directly to the UDW Program Mission and the 2005 EPAct Section 999 law. When the Program was originated, RPSEA carefully crafted this set of Needs specifically to focus on the most important and challenging aspects facing the ultra-deepwater community. This step was necessary to ensure that project funding targeted the most critical areas of concern, that research would be conducted in a logical and efficient manner, and that ultimately the mission of the Program and directive of the 2005 EPAct can be met. They remain a cornerstone of the Program, and the importance of these historical Needs to the Program will be highlighted below.

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 impact in 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.

While these Needs may not reflect the safety and environmental components directly, every active project has been scrutinized from that perspective. For example:

- The 2007 coil tubing intervention project (07121-1502-01) aimed to develop a safe and environmentally sound alternative to well interventions that will reduce the time to perform

operations, as well as eliminate multiple potential leak paths encountered with conventional tubing systems, and to develop such a system so that it is an attractive economic alternative.

- The 2007 Improved Oil Recovery Evaluation project (07121-1701) provides a starting point to develop concepts that will result in additional hydrocarbon recoveries from existing wells and surface footprints, thereby increasing reserves and Federal royalties, and reducing dependency on foreign sources.
- The 2007 flow phenomena in jumpers and hydrate characterization and dissociation projects (07121-1603a and b, respectively) provide a better picture of flow characteristics in subsea flowline loops and address the dangers of hydrate dissociation and either possible ruptures or sudden release, which might have devastating consequences.
- The work to study the effects of seawater and H2S on risers goes a long way towards eliminating a riser break or leak, which also can have catastrophic results.

This development of continuity between the "Mission Needs" driven program and the Goals from the refocused program can be described as the next step in ensuring that safety and environmental sustainability are addressed in the everyday life of ultra-deepwater. In 2012 and future years the two will be cast as a single directive and prioritized within the program in terms of the environment and safety goals, so that the UDW Program will continue to impact the previously identified Needs. Figure 4.7 below depicts the Mission Needs and Goals Topics. It indicates that there are a multitude of nodes in which the Needs and Topics will identify and complement one another. This rationale will result in a series of products that meet the requirements of the Program and maximize their value to the public, both in terms of environmental soundness and resource utilization effectiveness.

	GOAL TOPICS	1 Improved intervention techniques to regain well control in ultra-deepwater.	2 Improved casing and cementing design for ultra-deepwater wells.	3 Improved subsea ultra-deepwater measurement and monitoring instrumentation.	4 Improvement of flow assurance, expediting the completion of well control efforts, and reducing the risk of environmental impacts from hydrate plugging related ruptures during producing operations.	5 Increased understanding of complex fluid phase behaviors that occur under conditions of extreme pressure and temperature, and develop advanced models of hydrocarbon behavior.	6 Assess and quantify the risks of environmental impacts from deepwater oil and gas drilling and production activity, to include modeling and evaluation of industry systems, based on newly developed technologies.	7 Research on sensors, instrumentation, command electronics, and advanced data interpretation technologies.	8 Improved reservoir characterization and recovery methods which results in lower dependence on new field developments and new wells ...	9 Continued research and technology development of certain previously identified concepts and needs.
	MISSION NEEDS									
1	Drilling, Completion, and Intervention Breakthroughs	■	■				■			■
2	Appraisal and Development Geoscience and Reservoir Engineering						■		■	■
3	Significantly Extend Subsea Tieback Distances / Surface Host Elimination			■	■	■	■	■		■
4	Dry Trees / Direct Well Intervention in 10,000' Water Depths	■					■			■
5	Continuous Improvement / Innovation	■	■	■	■	■	■	■	■	■
6	Associated Safety and Environmental Concerns	■	■	■	■	■	■	■	■	■

Figure 4.7: UDW Program Topics – Needs Matrix

Project Selection Process

Proposals submitted for the Ultra-deepwater Program are divided into functional areas that are closely aligned to the Technical Advisory Committees. Non-conflicted evaluators are chosen from the TACs based on the particular subject matter expertise on 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 dollar value priorities to each TAC. The highest priority topic area proposals that address the most compelling or critical needs associated with the portfolio and that meet the objectives outlined in the Annual Plan 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, leveraging or other association with other competitive or complementary R&D, diversity of technical approach, and UDW Program future funding levels when developing a portfolio of projects intended to maximize the probability of meeting program goals.

Anticipated Awards for 2012 - 2014

Due to carry-over of funds that were not earmarked for selections from earlier years, as much as $6.5 million in addition to the $14.8 million annual funding may be available for 2012 - 2014 project awards following the anticipated 2010 bid selections. Cost sharing beyond the minimum is encouraged in all solicitations. For the 2012 Program year, the UDW program will target the award of approximately five large projects with a value of $1 to $5 million per project. Additionally, several smaller awards averaging $500,000 to $700,000 each may be funded as follow-on work to previous projects. Each project will be required to contain a go-no go stage-gated decision point of no longer than two years due to the Section 999 Program sunset date of third quarter of 2014. The projects will be aligned with the 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 subcontract. If a decision is made to advance to the next stage or decision point, or to gather additional data, additional funding will be provided from available funds at that time. This approach is taking on additional significance as RPSEA approaches Section 999 Program close-out.

C. Ongoing Activities

2007 – 2010 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. 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, risk reduction, and resource utilization.

Table 4.2 below summarizes the current project selections and active RFP solicitations by funding year. Of special note is the fact that the 2010 RFP solicitations were delayed due to changes in the RFPs following the 2010 Macondo blowout. The five-month delay afforded RPSEA, NETL, and the DOE ample opportunities to alter the focus on the RFPs to address safety or environmental sustainability.

Funding Year	Solicitations	Selections	Awards
2007	13	17	16
2008	11	14	14
2009	4	11	11
2010	7	TBD	TBD

Table 4.2: UDW Selection Summary

Technical Accomplishments

Fourteen (14) UDW projects have been completed through September 15, 2011, at an approximate cost of $8.1 million in RPSEA funding and $10.3 million in total cost. While the spending figures may seem insignificant in relation to the total program funding, the success and potential utilization of learning from these projects is indicative of the rapid pace of technical progress that will ultimately result from the UDW program once the remaining 27 projects along with future initiatives are completed. A few examples are included below.

In the Drilling, Completion, and Intervention Breakthroughs category two projects are complete.

- The coil tubing drilling and intervention system using a cost-effective vessel project offers the potential to go back into offshore subsea wells and intervene using a safer and faster methodology than conventional means. It uses coil tubing, which can be run into and out of the wellbore much quicker, and special adaptive tools for performing various functions. It contains dual blowout preventers that will be integrated to act in unison or as back-up safety mechanisms. Since the system is lighter weight than conventional systems, it may be adapted

to many more ocean-going vessels and thus will be faster to deploy. Eventually, this system may be adapted to drilling in UDW. This innovative design concept may ultimately be used to inspect, repair, and maintain subsea wells. Such a system can be a critical component of an integrated response to an unanticipated subsea event. The type of flexible, highly responsive system envisioned, might provide "first responder" capability in an emergency. In addition, due to its likely lower cost of operation, such a system will enable the development of additional hydrocarbon resources from existing, instead of new, wells, and from currently marginal accumulations, resulting in a larger energy return (additional reserves and royalties) for the same environmental footprint. While this project is only the first stage of a longer term program that will include field trials, it clearly indicates a step-change in technologies in UDW.

- The modeling and simulation of managed pressure drilling (MPD) for improved design, risk assessment, training and operations project stands to turn the MPD process on its head. It is the culmination of years of work that provides an accurate and quick assessment of MPD parameters, needed changes in drilling variables, actions required to avoid critical well situations, and ease of modeling for planning purposes. This project provides rationale and software to identify, model, and calculate fluid actions and subsequent reactions in all sorts of eccentric wellbore conditions, account for borehole and drill pipe interaction and behavior, and warn the driller of possible problems, as well as recommending corrective actions. It does what many software programs have claimed but none have delivered. Once adopted, it will be an added safety component to any MPD well.

In the category representing Appraisal & Development Geoscience and Reservoir Engineering two projects are complete.

- A research report and characterization database of deepwater and ultra-deepwater assets in the Gulf of Mexico includes technical focus direction, incentives, needs assessment analysis, and improved oil recovery (IOR) concepts identification. This comprehensive study is the first step in identifying GOM IOR potential from a basin-wide perspective. It serves to open the GOM to the possibility of increasing recoveries by determining reservoir types, strengths and weaknesses of recovery mechanisms, technology gaps and questions, and grouping patterns that will allow the offshore industry to identify opportunities and develop plans to significantly improve production from these important domestic resources. As a result, future reliance on foreign oil sources will decrease.

- The early reservoir appraisal utilizing a well testing system project resulted in the conceptual development of an integrated system that can more easily and productively test new wells than anything on the market today. The project goal was to gather information to help determine the economic potential of field discoveries and provide insights to safely commercialize the fields. The injection test concept was simulated and results were very encouraging, with the final data correlating to the results of conventional production tests. It involves pumping friendly fluids into the wellbore rather than extracting them, and measuring resultant pressures, followed by intricate modeling, to determine critical reservoir parameters. The method should result in a 35 to 50 percent reduction in well testing costs, and will allow the industry to more properly size its offshore facilities. Because the injection tests require less time compared to the duration of conventional tests and no live oil (i.e., oil with dissolved gas) is produced to the surface, flaring of gas at the surface is eliminated, as well as is the need to store or off-load produced oil; it is more environmentally friendly than the current method of testing. It can be adapted to many different drilling, well completion, or production scenarios. Eight different well testing systems that can be used in the GOM were architecturally designed and evaluated

for feasibilities, with five systems being ready or nearly ready for field deployment on a technology readiness scale. Most of these systems are less expensive options than conventional methods; and, when coupled with the injecting test method, provide a safe, environmentally preferable alternative.

In the category to Significantly Extend Subsea Tieback Distances and Eliminate Surface Hosts, four projects are complete.

- The wax control in the presence of hydrates project was conducted to assess the effectiveness of technologies for using un-insulated single subsea tiebacks or export lines so that marginal fields can be produced safely and economically. There was sufficient evidence that cold flow, a technology in which the oil is cooled to ambient temperature (which in the case of GOM deepwater fields was about 34°F - 36°F), is effective in minimizing both wax and hydrate deposition; however, selected chemical intervention is necessary and pigging capability will always be needed as a backup strategy in this situation. A novel cold flow system with a flow section and conditioning loop was designed, a number of cold flow tests were performed at various thermal fluxes, flow rates, and solids loading, and the hypothesis was tested and proven. The feasibility of cold flow was demonstrated, and small thermal flux did not lead to significant hydrates deposits. The pipeline restart process under cold flow conditions was compared with the restart process in conventional shutdowns and found to be problematic. The implication of this work is that it is possible to flow oil through deepwater lines from long distances. However, a secondary method to remove hydrate plugs must accompany a single, un-insulated line. Furthermore, specific reliable restarting processes and procedures must be developed on a case-by-case basis to avoid potential flowline collapses.
- The ultra-high conductivity umbilical project provided the first step in developing a much more efficient method of carrying power to the seabed. The goal is to achieve a conductivity capability for subsea umbilicals that is at least comparable to that of copper but at a much lower weight. A polymer nanotube-based high conductivity wire for umbilicals will extend the distance satellite wells can be located away from surface facilities, but will secondarily lead to a reduction in energy requirements and thus a reduced operations carbon footprint. Ultimately, the reduced size and weight of the umbilicals will result in easier and thus potentially safer handling of cable during installation (less likelihood for accidents). It will also result in lesser needs to build and use hubs and platforms, since more efficient power transmission will allow for the subsea option as opposed to a platform option in some cases. Finally, the successful application of this technology will be able to be extended onshore, which will result in added efficiency and less stress on onshore power grids. A follow-up project in waiting plans to further improve electrical conductivity to make it at least equivalent to current methods of power transportation in the subsea environment. The potential to use this technology, not only subsea, but also eventually in other industries and perhaps more commonly, and to reduce power losses over long distances may reduce power consumption in general.
- The deep sea hybrid power system project considered numerous power generation – energy conversion and storage technologies to support deep ocean operations. Analysis of various technologies and offshore constraining variables indicated that the top candidates were based on a small, pressurized water reactor: one coupled with a steam turbine-generator system and other with a solid-state thermoelectric generator. The leading candidates for energy storage were versions of sodium-beta batteries: sodium – sulfur and sodium – nickel-chloride. The significance of these findings is that they pave the way for the implementation of remote, reliable power usage for any offshore development. Follow-up work will focus on operational

requirements, specifications, interfacing, design criteria, deployment and installation plans, regulatory compliance, maintenance, emergency response plans, and dismantling – recovery procedures.

- The subsea systems engineering integration project involved developing a general purpose process simulator featuring minimal architectural overhead that puts all the functionality in user developed unit models. The underlying goal was to remove all unnecessary impediments to allow the user full modeling license. Hierarchical modeling can be added as needed by any user. Pre- and post-processing statistics modules were developed. The model was validated by comparison with results from an actual flow loop with a three-phase gravity separator. With an architecture that is a viable framework to simulate subsea processing, the two logical next steps are to tackle a process that more closely simulates desirable produced flow management requirements in the GOM, and to simulate fluids that come closer to real produced fluids.

The Dry Trees / Direct Well Intervention and Risers in 10,000-foot Water Depth category contains two completed projects that both focused on the same issue.

- The ultra-deepwater dry tree system for drilling and production projects have opened the door to a commercial product that will allow the oil and gas industry to safely and effectively drill for and produce oil and/or gas in water depths to 10,000 feet. To date, no system is capable of exceeding 9000 feet of water depth, and other ultra-deepwater drilling and production systems offer a much smaller work area, thus limiting the type of work that can be performed. Moreover, since this is a dry tree system, it will allow for direct well intervention in the safest of manners: re-entering wells will be accomplished on the drilling floor, where personnel can keep a close eye on systems and repair them easily when necessary.

The Continuous Improvement / Field Development Optimization category has three completed projects.

- The flow phenomena in jumpers and their relation to hydrate plugging risk project was designed to cover risky operating conditions and possible locations of hydrate formation in subsea flowline jumpers. It was found that, although it had been expected that velocity would play a major role in hydrate formation of 2- and 3-phased mixtures, fluid density and fluid viscosity had complex roles, too. Circulation volumes required to remove water from jumper systems were developed, so that procedures might be developed. As a result of this work, the beginnings of understanding of the complex nature of hydrate formation and plugging in jumpers have been developed.
- The accompanying hydrate characterization and dissociation strategies project aimed to understand the chemical and physical processes associated with both formation and breakdown of hydrates. Conclusions were drawn from the experimental results that allow industry to develop countermeasures so that hydrates are less likely to plug lines and cause disruptions, and if they do form, they can safely and effectively be dissociated, or “melted” before they harm someone as projectiles or the environment by rupturing a pipe.
- The design investigation of extreme high pressure, high temperature (xHPHT) subsurface safety valves (SSSV) project looked at several conventional and unconventional well safety valve designs and attempted to determine gaps and remedy issues associated with them for pressure and temperature conditions from super-cooled ambient pressure to 30,000 psig and 350°F. Through finite element analysis, historical records, and lab tests, the project identified design

problems that would be considered flaws in xHPHT applications. Exotic materials were analyzed to improve the design characteristics, but they did not solve the problem. Although the project was unable to develop a solution to the xHPHT problem for SSSVs, the information that resulted from the work will form the basis of additional work to follow to improve the reliability of these important safety devices, which are used in wells as emergency shut-off devices below the mudline and are critical in cases such as wellhead shearing.

In the Associated Safety and Environmental Concerns area one project is complete.

- The effect of global warming on North Atlantic hurricane activity project provided the first glimpse of interaction between climate change and GOM storm activity. The work was able to correlate developments in east Africa to the size, strength, and speed of movement, and general direction of activity in the Atlantic Ocean. Using historical 50-year data, it developed and verified a model that could predict the number of storms in any 70 km x 70 km area, and predict the destructive tendencies. It then reconfigured the same model for the past 15 years and correlated higher temperatures with fewer, but more dangerous storms. The attempt to reduce grid size for more accurate prediction and forecasting had to be cut because of the tremendous amount of computer power necessary to test the theory and tune the model (three months per run). A follow-up project is planned to further this development. The importance of this project lies in the fact that it will provide necessary planning information to industry, which currently relies on historical storm information, and will allow it to design its offshore infrastructure more appropriately.

A listing of all projects for the years 2007–2009 can be found in Appendix C. Abstracts and additional project status information for each of the projects can be found on the RPSEA website at www.rpsea.org.

E. Administrative Activities

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 2012 include:

- Issue one to four solicitations for 2012
- Establish FY 2012 R&D priorities based on results of 2007-2011 subcontracts, project selections, solicitations, and inputs from the TACs, PAC, and UDAC, as well as from the NETL/DOE.

F. Milestones

The solicitation topics for 2011 are being determined following recent transmittal of the 2011 Annual Plan to Congress by the Secretary of Energy. It will be closely followed by the release of the solicitations, which will remain open for a minimum of 45 days. The review and selection process will take approximately three months, followed by an average six-month subcontract negotiation and supporting documentation submittal period.

An important activity for the UDW Program Consortium will be the active management of all R&D projects to date, as well as planning the R&D Program for 2013 and beyond. The Consortium will accelerate its future year planning to front load its remaining projects, inasmuch as possible, in order to account for the fiscal year 2014 sunset date, unless otherwise extended.

Chapter 5 Unconventional Natural Gas and Other Petroleum Resources Program

A. 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.

A specific goal of Unconventional Resources Program (UCR) is to unlock the vast resources of natural gas trapped within unconventional 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. 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.

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. 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.

Since one of the greatest barriers to full development of domestic shale gas resources is public concern over the impact and safety of that development, the program will be focused on the development of cost-effective technologies that will enable and ensure safe and environmentally responsible exploration for and production of shale gas resources. Specific objectives are discussed in the following Implementation Plan.

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.

B. Implementation Plan

The original objectives for the Unconventional Resources Program were developed with input from the Unconventional Resources PAC. Over the course of the execution of the program, 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 2011 Annual Plan by the URTAC, (3) input provided by PAC and TAC members involved with the selection process for the 2010 program, and (4) discussions at events such as the 2011 RPSEA Unconventional Gas Conference in Golden, Colorado and the 2011 RPSEA Environmental Forum in The Woodlands, Texas.

In response to the recent public concern over the safety and environmental impact of shale gas development, the Department of Energy has convened a Subcommittee on Natural Gas of the Secretary of Energy Advisory Board (SEAB). That committee has made a series of initial recommendations regarding research needs for shale gas development, and this plan incorporates those recommendations.

The objectives for the 2012-2014 program years are focused on developing technology to minimize the environmental impact and mitigate the risks associated with shale gas development, in order to ensure that the benefits of the development of this resource far exceed the associated risks. Specific objectives are listed below.

- Minimize surface disruption associated with shale gas development. This includes not only well site construction, but includes air emissions, noise, visual impact and impact on surface water resources.
- Ensure isolation of producing formations and wellbores from shallower formations, particularly near-surface aquifers.
- Maximize the efficiency of hydraulic fracturing operations to ensure that the minimum amount of fluid is used to completely stimulate the reservoir zone and the need for refracture treatments is minimized.
- Predict and mitigate induced seismicity associated with unconventional gas development, including hydraulic fracturing and injection well disposal.
- Develop means for managing the fluid use associated with shale gas development. This includes understanding and minimizing the impact on regional water resources, the development of "green" drilling and fracturing fluids that minimize contamination concerns, the development of improved treatment and re-use options and the minimization of fluid waste streams.

- Demonstrate and integrate promising technologies to facilitate early utilization and commercialization.

One specific area that is crucial to the successful development of shale gas resources in the U.S. is the assessment of risk associated with various aspects of the shale gas production process. That topic is a primary focus of the Section 999 Complementary Program being executed by the NETL Office of Research and Development, and risk assessment is an important part of studies being conducted by the EPA and other agencies. Risk assessment is a key element of several of the potential solicitation topics listed in this plan; however the solicitations developed under this plan will be carefully coordinated with the activities of other organizations to prevent unnecessary duplication of effort.

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 5.1. The program components are prioritized for a particular resource target that has been identified as having significant potential. The most compelling 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.

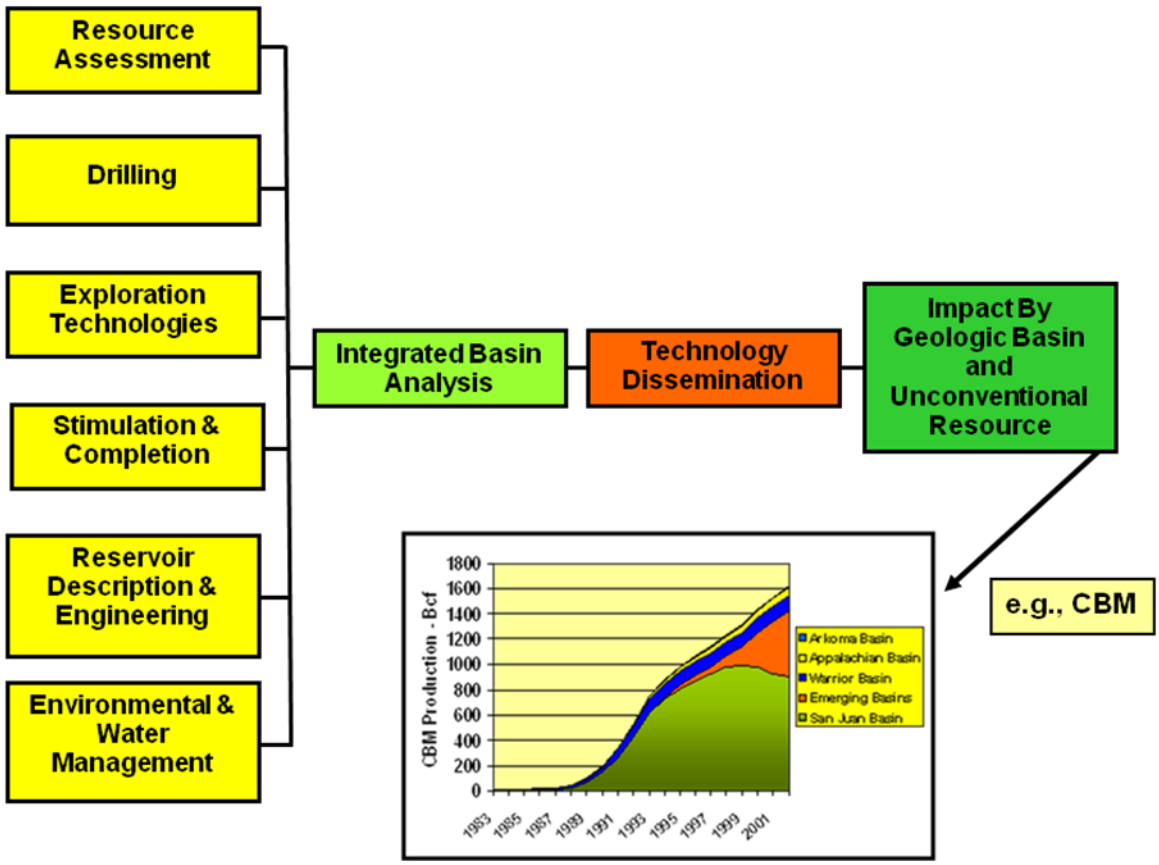


Figure 5.1: Program Development Component and Implementation Approach

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

Description of Planned Solicitations

The solicitations issued during the 2012-2014 program years will be designed to integrate and build on the portfolio of projects developed during the 2007-2011 program years, while continuing the expanded emphasis on safety and environmental responsibility that was initiated in the 2011 program year. Due to the program sunset date of September 30, 2014, projects funded under the 2012-2014 program years will necessarily be of relatively short duration, probably no more than 18 months. They will be designed to build upon earlier projects and address gaps in the program that remain after the 2011 projects are added to the portfolio.

At least one, but no more than three, solicitations are anticipated to be issued during the 2012-2014 program years, depending upon the evolving needs of the program. Due to the necessity of completing projects prior to the sunset date, it is not anticipated that solicitations will be issued after 2012. The objective will be to commit all remaining program funds to projects selected as a result of the solicitation(s) issued in 2012.

2012-2014 Solicitations

The following list of potential solicitation topics are examples of areas that may be included in solicitations issued under this plan. The recommendations from the SEAB Subcommittee on Natural Gas are specifically identified, and then followed by additional recommendations developed from the other sources of input described above. The program in its current form clearly lacks the time and the funding to effectively pursue initiatives in each of these areas. The topics included in specific solicitations will depend on the content of the portfolio after the 2011 program year selections are made, the coverage of the identified topics by research being undertaken within DOE or other agencies or organizations, and the specific priorities identified by RPSEA and DOE at the time solicitations are issued. Further, solicitations will be directed toward topics in which it is likely that meaningful results can be obtained within the limited time remaining before the program sunset date.

The specific R&D topics mentioned in the SEAB Shale Gas Subcommittee 90-day Report are listed below. Additional recommendations issued after the development of this plan will be incorporated into the solicitations issued under this plan, as will other developments that might create new research priorities not contemplated when this plan was written.

- Basic research on the relationship of fracturing and micro-seismic signaling
- Determination of the chemical interactions between fracturing fluids and different shale rocks – both experimental and predictive
- Understanding induced seismicity triggered by hydraulic fracturing and injection well disposal
- Development of "green" drilling and fracturing fluids
- Development of improved cement evaluation and pressure testing wireline tools assuring casing and cementing integrity

Additional potential research topics include the following:

- Develop methods for maximizing production associated with a given surface facility.

  Develop improved methods for reducing the site impact of drilling individual wells and increasing the reach associated with multiple wells drilled from a single pad, so that larger portions of a producing reservoir may be accessed from a given surface facility.

- Acquire methods to develop a given resource with fewer wells.

  Increase the producible volume of reservoir associated with an individual well or alternatively develop methods to characterize subsurface properties so that subsurface zones with poor productivity given current production and stimulation technology are not drilled.

- Develop improved techniques to characterize and control the stimulated zone associated with a hydraulic fracture treatment, and increase the efficiency of such treatments.

Determine whether the zone stimulated by hydraulic fracture treatments is accurately delineated by microseismic or other mapping techniques and develop improved approaches to control the size and orientation of the stimulated zone. Develop methods to increase the volume and permeability of the zone stimulated with a given amount of fracturing fluid.

- Evaluate the effectiveness of current methods of protecting groundwater from contamination during shale drilling, casing, cementing and production operations. Develop new methods for ensuring effective isolation of producing zones and wellbores from groundwater resources.

  Assess and quantify impacts on groundwater and drinking water during the drilling, casing and cementing of wells. Review current regulations and best practices. Develop new methods for quantifying and evaluating potential risks resulting from the 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.

- Develop improved approaches for managing waste streams associated with shale gas development.

  Develop additional options for treatment, re-use and disposal of liquid and solid waste streams associated with shale gas development, including naturally occurring radioactive material (NORM) and drill cuttings. Develop drilling and production approaches that reduce the total volume and/or the proportion of harmful constituents in waste streams. 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, transportation, treatment, and disposal. Make data from these research activities available for regulatory agencies in making informed decision on promulgating sound science-based regulations.

- Quantification of methane emissions during shale gas development, to include life of well emissions, 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. Include as a time frame the expected well lifetime for a complete assessment of methane emissions.

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.

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, research organizations 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 requirements of the Unconventional Resources project portfolio. The proposals that address the most compelling needs associated with the portfolio 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. In order to ensure that projects are completed prior to the program sunset date in 2014, some funds from the 2012-2014 program years will be allocated to support projects selected in the 2011 program or to provide additional funding to support ongoing projects selected in prior years. Depending on funds available after the 2011 program obligations, it is anticipated that approximately $13 to $20 million will be available for award in project year 2012 to support projects selected under this plan. Approximately four to fifteen awards are anticipated under this plan.

The typical award is expected to have duration of one year, although longer awards may be considered if the program duration allows. 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 an 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.

C. Ongoing Activities

Thirty-eight projects have been awarded and eight projects are pending contract execution based on selections from the 214 proposals submitted in response to the 2007 through 2010

solicitations for the Unconventional Resources Program. Table 5.1 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 *Technology Integration (HARC) $6.0*	Piceance (CSM) $2.9 *Piceance Permeability Prediction (CSM) $0.5*	
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 *Cryogenic Frac Fluids(CSM) $1.9* *Geomechanical Frac Containment Analysis (TAMU) $0.65* *Frac Diagnostics (TAMU) $0.76*	Gel Damage (TEES) $1.05 Frac Damage (Tulsa) $.22 Foam Flow (Tulsa) $0.57	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 *NORM Mitigation (GE) $1.6*	Frac Water Reuse (GE) $1.1 *Engineered Osmosis Treatment (CSM) $1.3*	
Environmental	Environmentally Friendly Drilling (HARC)* $2.2 *Zonal Isolation (CSI) $3.0*	*	*
Resource Assessment	Alabama Shales (AL GS) $.5 Manning Shales (UT GS) $.43	Rockies Gas Comp. (CSM) $.67	

2007 Projects
2008 Projects
2009 Projects
2010 Projects

Table 5.1: 2007-2010 Project Selections Classified by Primary Resource Target and Technology Area

Table 5.1 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 ensure that the projects in each of the technical disciplines addressed the challenges of safe and environmentally responsible unconventional gas development.

2012 Objectives	Gas Shales	Tight Sands
Minimize Surface Disruption	**Hi Res. Imag. (LBNL) $1.1** **Gas Isotope (Caltech) $1.2** **Marcellus Nat. Frac./Stress (BEG) $1.0** **Multi-Azimuth Seismic (BEG) $1.1** **Coupled Analysis (LBNL) $2.9** **Shale Simulation (OU) $1.05** **Frac-Matrix Interaction (UT-Arl) $0.46** **Marcellus Geomechanics (PSU) $3.1**	**Wamsutter (Tulsa) $.44** **Condensate (Stanford) $.52** **Tight Gas Exp. System (LBNL) $1.7** **Rockies Gas Comp. (CSM) $.67** **Strat. Controls on Perm. (CSM) $0.1** **Fluid Flow in Tight Fms. (MUST) $1.2**
Ensure Zonal Isolation	***Zonal Isolation (CSI) $3.0***	
Maximize Hydraulic Fracturing Efficiency	**Cutters (Carter) $.09** **Frac (UT Austin) $.69** **Refrac (UT Austin) $.95** **Frac Cond (TEES) $1.6** **Stimulation Domains (Higgs-Palmer) $0.39** **Drilling Fluids for Shale (UT Austin) $0.6** ***Geomechanical Frac Containment Analysis (TAMU) $0.65*** ***Frac Diagnostics (TAMU) $0.76***	**Gel Damage (TEES) $1.05** **Frac Damage (Tulsa) $.22**
Predict and Mitigate Induced Seismicity	**Fault Reactiviation (WVU) $0.85**	
Manage Fluids	**Integrated Treatment Framework (CSM) $1.56** **Frac Water Reuse (GE) $1.1** **Barnett & Appalachian (GTI) $2.5** ***NORM Mitigation (GE) $1.6*** ***Cryogenic Frac Fluids(CSM) $1.9***	***Engineered Osmosis Treatment (CSM) $1.3***
Technology Integration and Demonstration (Address Multiple Objectives)	**New Albany (GTI) $3.4** **Environmentally Friendly Drilling (HARC) $2.2** **Marcellus (GTI) $3.2** ***Technology Integration (HARC) $6.0***	**Piceance (CSM) $2.9** ***Piceance Permeability Prediction (CSM) $0.5***
2007 Projects **2008 Projects** **2009 Projects** ***2010 Projects***		

Table 5.2: 2007-2010 Project Selections That Relate to the 2012 Objectives for the Unconventional Resources Program Element

Table 5.2 shows how many of the current portfolio of projects relates to the six objectives listed at the beginning of Section B. (Implementation Plan) of this Chapter. While this table illustrates that much of the current portfolio does address the safety and environment sustainability objectives of this plan, it should be noted that there are elements of these objectives that are not comprehensively addressed within the current portfolio. For example, the projects listed in Table 5.2 associated with the Minimize Surface Disruption objective are directed toward an improved understanding of reservoir properties that will allow maximum recovery from unconventional gas reservoirs with the minimum number of surface facilities. Another

important aspect of this objective is minimizing the impact of each required surface facility in terms of surface footprint, air emissions, waste generation, etc. While the Environmentally Friendly Drilling project listed as a Technology Integration and Demonstration project addresses some of these issues, it may be appropriate to specifically include such topics in solicitations released under this plan.

D. 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 2012 portfolios are listed in Chapter 8.

The solicitation for the 2012 portfolio will be released after transmittal of the 2012 Annual Plan to Congress and approval by the Secretary of Energy. It will remain open for a minimum of 45 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 2012 include:

- Issue and complete at least one solicitation.
- Engage advisory committees to review the solicitation to ensure that it reflects sufficient breadth and depth of industry experience
- Select and award 4 - 15 projects for the 2012 portfolio

Summary of 2007- 2011 Activities

Appendix C 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 2011 solicitations for proposals will be released in fourth quarter, calendar 2011.

Table 5.3 below summarizes the number of solicitations, selections, and project awards for 2007 through 2011 as of September 30, 2011.

Funding Year	Solicitations	Selections	Awards
2007	1	19	19
2008	1	9	9
2009	1	11	10
2010	1	8	pending

Table 5.3: UCR Program Solicitations, Selections and Awards

Technical Accomplishments

The Unconventional Resources program has a goal of developing the enabling technology that will attract the additional industry investment necessary for the safe and environmentally responsible development of the nation's vast unconventional gas resources. Development of these resources will ensure a stable, low-carbon domestic energy supply for transportation, power generation and other uses. The technology developed and applied during this program will position U.S. companies as the primary source of technology and services as other nations begin to develop their own indigenous unconventional gas resources. Six projects have been completed, out of the 38 awards made in the 2007-2009 program years. Information regarding the completed projects is given below, along with highlights from a few examples of ongoing projects.

Completed Projects

Novel Concepts for Unconventional Gas Development in Shales, Tight Sands and Coalbeds

The project objective was to develop an alternative method of formation stimulation, beyond hydraulic fracturing, which could effectively increase the net production of gas from shale while reducing the amount of water required. Over a dozen new concepts were evaluated, leading to the identification of a promising new method. 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. Discussions are under way with service companies regarding commercializing the technology.

New Albany Shale Gas

The New Albany shale project is a field-based industry cooperative project with producer involvement and support, which combines scientific and technical analyses with field data acquisition, testing, and field validation in order to characterize a substantial gas resource (100 TCF+) that currently has very marginal economics. A multidisciplinary approach was taken, integrating geologic studies with engineering aspects such as drilling and completions, producing technologies, and estimations of producing rates and reserve recoveries for wells in the New Albany shale. An optimum approach was developed involving certain types of fracture treatments on relatively short horizontal sections, but the development strategy is not generally economic at $4.00/MCF gas prices. This work has focused future efforts on ways to reduce the cost of these wells, either by reducing drilling cost (perhaps through coiled-tubing drilling) or completion cost. Rather than a haphazard effort to try various options, New Albany Shale operators are now able to focus on cost reduction for a very specific drilling and completion methodology. When costs are sufficiently reduced, development of this significant resource is likely to take off. A number of active horizontal drilling programs are currently underway to extract biogenic gas.

Geological Foundation for Production of Natural Gas from Diverse Shale Formations

To assist in the development of emerging gas shale plays in Alabama, the Geological Survey of Alabama has completed a three-year study that provides a geologic foundation for exploration and development. The study employs a systematic, multidisciplinary approach to the

evaluation of shale reservoirs. Key geologic variables addressed are stratigraphy, sedimentation, structure, hydrodynamics, geothermics, petrology, geochemistry, Gas storage, and permeability. Original gas in place (OGIP) in the Alabama shale formations is estimated to be about 826 TCF. Technically recoverable resources in areas with significant development potential are estimated to be between 70 and 139 TCF. Hence, the prospective shale formations contain enough natural gas to have a major impact on domestic gas reserves. Important technical hurdles that must be overcome to bring these resources to market include the development of completion technologies for giant, tectonically deformed shale masses, as well as development strategies for thin shale formations.

Enhancing Appalachian Coalbed Methane Extraction by Microwave-Induced Fractures
Microwave energy can, in the absence of confining stress, induce fractures in coal. Creation of new fractures and increasing existing cleat apertures via short burst, high-energy microwave energy was evaluated for both hydrostatically stressed and unstressed North American bituminous coal cores. The results of this study indicate that it is likely that microwaves have the potential to enhance the communication between a horizontal wellbore and the existing cleat network in coal seams at depth, for improved gas recovery or CO_2 injection.

Optimizing Infill Drilling at Wamsutter
In order to make sound decisions regarding development strategy in any gas reservoir, it is important to be able to determine the reserve additions and acceleration of production that will be associated with drilling a new well. Unlike conventional reservoirs, optimization of infill well locations in tight gas reservoirs is challenging due to significant variation in reservoir properties and lack of spatial continuity. Appropriate location of 40-acre spacing wells in the Wamsutter field could increase the potential reserves by as much as 40% (approximately 3 to 4 TCF). This study used a combination of streamline simulation and modified flow simulation methods to properly account for the dynamic connectivity in the reservoir. Also, since reservoir simulation studies are not always possible, a methodology for predicting the future performance of the wells using production data only was devised. This method predicts both incremental and acceleration potentials from a newly drilled well, allowing maximum recovery from the Wamsutter and other tight gas reservoirs.

An Integrated Framework for the Treatment and Management of Produced Water
This project has produced a web-based Produced Water and Beneficial Use Information Center. This site provides information on location and quality of CBM produced water, current and potential future treatment and use of CBM produced water, state and federal regulations pertaining to discharge and use, and guidelines and tools for selection of treatment technologies for optimal management practices. The site provides introductory information on beneficial uses of produced water, a beneficial use matrix, as well as key criteria and case studies to aid in the assessment of beneficial uses. By providing the tools and information required to allow operators to readily evaluate options for treatment and beneficial use of produced water, the site will encourage such use and reduce the cost and environmental impact associated with produced water disposal.

Selected Ongoing Projects

Comprehensive Investigation of Factors Enhancing Microbially Generated Coal Bed Methane
Enhancement of microbial methane production from coal has shown promise, but the fundamental factors influencing methane generation from coal are not well understood. If 1% of the coal in the Powder River Basin could be converted to methane, approximately 30 TCF of gas would be produced. Existing infrastructure in depleted CBM fields could be used, resulting in a substantial energy reserve with a relatively minor environmental impact. The project is determining the microbial environment that will best enhance the generation of methane from coal, and investigating pre-treatment agents that will facilitate the process.

A Self-Teaching Expert System for the Analysis, Design and Prediction of Gas Production from Shales
One of the challenges of unconventional gas development is to rapidly assimilate the information that becomes available when the initial wells in a resource are drilled and completed in order to rapidly move up the learning curve in terms of the most effective development approaches. This project has accomplished a step forward in developing a self-teaching expert system (SeTES) that can incorporate evolving databases involving any type and amount of relevant data (geological, geophysical, geomechanical, stimulation, petrophysical, reservoir, production, etc.) originating from unconventional gas reservoirs, i.e., tight sands, shale or coalbeds. Beyond that, it can help make recommendations about well stimulation, well location, orientation, design and operation. It offers predictions of the performance of proposed wells and permits the analysis of data from installed wells for parameter estimation and continuous expansion of its database.

The deliverable of this project is an alpha release of a self-teaching expert system (SeTES) that can be a vital tool in the attempt to increase reserves and implement a development strategy that maximizes the production associated with a given investment in terms of cost and environmental impact.

Barnett and Appalachian Shale Water Management and Reuse Technologies,
The overall objective of this project is to develop 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 natural gas development in the Barnett and Appalachian Shale Plays.

Areas of emphasis include: 1) Evaluation of promising commercially-available technologies for water reuse; 2) Development of novel coatings to improve performance and cost of ultrafiltration, nanofiltration and reverse osmosis treatment technologies in the demineralization of flowback waters; 3) Development of electrodialysis reversal for low-cost produced water and flowback water demineralization; and, 4) Identification and evaluation of alternate sources of water that may be useful as replacements for groundwater or surface waters that serve as community water supplies.

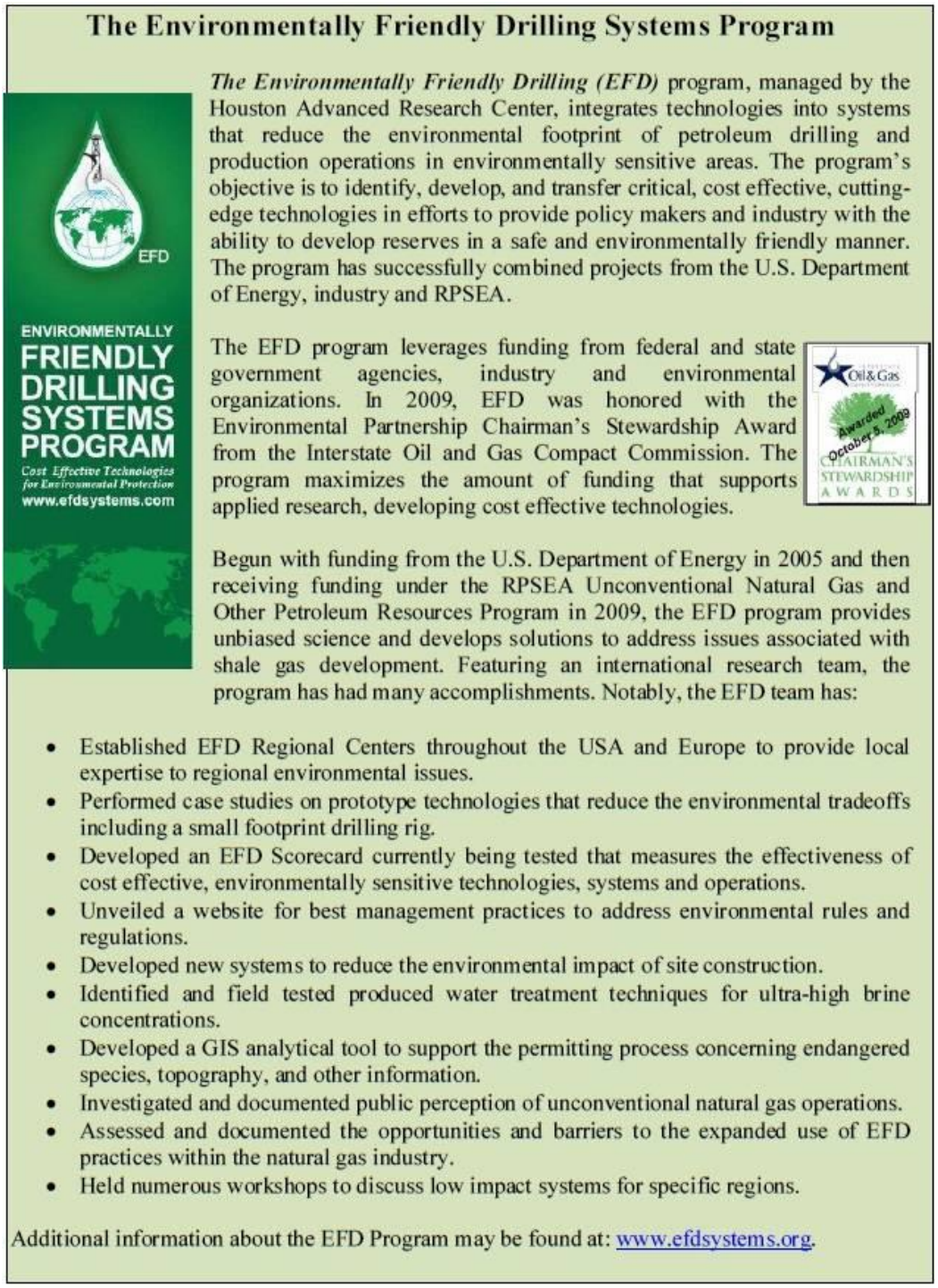
The work is periodically reviewed by the Barnett Shale Water Conservation and Management Committee (BSWCMC) and the Appalachian Shale Water Conservation and Management Committee (ASWCMC). Membership of these committees includes over 20 producing companies in the respective shale gas plays

Pretreatment and Water Management for Frac Water Reuse and Salt Production
GE Global Research is developing a process to treat shale gas frac flowback water to 1) reduce the net amount of fresh water used in the production of natural gas from gas shale, 2) reduce the amount of wastewater, and 3) produce a salable by-product.

This program is evaluating methods of pretreating the frac flowback water (before it is sent to the evaporator and crystallizer) to remove salts and metals that cause corrosion or scaling in the thermal equipment and/or are undesirable in the final solid salt product. The overall water treatment process is being evaluated to determine its performance, cost, and mobility.

The Environmentally Friendly Drilling Systems Program
This project has the overall goal of reducing the environmental impact of drilling and production operations. It is a comprehensive project that combines technical, environmental and societal issues toward the overall improvement of production operations. The project leverages funding from a number of organizations beyond RPSEA, and the accomplishments of the overall program are detailed in Figure 5.2 below.

Figure 5.2: Accomplishments of Environmental Drilling Systems Program



Abstracts and project information for each of the projects can be found on the DOE web site at www.netl.doe.gov/technologies/oil-gas/EPAct2005 and on the RPSEA website at www.rpsea.org.

Chapter 6 Small Producer Program

A. Goal

The overall goal of the Small Producer 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.

Typically, the small producer operates fields that are mature. As such, a significant way in which the environmental impact of oil and gas production can be minimized is to extend the life of production from the existing infrastructure. 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 production entails. Environmental safeguards that allow continued production are important technologies to implement in ways that are economically viable.

The small producer community is quick to adopt new technology that has been shown to have an economic benefit in their operating environment, but sometimes does not have the same level of time or resources that a larger company might have in order 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 approach to enhancing the impact of small producers on safe and environmentally responsible 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 technologies to enhance the production of hydrocarbons in an economic and environmentally responsible manner. Support provided through the program will help 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 technology applications throughout the small producer community.

B. Implementation Plan

The original objectives for the Small Producer Program were developed with input from the Small Producer Advisory Committee, SPAC, (formerly known as the Research Advisory Group, RAG), consisting of industry and academic representatives that are closely tied to the national small producer community. The SPAC focuses on identifying, targeting, and prioritizing specific technology needs consistent with the goals of the program and provides valuable advice in the overall implementation of the program. Goals related to the environmental footprint of oil and gas production were emphasized in response to growing public concern surrounding onshore oil and gas operations.

The overarching Small Producer Program objectives for the 2012–2014 program years are:

- *Reduce Cost and Improve Efficacy of Well Interventions and Drilling*

  Develop and demonstrate technologies to reduce the cost of, reduce the environmental impact of, and/or improve the efficacy of well interventions or drilling.

- *Extend Economic Life of Mature Fields Through Environmentally Safe Efficiency Improvements*

  Develop and demonstrate technologies to improve oil and gas recovery from mature fields in an environmentally sound and safe way.

- *Mitigate Environmental Impacts in Mature Fields*

  Develop and demonstrate technologies for mitigating environmental impacts from past or current operations in mature producing areas, including development drilling and completion operations.

- *Reduce Operating Costs Through More Effective and Efficient Compliance with Operating Regulations*

  Carry out research that will assist in regulatory compliance and demonstration of regulatory compliance.

While the SPAC will be responsible for providing direction to 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 and the Unconventional Resources Program. The SPAC will interact with the Unconventional Resources PAC through the RPSEA Unconventional Resources Program Vice President and through a SPAC representative, who will hold a seat on the Unconventional Resources PAC.

2012-14 Solicitations

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 2012-2014 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

- Leverage of existing wellbores and surface footprint to maximize recovery of additional hydrocarbons
- Development of methods that reduce environmental impact, or improve the safety of development and operations
- 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
- Development of cost-effective, intelligent well monitoring and reservoir modeling methods that will provide operators with the information required for efficient, safe, and environmentally responsible field operations.
- 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
- 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
- Collection and organization of existing well and field data from multiple sources into a readily accessible and usable format that attracts additional investment or supports the development of economically practical and enforceable water management standards and other regulations.
- Creative capture and reuse of industrial waste products (produced water, excess heat) to reduce operating costs, improve recovery, reduce environmental impact, or improve safety.)
- Addressing novel concepts that may be applied to increase production from mature fields.

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 the on the assessment of proposals received and the availability of 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 SPAC. The SPAC consists of representatives of industry and academics with experience working with small producers on topics related to the program theme. A technical evaluation of each proposal is made by three or more reviewers. The reviewers may be SPAC members or other qualified people with the appropriate expertise. In addition to technical merit, alignment with program goals, and capabilities of the proposer, the SPAC 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 there will be $3.17 million available for funding the Small Producer Program during each of the remaining fiscal years. In order to ensure that projects are completed prior to the program sunset date of September 30, 2014, the majority of funds from the 2012-2014 program years will be allocated to support projects selected in the 2011 program. Depending on funds available after the 2011 program obligations, it is anticipated that approximately $3 million will be available to support projects selected under this plan. Approximately two to eight awards are anticipated under this plan.

The typical award is expected to have duration of one year, although longer awards may be considered if the program duration allows. 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 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.

C. Ongoing Activities

The 2007 through 2009 solicitations focused on application of available technologies for oil and gas recovery, water management issues, minimizing environmental impact, and aiding in regulatory compliance. Seven projects were selected from the 2007 solicitation, six from the 2008 solicitation, and six from the 2009 solicitation. These are listed in Appendix C. All awards were made to consortia consistent with EPAct guidelines. The prime contractor is listed as the awardee and the other consortia members are listed as participants. The 2010 solicitation was issued in July 2010 and had the same general focus as the previous 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. Three projects were selected from the 2010 solicitation and these are listed in Appendix C.

Technical Accomplishments

There are 19 completed or ongoing projects in the Small Producer portfolio. In addition, three are in contract negotiations. The ongoing work covers topics such as lowering the environmental footprint of oil field access roads, produced water clean-up and electrical generation from the energy in produced water, web-based software that aids in regulatory compliance, and a number of projects that investigate various technologies to improve recovery from mature fields. Results from completed projects and selected op-going projects are summarized below.

Completed Projects:

Preformed Particle Gels For Mitigating Water Production And Extending The Life Of Mature Oil Wells and Further Improve Particle Gel Technology

The goal is to develop methods to optimize preformed particle gel (PPG) treatments to increase oil recovery and reduce water production by improving waterflood sweep efficiency. Field applications of PPG conformance control treatments in various reservoir conditions were summarized. Guidelines for PPG treatment design were provided. The results will aid in the field design of PPG treatments for a large range of well conditions, allowing for improved recovery from existing waterflood operations.

Near Miscible CO_2 Application to Improve Oil Recovery for Small Producers

This study investigated the feasibility of near miscible CO_2 flooding for improved oil recovery in an Arbuckle reservoir in Kansas. Arbuckle reservoirs are a significant resource in Kansas for improved oil recovery. These reservoirs have produced an estimated 2.2 billion barrels of oil representing 35% of the 6.1 billion barrels of oil of total Kansas oil production. Many of the Arbuckle reservoirs operate at pressures below the minimum miscibility pressure (MMP), the pressure at which CO_2 and oil will completely mix. The study has found that injection of CO_2 at field operating pressures, below the MMP can improve recovery of oil and leave residual CO_2 behind in the reservoir after depletion. Reservoir simulations indicate injection of CO_2 at near miscible pressure improves oil recovery. Maximum recovery efficiency can be achieved by proper design and implementation of CO_2 injection. A follow on study, ***Characterization of Potential Sites for Near Miscible CO_2 Applications to Improve Oil Recovery in Arbuckle Reservoirs, RPSEA project 09123-18,*** will conduct a reservoir characterization study and develop plans for a field test of the process.

Mini-Waterflood: A New Cost Effective Approach to Extend the Economic Life of Small, Mature Oil Reservoirs

The purpose of this project was to improve oil recovery in marginal oil plays that have been ignored for secondary and/or tertiary recovery by major producers. Typically these types of reservoirs are limited in extent, poorly characterized, at low pressure and temperature and frequently are shallow discoveries after deeper targets proved non-productive. The Round Tank (Queen) Field in Southeast New Mexico fits all of these criteria and thus was selected to test the feasibility of injecting water and improving oil recovery. Pitfalls to avoid and evaluation methods to use are identified to help producers design a mini-waterflood.

Selected On-going Projects:

Reducing Impacts of New PIT Rules on Small Producers

In 2008, the state of New Mexico revised its rules covering oil and gas waste pits. The revised "Pit Rules" have impacted New Mexico's producers through increased time for permitting and expenses for drilling. The New Mexico Pit Rule Mapping Portal, http://ford.nmt.edu/react/pitrules_index.html, was designed to help oil and gas operators comply with the New Mexico Pit Rule (Form C-144). To determine whether a proposed oil or gas site meets the Siting Criteria, the operator would have to invest many hours gathering the data from disparate source. The mapping portal solved this problem by compiling the majority of data required by the Siting Criteria into one location that is accessible via the internet. Users can access this information using any standard web browser and view the data on a variety of base maps.

The Pit Rules project has been very popular with producers and regulators. It has provided a tool for the small producers to increase their compliance with environmental regulations and has reduced the time required for regulators to work with small producers to ensure compliance. The end result is a better understanding of the requirements and overall improved compliance with appropriate regulations. When last measured, the portal was experiencing 40-50 users a day, with ~40% of the users being regulatory agencies.

Field Site Testing of Low Impact Oil Field Access Roads: Reducing the Footprint in Desert Ecosystems

The overall objective is to test environmentally friendly components of drilling and production in a desert-like ecosystem that can be used cost effectively to maintain mature field operations. Several innovative, minimal impact lease road designs are being tested for longevity and effectiveness in reducing the environmental footprint of field development in sensitive desert ecosystems; Scott's Environmental Artificial Gravel Road, University of Wyoming and Heartland Biocomposites Inc. Laydown Road, and Newmark Mat Road. A test of these was done at the Texas A&M University Desert Test Center near Pecos, Texas, and is now being moved to the Cerrito Preito Ranch in the Eagle Ford shale area.

Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers

This project focuses on the development and demonstration of a low-temperature distillation unit using co-produced energy sources for produced water purification at wellhead. The prototype design capacity is 20 bbl/day. Total dissolved solids (TDS) and total organic carbon (TOC) were reduced more than 90%. The purified produced water is suitable for alternative uses, such agriculture, irrigation and industrial processing. Field testing and design improvements are currently ongoing.

Electrical Power Generation from Produced Water: Field Demonstration of Ways to Reduce Operating Costs of Small Producers

The overall objective of this project is to identify and demonstrate technology that will reduce the field operating cost of electricity and minimize the environmental impact by creating green electricity using produced water and no additional fossil fuel. Installation of the Green Machine

was completed on June 1, 2011 with the delivery of power to the Dixie Co-op. The field installation time was seven hours including connecting to the Denbury Resources, LLC oilwell. The Denbury field team completed their task in a very short time, which allowed for the installation to go smoothly and quickly.

Development Strategies for Maximizing East Texas Oil Field Production

The East Texas Oil Field is one of the largest fields ever discovered. It was discovered in 1930 and has produced a cumulative oil production of over 5 billion barrels. The nature of the reservoir has allowed for an estimated 80% of the original oil in place to have been drained already. This study is devoted to finding ways to increase this recovery even more. Due to its very large size, even a 1% increase in overall recovery could mean an additional 50 million barrels. Additional recovery strategies to be studied are targeted recompletions of lower stringers and oil at the top of sandstones, efficiently managed large and small waterfloods, and enhanced oil recovery techniques including CO_2 flooding, surfactant/polymer flooding, and their economic and environmental impacts.

D. 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 2012 programs are listed in Chapter 8.

The solicitation for the 2012 program will be released after transmittal of the 2012 Annual Plan to Congress and approval by the Secretary of Energy. It will remain open for a minimum of 45 days. The review and selection process will take about two months, and the award process will take approximately three months.

Short term administrative activities to be completed before the end of FY 2012 include:

- Issue and complete at least one solicitation.
- Engage technical advisory committees to review the solicitation to ensure that it reflects sufficient breadth and depth of industry experience
- Select and award two to eight projects for the 2012 portfolio.

Chapter 7 Approach to Technology Transfer

In order to meet Program goals, 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.

This Chapter describes the approaches that are being used for technology transfer within the program. A summary of actual technology transfer activities and accomplishments is provided in Appendix B. Since the inception of the program, program results have been reported through at least 230 reports, presentations and publications. The actual number likely exceeds that significantly due to a tendency of investigators to under-report presentations and publications in which RPSEA provided only partial support for the work. In addition, many publications and presentations take place after a project is closed, when RPSEA does not have the ability to track them. Since mid-2010, RPSEA has conducted 13 Conferences, Forums and Project Workshops with a collective attendance of over one thousand people. As projects funded in the initial years of the program reach completion, we anticipate even more of the types of events and activities that are described in this chapter and documented in Appendix B.

The general approach that RPSEA uses for technology transfer, including coordination with NETL, is illustrated in Figure 7.1. 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, workshops, 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 reaches 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.

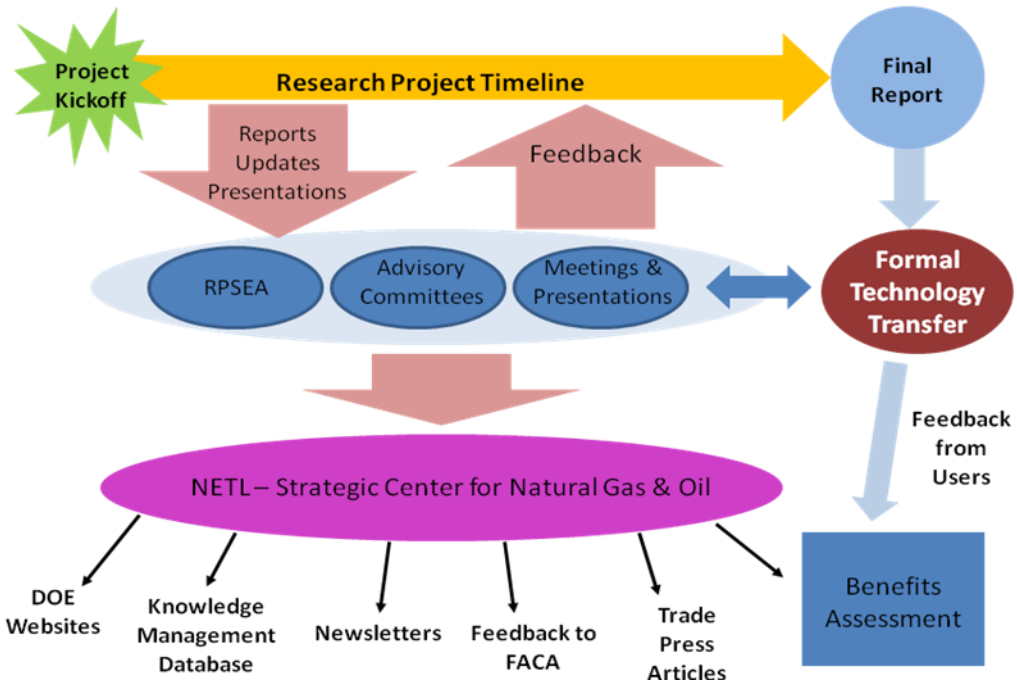


Figure 7.1: Flow Chart for Technology Transfer

Specific technology transfer approaches incorporated in the Program include:

1. The engagement of Program Advisory Committee (PAC) and Technical Advisory Committee (TAC) members through involvement in needs assessment, project selection, and ongoing project review promotes ongoing interests in developing projects and facilitating 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 regardless of membership status. 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 subcontractors 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 (EFD) Program project and the May 2011 issue of *Discover* magazine that noted the same project's work related to hydraulic fracturing and its EFD scorecard. A number of other articles have been published, and links are posted on the RPSEA website. This type of coverage in widely read trade, technical, and general interest 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 SPAC (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.
- The UDW Program hosted its second annual UDW Technology Conference in 2011, following the success of its first conference during 2010. 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 conference will be used to plan similar annual events.
- Like the UDW Technology 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.
- RPSEA has subcontracted the Petroleum Technology Transfer Council (PTTC) to handle certain aspects of this technology transfer program at the Program level. PTTC provides cost-effective services, performed through a network of industry experts and supporters. They provide a multi-pronged package of services that, through synergy, will deliver results beyond that of any single technology transfer service. Currently in year two of the contract, PTTC has worked on a regional basis through their Regional Lead Organizations (RLO's) structure to reach out to the independents and small producers who in many instances have assets in mature fields that without new technology to unlock the resources will not be produced. They have promoted and coordinated technology transfer review meetings in which investigators of RPSEA projects present their results. These meetings enhance communications at the Program level and allow the oil and gas community to network together to discuss cooperation and opportunities to develop additional resources at both the regional level and the national level. RPSEA also

directs PTTC to work on technology transfer projects as needed such as the current upgrade to the RPSEA website to better align the website with technology transfer activities and reporting capabilities.

- A particular new initiative is a series of regional workshops aimed at bringing the results of the Small Producer program element to the thousands of producers scattered around the nation. An October 2011 Small Producer workshop held in Bakersfield, California, was well received, and additional sessions during 2011 are planned in Lawrence, Kansas, and Golden, Colorado. These workshops represent a cooperative effort between the PTTC Regional Lead Organizations and RPSEA intended to leverage our tech transfer relationship with PTTC.

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 which increase the program's 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 is 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, AADE, IADC, DEA, Hart's, Pennwell, Quest Offshore, World Oil, American Oil and Gas Reporter, state and regional oil and gas associations, 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.

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 will be 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 subcontractors, 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.

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 the annual Offshore Technology Conference, where several offshore technologies being developed under the UDW were highlighted, and the 2011 RPSEA Unconventional Gas Conference in Denver, CO. A more extensive list of technology transfer events and activities is given in Appendix B, Technology Transfer Accomplishments. As new events are scheduled, they will be included on the RPSEA Calendar of Events.

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. Support for and coordination with that program is a key part of the RPSEA technology transfer effort.

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

1. Engage project performers, through collaborative agreements, 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 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 7.1 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 7.1.

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. 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.

		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 Information
Delivery Vehicle	**Project Websites**			Selected projects have websites	
	Program Websites	RPSEA wite with links	Portal on NETL sites with links (KMD)		Pages on DOE site
	Publications	Newsletters, Articles in Trade Press	Newsletters, 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-Administed Program.

Table 7.1: Matrix Outlining Products and Delivery Vehicles for Section 999 Research Results

Chapter 8 Administrative Activities

Solicitation Process

Eligibility

Pursuant to Title IX, Subtitle J 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 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, RPSEA submitted an OCI Plan 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."

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

Solicitations are developed by RPSEA based on the approved Annual Plan submitted to Congress by DOE. These solicitations are submitted to NETL for approval prior to their release by RPSEA. Project selection is through a fully open and competitive process. Beginning with the 2008 solicitation cycle, a two-step process has been employed by the Program Consortium

(RPSEA). 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) provide technical reviews of proposals, while the RPSEA Program Advisory Committees (PACs) select projects for award. The selections recommended by RPSEA are submitted to NETL for final review and approval.

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 of the technology (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

For 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

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 2012 portfolio will be determined in consultation with NETL after the *2012 Annual Plan* has been submitted to Congress and the Secretary has approved the solicitations. After release, solicitations will remain open for a minimum of 45 days. The administrative milestones for all three of the project portfolios are listed in Table 8.1.

RPSEA 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													

Table 8.1: Program Elements Timeline

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. Proposals 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.

Funding Estimates

For each fiscal year, it is anticipated that approximately $14.9 million will be available for the UDW program, $13.7 million for Unconventional Resources and $3.2 million for the Small Producer program. In order to ensure that projects are completed prior to the program sunset date in 2014, some funds from the 2012-2014 program years will be allocated to support projects selected in the 2011 program or to augment the funding of projects selected in previous years. Depending on funds available after the 2011 program obligations, it is anticipated that the approximate funding for one fiscal year will be available to support projects in each of the program elements under this plan.

The typical award is expected to have duration of one year, although longer awards may be considered if the program duration allows. The solicitations will specify a maximum award duration that is consistent with the authorized ending date for the program. All projects will be fully funded to the completion of an 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.

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 producers, universities, Non-Government Organizations (NGOs), etc.)
- Petroleum Technology Transfer Council (PTTC)

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.
- ***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).
- ***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.
- ***Technology Transfer –*** 2.5 percent of the amount of each award must be designated for technology transfer and outreach activities.
- ***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.

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

Appendix A: RPSEA Membership and Committee Lists

RPSEA Members

Advanced Resources International, Inc.
Advantek International, Corp.
AGR Subsea, Inc.
Alcoa Oil and Gas
Altira Group LLC
AMOG Consulting, Inc.
Anadarko Petroleum Corporation
Apache Corporation
APS Technology, Inc.
At Balance Americas LLC
Athens Group
Baker Hughes Incorporated
BG Group plc
BHP Billiton Petroleum
Bill Barrett Corporation
BJ Services Company
Blade Energy Partners, Ltd
BlueView Technologies Inc.
BMT Scientific Marine Services Inc.
BP America, Inc.
Cameron/Curtiss-Wright EMD
Campbell Applied Physics
CARBO Ceramics, Inc.
CDL Inc
C-FER Technologies
Chesapeake Energy Corporation
Chevron Corporation
Colorado Oil & Gas Association
Colorado School of Mines
ConocoPhillips Company
Conservation Committee of California Oil & Gas Producers
Consortium for Ocean Leadership
Consultate L.L.C.
Consumer Energy Alliance
Correlations Company Inc.
CSI Technologies, Inc.
Cubility

DCP Midstream, LLC
DeepFlex Inc.
Deepwater XLP Technology, LLP
Det Norske Veritas (USA)
Devon Energy Corporation
DOF Subsea USA
Drilling & Production Company
EnCana Corporation
Energy Corporation of America
Energy Valley, Inc.
Energy Ventures
Entropy Risk Management, Inc.
ExxonMobil Corporation
Fluor Corporation
Foro Energy, Inc.
Gas Technology Institute
GE Oil & Gas
General Marine Contractors, LLC
Granherne, Inc.
Greater Fort Bend Economic Development Council
Greensburg Oil, LLC
GSI Environmental, Inc.
Gunnison Energy Corporation
Halliburton
Hamilton Group
Harvard Petroleum Corporation
Hess Corporation
HIMA Americas, Inc.
Hoerbiger Corporation of America Inc.
Hogan Lovells US LLP
Houston Advanced Research Center
Houston Offshore Engineering, LLC
Houston Technology Center
HydroFlame Technologies, LLC
Idaho National Laboratory
Independent Petroleum Association of America
Independent Petroleum Association of New Mexico
Interstate Oil and Gas Compact Commission
Jacobs Engineering Group Inc.
Jet Propulsion Laboratory
Julander Energy Company
KC Harvey Environmental, LLC
Knowledge Reservoir, LLC
Kongsberg Oil & Gas Technologies, Inc.

Kvaerner
Laserlith Corporation
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.
M&H Energy Services
Nalco Company
Nance Resources Inc.
NanoRidge Materials, Inc.
Natural Carbon, LLC
Nautilus International, LLC
Nautronix, Inc.
Neptec USA
New England Research, Inc.
New Mexico Institute of Mining and Technology
Nexen Petroleum USA
NGAS Resources, Inc.
NGO Development Corporation
NiCo Resources
Noble Energy, Inc
Oak Ridge National Laboratory
Oceaneering International, Inc.
Octave Reservoir Technologies
Oklahoma Independent Petroleum Association
Oklahoma State University
OTM Consulting Ltd.
Oxane Materials, Inc.
Panther Energy Company, LLC
Paulsson Inc.
Peritus International, Inc.
Petris Technology, Inc.
Petrobras America, Inc.
Petroleum Technology Transfer Council
Pioneer Natural Resources Company
Propel, Inc.

Q O, Inc.
Quest Offshore Resources, Inc.
Radoil, Inc.
Rice University
Robert L. Bayless, Producer LLC
Rock Solid Images
Roxar
RTI Energy Systems
Sandia National Laboratories
Schlumberger Limited
Shell International Exploration & Production
Siemens Energy, Inc.
Southern Methodist University
Southwest Research Institute
Spatial Energy
SR2020 Inc.
Stanford University
Statoil
Strata Production Company
Stress Engineering Services, Inc.
Subsea Riser Products
Technip USA Inc.
Technology International Inc.
Tejas Research & Engineering, LP
Tenaris
Texas A&M University
Texas Energy Center
Texas Independent Producers and Royalty Owners Association
Texas Tech University
The Fleischaker Companies
The Ohio State University
The Pennsylvania State University
The Research Valley Partnership, Inc.
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 Colorado at Boulder
University of Houston
University of Southern California

Water Standard
Weatherford International Ltd.
West Virginia University
Western Energy Alliance
WFS Energy & Environment
Woods Hole Oceanographic Institution
Wright State University
2H Offshore Inc.
3D at Depth, LLC

RPSEA Board of Directors

BOARD MEMBER	AFFILIATION
Mr. John Warren– Board Chair	Petrobras America
Mr. John Allen	GE Oil & Gas
Dr. Richard A. Bajura	West Virginia University
Dr. Iraj Ershaghi	University of Southern California
Mr. Jeff Fisher	Chesapeake Energy Corporation
Mr. David Fleischaker	The Fleischaker Companies
Mr. Jeff Harvard	Harvard Petroleum
Dr. Richard C. Haut	Houston Advanced Research Center
Dr. Stephen A. Holditch	Texas A&M University
Mr. Craig Howard	Representing Independent Petroleum Association of America
Mr. Fred Julander	Representing Colorado Oil & Gas Association
Dr. Thomas Klei	Louisiana State University
Mr. Vello Kuuskraa	Advanced Resources International, Inc.
Mr. Guy Lewis	Gas Technology Institute
Dr. Daniel H. Lopez	New Mexico Institute of Mining and Technology
Dr. Dag Nummedal	Colorado School of Mines
Mr. Gene Ratterman	Baker Hughes Incorporated
Mr. Hani Sadek	Chevron Corporation
Mr. Jim Schroeder	Representing Western Energy Alliance
Dr. Robert Siegfried	Research Partnership to Secure Energy for America
Mr. C. Michael Smith	Interstate Oil and Gas Compact Commission
Mr. Jay Still	Pioneer Natural Resources Company
Dr. Kenneth Tubman	ConocoPhillips
Mr. T.J. Wainerdi	University of Houston
Mr. Thomas E. Williams	Nautilus International, LLC
Dr. Mark Zoback	Stanford University

RPSEA Strategic Advisory Committee (SAC)

NAME	AFFILIATION
Dr. Van Romero – Chair	New Mexico Institute of Mining and Technology
Scott Anderson	Environmental Defense Fund
Ralph Cavanagh	Natural Resources Defense Council
Paul Doucette	GE Oil & Gas
David Fleischaker	The Fleischaker Companies
Dr. Stephen Holditch	Texas A&M University
Fred Julander	Julander Energy Company
Melanie Kenderdine	Massachusetts Institute of Technology
Vello Kuuskraa	Advanced Resources International, Inc.
Dan LeFevers	Gas Technology Institute
Dirk McDermott	Altira Group LLC
C. Michael Ming	State of Oklahoma
Dr. Donald Paul	Energy Technology Services, LLC
Dr. Robert Siegfried	Research Partnership to Secure Energy for America
Kyle Simpson	Hogan Lovells US LLP

RPSEA Ultra-Deepwater Program Advisory Committee (PAC)

NAME	AFFILIATION
Gail Baxter	Marathon Oil Corporation
Dom Berta	ConocoPhillips Company
Paul Bommer	The University of Texas at Austin
Arne Lyngholm	Statoil
Philip Grossweiler	M&H Energy Services
Terry Lechinger	Stress Engineering Services
Khalid Mateen	Total E&P Research & Technology USA, Inc.
David Morgan	Cameron
Robert Pilko	Blade Energy Partners, Ltd
Jim Raney	Anadarko Petroleum Corporation

Hani Sadek	Chevron Corporation
Luiz Fernando Souza	Petrobras America Inc.
Ron Sweatman	Halliburton
Mike Theobald	Maersk Group
John Vicic	BP America, Inc.
Jane Zhang	Shell International Exploration & Production
Gary Covatch	National Energy Technology Laboratory (Ex-Officio)
Roy Long	National Energy Technology Laboratory (Ex-Officio)

RPSEA Unconventional Resources Program Advisory Committee (PAC)

NAME	AFFILIATION
Kent Perry, Chair	Gas Technology Institute
Jeff Fisher	Chesapeake Energy Corporation
Richard Keck	BP America, Inc.
John Hallman	Weatherford International Ltd.
Dr. Valerie Jochen	Schlumberger Limited
Dr. Dennis Johnston	Devon Energy Corporation
Randy LaFollette	Baker Hughes
Dr. John Lee	Texas A&M University
Mark Malinowsky	Rosewood Resources, Inc.
David Martineau	Pitts Oil Company, LLC
Steve McKetta	Southwestern Energy Company
Brook Phifer	NiCo Resources, LLC
Darrell Pierce	DCP Midstream, LLC
Dr. Nafi Toksoz	Massachusetts Institute of Technology
Jim Venditto	Anadarko Petroleum Corporation
Mark Zoback	Stanford University
Roy Long	National Energy Technology Laboratory (Ex-Officio)

Small Producer Advisory Committee (SPAC)

NAME	AFFILIATION
Jeff Harvard, Chair	Harvard Petroleum Company, LLC
Cheryl Desforges	Sabco Oil and Gas Company
Dr. Iraj Ershaghi	University of Southern California
Tom Gill	Gunnison Energy Corporation
John Hallman	Weatherford International
Bob Kiker	Petroleum Technology Transfer Council
Dr. Douglas Patchen	West Virginia University
Brook Phifer	NiCo Resources, LLC
Jin Schroeder	Representing Western Energy Alliance
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)

NAME	AFFILIATION
Dr. Richard Haut, Chair	Houston Advanced Research Center
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 Environmental, LLC
Chuck Horn	Technip USA
Dr. Joe Kiesecker	The Nature Conservancy
Roy Long	National Energy Technology Laboratory
Dr. Pam Matson	Stanford University
Dr. Charles Newell	GSI Enviornmental, Inc.
Dr. Mason Tomson	Rice University

Heidi VanGenderen	American Council on Renewable Energy

Appendix B: 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 Technology 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 RPSEA Technical Conferences, 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
Jun-11	Program Presentation	Overall Program	***Society of Petroleum Engineers Research & Development Symposium***, Austin, TX
Mar-10	Presentation: ***"Natural Gas – An Unconventional Future with Efficiency & Renewables"***	Overall Program	***Sustainable Opportunities Summit***, Denver, CO
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
Oct-09	Panel discussion	Overall Program	***Renewable & Sustainable Energy Institute***, Boulder, CO
Oct-09	Plenary presentation	Overall Program	***Society of Exploration Geophysicists 2009 Forum***
Oct-09	Presentation	Overall Program	***Innovation Showcase***, Houston, TX
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
Sep-09	Lecture	Overall Program	***Energy Management Program***, Tulsa University, Tulsa, OK
Aug-09	Program Presentation	Overall Program	***Colorado School of Mines Produced Water Project Advisor/Stakeholders' Meeting***, Golden, CO
Jul-09	Environmental Panel discussion	Overall Program	***Colorado Oil and Gas Association Annual Meeting***, Denver, CO
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
May-09	Clean Tech Panel Discussion Presentation: ***"Traditional Energy – Natural Gas: A Bridge, Enabler and a Destination"***	Overall Program	***Clean Tech 2009 Conference***, Houston, TX

Date	Description	Program/ Contract No.	Event Title
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
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
Mar-09	Program Presentation	Overall Program	***Global New Energy Summit***, Santa Fe, NM
Feb-10	Project progress presentations and discussion	Small Producer Program	***Small Producers Program Showcase***, Midland, TX
Feb-09	Project progress presentations and discussion	Small Producer Program	***CO_2 Forum***, Austin, TX
Jul-11	Project progress presentations and discussion	UDW Program	***UDW Technology Conference***, The Woodlands, TX
May-11	Poster presentations	UDW Program	***Offshore Technology Conference***, Houston, TX
Apr-11	Keynote speaker presentation on RPSEA projects	UDW Program	***American Association of Drilling Engineers Annual Conference***, Houston, TX
Mar-11	Chair	UDW Program	***Society of Petroleum Engineers National Academy of Engineering Gulf of Mexico Ultra-Deepwater Drilling & Completions Regulations Summit***
Feb-11	Chair	UDW Program	***Society of Petroleum Engineers Deepwater Completions & Operations Symposium***, Houston, TX
Jun-10	Project progress presentations and discussion	UDW Program	***UDW Technology Conference***, Houston, TX
Mar-10	Presentation: ***"A Different Approach to Oilpatch and R&D Technology Development"***	UDW Program	***PennWell Subsea Tieback Forum***, Galveston, TX

Date	Description	Program/ Contract No.	Event Title
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
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
Jan-10	Project progress presentations and discussion	UDW Program	***UDW Met-ocean Technical Advisory 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
Nov-09	Project progress presentations and discussion	UDW Program	***UDW Geoscience Technical Advisory Meeting***, Houston, 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

Date	Description	Program/ Contract No.	Event Title
Oct-09	Project progress presentations and discussion	UDW Program	***UDW Met-ocean Systems Technical Advisory Meeting***, Houston, TX
Oct-09	Project progress presentations and discussion	UDW Program	***Chevron Technology Showcase Meeting***, Houston, TX
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
Aug-09	Organized and Participated	UDW Program	***Composite Reinforced Drilling Risers Workshop***, Houston, 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
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
Mar-09	Project progress presentations and discussion	UDW Program	***UDW Floating Systems Technical Advisory Meeting***, Bellaire, TX

Date	Description	Program/ Contract No.	Event Title
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
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
Aug-11	Project presentations	Unconventional Resources Program	***Focusing on Environmental Issues Associated with Unconventional Natural Gas Operations Workshop***, The Woodlands, TX
Jun-11	Project presentations	Unconventional Resources Program	***American Rock Mechanics Association meeting***
Jun-11	Project workshop presentations	Unconventional Resources Program	***Accessible Software Developed for Application to Unconventional Resources Workshop***, Houston, TX
Apr-11	Project progress presentations and discussion	Unconventional Resources Program	***Unconventional Resources Technology Conference***, Denver, CO
Apr-11	Project workshop presentations	Unconventional Resources Program	***Piceance Basin, Mamm Creek Field Project Reviews Workshop***, Denver, CO
Mar-11	Hydraulic fracturing research project presentations	Unconventional Resources Program	***Woodford Summit***, Norman, OK
Apr-10	Project progress presentations and discussion	Unconventional Resources Program	***Unconventional Resources Technology Conference***, Golden, CO
Nov-09	Presentation	Unconventional Resources Program	***Geothermal Conference***, Dallas, TX
Nov-09	Presentation	Unconventional Resources Program	***Oklahoma Independent Petroleum Association Unconventional Gas Forum***, Tulsa, OK

Date	Description	Program/ Contract No.	Event Title
Nov-09	Presentation	Unconventional Resources Program	***EDGER Seismic Forum***, Austin, TX
Oct-09	Presentation: ***"Reservoir Imaging in Difficult Environments"***	Unconventional Resources Program	***Industry Technology Facilitator Theme Day***
Sep-09	Session co-chair and panel discussion	Unconventional Resources Program	***PennWell Unconventional Gas Conference***, Fort Worth, TX
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
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
Apr-09	Project progress presentations and discussion	Unconventional Resources Program	***Unconventional Resources Annual Project Review Meeting***, Golden, CO
Jun-11	Project workshop presentations	07121-1301	***Improvements to Deepwater Measurement Workshop***, Houston, TX
Dec-09	Nano-Umbilical Workshop, Rice University, Houston, TX	07121-1302	***Ultra-high Conductivity Umbilicals***
May-11	Project workshop presentations	07121-1401	***Composite Reinforced Ultra-Deepwater Drilling Riser Technology Transfer Workshop***, Houston, TX
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***
Feb-10	Poster presentation: ***"New Albany Shale Gas Project",*** NAPE Conference, Houston, TX	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***

Date	Description	Program/ Contract No.	Event Title
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***
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, AL, 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, 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***
Oct-09	Presentation: World Gas Conference, Buenos Aires, Argentina (Best Project Award)	07122-16	***New Albany Shale Gas***
Sep-09	Presentation: ***"Top-Down Intelligent Reservoir Modeling of New Albany Shale"***, 2009 SPE Eastern Regional Meeting, Charleston, West Virginia, 23–25 September 2009, Dahaghi, A. Kalantari and S. D. Mohaghegh.	07122-16	***New Albany Shale Gas Project***

Date	Description	Program/ Contract No.	Event Title
Sep-09	Discussion with New Albany shale geologist during the Regional AAPG Conference, Evansville, IN	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***
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***
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***
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***
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***
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***
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***

Date	Description	Program/ Contract No.	Event Title
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***
Mar-10	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	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***
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***
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***
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***

Date	Description	Program/ Contract No.	Event Title
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***
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***
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***

Date	Description	Program/ Contract No.	Event Title
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, LA, April 11-14	07122-44	***Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures***
Jul-11	Project workshop presentations and core workshop	07122-45	***Shale-Gas and Tight-Gas-Sand Reservoirs of Utah Core Workshop***.
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***
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***

Date	Description	Program/ Contract No.	Event Title
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 Opportunities***
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***
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***
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***
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, CA, 24-26, March 2009.	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, 24-26, March 2009.	07123-05	***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers***
Mar-10	Technology Transfer - Semi-annual website updates	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***
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***
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***
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***
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***
Nov-08	Data Presentation and Feedback: Meeting with producers; Farmington, 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***
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***
Sep-08	Technology Transfer - build website	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***
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
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***
May-11	Presentation	08121-2502-01	***Offshore Technology Conference Technical Session***, Houston, TX
Jul-11	Project workshop presentations	08122-35	***Lowering the Environmental Footprint of Marcellus Shale Development Workshop***, Morgantown, WV
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***
Jan-10	Publication in Hart's E&P: ***"Cooperative Efforts Lead to Safer Operations"***	08122-35	***The Environmentally Friendly Drilling Systems Program***
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***
Dec-09	***"Local Leaders' Perceptions of Energy Development in the Barnett Shale."*** Southern Rural Sociology24(1): 113-129.	08122-35	***The Environmentally Friendly Drilling Systems Program***

Date	Description	Program/ Contract No.	Event Title
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***
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***
Aug-09	Web page www.efdsystems.com	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***
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***

Date	Description	Program/ Contract No.	Event Title
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***
May-11	Presentation	09121-3300-08	***Offshore Technology Conference Technical Session***, Houston, TX

Table Appendix B.1: Technology Transfer

Appendix C: 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	Completed	$820,000	2008
DW2502: Modeling and Simulation of Managed Pressure Drilling for Improved Design, Risk Assessment, Training and Operations	Stratamagnetic Software, LLC	Completed	$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				
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
		Subtotal:	**$1,103,000**	
Initiative 3: Intervention (Downhole Services)				
DW1502: Coil Tubing Drilling and Intervention System Using Cost Effective Vessels	Nautilus International, LLC	Completed	$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.	JAugust 2012	$1,551,239	2009
		Subtotal:	**$5,753,256**	
		Need 1 Total:	***$8,525,602***	
Need 2: Appraisal and Development Geoscience and Reservoir Engineering				
Initiative 1: Reservoir Characterization and Appraisal				

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
DW2001: Synthetic Benchmark Models of Complex Salt	SEAM	March 2012	$2,633,364	2007
DW2701: Resources to Reserves Development and	The University of Texas at Austin	September 2011	$200,331	2008
RPSEA Draft Annual Plan	124			November 2011
		Subtotal:	**$2,833,695**	
Initiative 2: Improved Recovery				
DW1701: Improved Recovery	Knowledge Reservoir	Completed	$1,599,712	2007
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:	***$6,427,736***	
Need 3: Significantly Extend Satellite Well Tieback /Surface Host Elimination				
Initiative 1: Subsea Processing & Boosting				
DW1301: Improvements to Deepwater Subsea Measurements	Letton-Hall Group	December 2011	$3,600,126	2007
DW1901: Subsea Processing System Integration Engineering	GE Global Research	Completed	$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	April 2014	$2,000,000	2009
		Subtotal:	**$7,927,967**	
Initiative 3: Stabilized Flow				
DW1201: Wax Control	University of Utah	August 2011	$400,000	2007

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
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

Experimental Data and CFD Simulations				
		Subtotal:	**$1,114,952**	
		Need 3 Total:	***$13,843,045***	
Need 4: Dry Trees and Risers in 10,000 Feet Water Depth				
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	Completed	$1,841,398	2007
DW1403: Fatigue Performance of High Strength Riser Materials	Southwest Research Institute	November 2011	$800,000	2007
DW3500-02: Fatigue Testing Of Shrink-Fit Riser Connection For High Pressure Ultra Deepwater Risers	Subsea Riser Products	November 2011	$348,563	2009
		Subtotal:	**$2,989,961**	
		Need 4 Total:	***$4,080,689***	
Need 5: Continuous Improvement and Innovation				
Initiative 1: Improve Operating and Inspection Processes				
DW2101: New Safety Barrier Testing Methods	Southwest Research Institute	December 2011	$128,000	2008
DW2201: Heavy Viscous Oil PVT	Schlumberger	June 2014	$502,961	2008
DW3300-06: High Resolution 3D Laser Imaging for Inspection, Maintenance, Repair, and Operations	3D at Depth, LLC	February 2012	$498,898	2009

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
DW3300-08: Sensors & Processing for Pipe, Riser, Structure, & Equipment Measurements, Corrosion Detection, Leak	Blueview Technologies, Inc.	June 2012	$468,463	2009
		Subtotal:	**$1,598,322**	
Initiative 2: Graduate Student and Innovative Game-Changing Technologies				
DW1603-A: Graduate Student Design Project. Flow Phenomena in Jumpers	The University of Tulsa	Completed	$120,000	2007
DW1603-B: Graduate Student Design Project. Hydrate Plug Characterization and Dissociation Strategies	The University of Tulsa	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
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	December 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 Pipelines in Real-Time and at a Negligible Marginal Cost Per Analysis: A Proof of Concept Study	Livermore Instruments Inc.	February 2013	$119,716	2008
DW2902-07: Fiber Containing Sweep Fluids for Ultra Deepwater Drilling Applications	The University of Oklahoma	January 2012	$119,971	2008
		Subtotal:	**$1,079,688**	
		Need 5 Total:	***$2,678,010***	

Project	Lead Performer	Project End Date/ Duration	Program Funding	Funding Portfolio Year
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)	Completed	$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	***$38,790,143***	

UCR Project Portfolio

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
2007 Funding Year				
07122-07 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.
07122-09 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 June 2012	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
07122-12 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

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
07122-14 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
07122-15 Reservoir Connectivity and Stimulated Gas Flow in Tight Sands	Colorado School of Mines	$2,894,256 May 2012	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
07122-16 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
07122-17 Geological Foundation for Production of Natural Gas from Diverse Shale Formations	Geologic Survey of Alabama	$497,459 Completed	Geologic characterization of diverse shales in Alabama	
07122-22 Petrophysical Studies of Unconventional Gas Reservoirs Using High-Resolution Rock Imaging	Lawrence Berkeley National Laboratory	$1,071,105 Nov 2012	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
07122-23 A Self-Teaching Expert System for the Analysis, Design and Prediction of Gas Production from Shales	Lawrence Berkeley National Laboratory	$1,774,840 Nov 2011	User friendly software package for gas shale production prediction	Texas A&M University; University of Houston; University of California Berkeley; Anadarko; Southwestern Energy
07122-27 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
07122-29 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	
07122-33 Advanced Hydraulic Fracturing Technology for Unconventional Tight Gas Reservoirs	Texas A&M University	$1,045,551 Sep 2012	Design methodology for hydraulic fracturing considering new conductivity model	Carbo Ceramics; Schlumberger; Halliburton Energy Services; BJ Services
07122-35 Optimizing Development Strategies to Increase Reserves in Unconventional Gas Reservoirs	Texas A&M University	$314,606 Jan 2012	Reservoir and decision model incorporating uncertainties	Unconventional Gas Resources Canada Operating Inc.; Pioneer Natural Resources
07122-36 Novel Fluids for Gas Productivity Enhancement in Tight Formations	The University of Tulsa	$219,920 Sept 2012	Model for the mitigation of gel damage due to hydraulic fracturing in the near wellbore region	Williams Exploration & Production
07122-38 Improvement of Fracturing for Gas Shales	The University of Texas at Austin	$691,821 Aug 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
07122-41 Improved Reservoir Access through Refracture Treatments in Tight Gas Sands and Gas Shales	The University of Texas at Austin	$949,318 Feb 2012	Strategy for refracture of tight gas and gas shale wells. Define window of refracture opportunity	Noble Energy; BJ Services; Anadarko; Jones Energy; Pinnacle Technologies
07122-43 Optimization of Infill Well Locations in Wamsutter Field	The University of Tulsa	$443,563 Completed	Simulation technique for high-grading downsized spacing locations in a tight gas reservoir	Texas A&M University; Devon Energy
07122-44 Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures	The University of Utah	$1,068,863 Oct 2012	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
07122-45 Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities	Utah Geologic Survey	$428,491 May 2012	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

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
2008 Funding Year				
08122-05 Barnett and Appalachian Shale Water Management and Reuse Technologies	Gas Technology Institute	$2,500,000 Dec 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
08122-15 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
08122-35 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
08122-36 Pretreatment and Water Management for Frac Water Reuse and Salt Production	GE Global Research	$1,105,000 Sep 2011	Technology that enables recycle of fracturing flowback water, and production of a salable salt by-product	STW Resources, Inc.
08122-40 Stratigraphic Controls on Higher-Than-Average Permeability Zones in Tight-Gas Sands in the Piceance Basin	Colorado School of Mines	$111,216 June 2012	Evaluation of the stratigraphic controls on the distribution and quality of tight-gas reservoirs in the Piceance Basin	

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
08122-45 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.
08122-48 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.
08122-53 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
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	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

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
2009 Funding Year				
09122-01 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
09122-02 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
09122-04 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
09122-06 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
09122-07 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

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
09122-11 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.
09122-12 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 Apr 2013	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.
09122-29 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
09122-32 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

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
09122-41 Improved Drilling and Fracturing Fluids for Shale Gas Reservoirs	The University of Texas at Austin	$600,000 Dec 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
2010 Funding Year				
10122-06 The Technology Integration Program: An Extension of the Environmentally Friendly Drilling Systems Program	Houston Advanced Research Center	$6,000,000 36 mo	The TIP will establish a network of regional centers that will perform field tests, technology transfer and outreach activities. Field tests of identified technologies will be performed and documented. The integrated technologies are expected to significantly accelerate the safe and environmentally responsible development of gas shales across the USA. Technology Transfer-Outreach-Education materials include web sites, reports from conferences, brochures, and publications	Texas A&M University, Texas A&M University – Kingsville, Texas AgriLife Extension Service, Sam Houston State University, Utah State University, Tom Williams, Epic Software, Petris Technology, Oak Ridge National Laboratory, University of Arkansas, University of Colorado, Land Steward Consultants, Black Brush Oil and Gas, Scott Environmental Services, Newpark Mats and Services, Natures Composites, MI SWACO, University of Texas Bureau of Economic Geology, AVI LLC (Rice University), Ames Energy Advisors, Fountain Quail, 212 Resources, Dow Chemical Company, Water Resources Company, Consumer Energy Alliance, Goodrich Petroleum Company, The Nature Conservancy, Campbell Applied Physics, Rancho San Pedro, Petrohawk.

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
10122-07 NORM Mitigation and Clean Water Recovery from Marcellus Frac Water	GE Global Research	$1,600,000 24 mo	Development and validation at the pilot scale, of two technologies to economically recover 90-95% of Marcellus frac water as clean water and a salable salt	GE Water & Process Technologies, Endicott Interconnect Technologies, Inc.
10122-19 Lowering Drilling Cost, Improving Operational Safety, and Reducing Environmental Impact through Zonal Isolation Improvements for Horizontal Wells Drilled in the Marcellus and Haynesville Shales	CSI Technologies	$3,005,500 24 mo	A comprehensive study of the cementing process applied in the Marcellus Shale fields and an integrated process to optimize zonal isolation, reduce job problems, minimize remedial cementing requirements, and reduce rig time spent waiting on cement.	University of Houston Chemical Engineering Department

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
10122-20 Development of Non-Contaminating Cryogenic Fracturing Technology for Shale and Tight Gas Reservoirs	Colorado School of Mines	$1,990,568 36 mo	Test and develop an innovative technology for enhanced gas recovery (EGR) from low-permeability shale gas and tight gas reservoirs. In particular, the proposed research is focused on developing a novel cryogenic fracturing technology for significant reduction of flow resistance near wells and increase mobile gas volume in unconventional gas reservoirs. The success of this technology could dramatically reduce water use for shale fracturing.	CARBO Ceramics, Pioneer Natural Resources USA, Inc., Lawrence Berkeley National Laboratory (LBNL)
10122-39 Novel Engineered Osmosis Technology: A Comprehensive Approach to the Treatment and Reuse of Produced Water and Drilling Wastewater	Colorado School of Mines	$1,323,805 24 mo	Novel membranes and membrane systems, new methods to enhance and improve osmotic and other water treatment processes, and computer programs to facilitate the implementation of these new systems	Hydration Technology Innovations, LLC, Bear Creek Services (BCS) Pinnacle Operating Company, Inc., Stewart Environmental Consultants, Inc., SM Energy Company, PENN Virginia Oil and Gas, L.P., Emerging Products Technical Consulting, LLC, and more

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
10122-42 A Geomechanical Analysis of Gas Shale Fracturing and Its Containment	Texas A&M University	$650,891 24 mo	Study(i) to understand the role of rock texture, fabric, and deformation regime on the nature and extent of induced fractures, (ii) to develop better understanding of the impact of rock property and interfaces/discontinuities characteristics on containing fractures in gas shale reservoirs, and (iii) to numerically study fracture complexity and contained stimulated volume while considering rock heterogeneity and discontinuity based on experimental observations.	Shell Oil, Matador, APEXHiPoint, and Schlumberger-TerraTek
10122-43 Diagnosis of Multiple Fracture Stimulation in Horizontal Wells by Downhole Temperature Measurement for Unconventional Oil and Gas Wells	Texas A&M University	$763,048 36 mo	A new methodology for hydraulic fracturing diagnosis using downhole temperature and pressure date to identify fracture locations and types (longitudinal versus transverse), estimate fracture geometries and evaluate fractured well performance	Hess, Shell USA

Project	Recipient	Program Funding/ Complete Date	Deliverable	Other Participants
10122-47 Predicting Higher-Than-Average Permeability Zones In Tight-Gas Sands, Piceance Basin: An Integrated Structural And Stratigraphic Analysis	Colorado School of Mines	$511,843 24 mo	An improved, fully integrated understanding of subsurface geologic controls on tight-gas sand resources will help predict critical "sweet spots" in the Piceance basin. Optimum well placement will result in a decrease in the number of wells necessary to develop the resource.	Bill Barrett Corporation and Williams E&P

SP Project Portfolio

Project	Recipient	Program Funding/ Completion Date	Deliverable	Other Participants
2007 Funding Year				
07123-01 Field Site Testing of Low Impact Oil Field Access Roads: Reducing the Footprint in Desert Ecosystems	Texas A&M University	$284,839 Dec 2011	Identify materials and processes that will lessen the environmental impact of oilfield operations	Rio Vista Bluff Ranch; Halliburton
07123-02 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
07123-03 Near Miscible CO_2 Application to Improved Oil Recovery for Small Producers	The University of Kansas	$274,171 Completed	Define the potential for CO_2 recovery or sequestration in near-miscible reservoirs	Carmen Schmitt
07123-04 Enhancing Oil Recovery from Mature Reservoirs Using Radial-Jetted Laterals and High-Volume Progressive Cavity Pumps	The University of Kansas	$248,385 Dec 2012	Application of available technology to increase oil recovery while effectively disposing of water	Kansas Geological Survey American Energies Corporation
07123-05 Cost-Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers	New Mexico Institute of Mining and Technology	$420,543 Jan 2012	A process to purify produced water at the wellhead	Robert L. Bayless, Producer LLC; Harvard Petroleum Company
07123-06 Seismic Stimulation to Enhance Oil Recovery	Lawrence Berkeley National Laboratory	$723,373 June 2012	Methodology to predict if a reservoir is amenable to seismic stimulation	U.S. Oil & Gas Corporation; Berkeley GeoImaging Resources

Project	Recipient	Program Funding/ Completion Date	Deliverable	Other Participants
07123-07 Reducing Impacts of New Pit Rules on Small Producers	New Mexico Institute of Mining and Technology	$509,185 Aug 2012	Access to online compliance data and automating permitting process	Independent Petroleum Association of New Mexico; New Mexico Oil Conservation Division
08123-02 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
08123-07 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 completed	Demonstrate the feasibility of waterflooding small oil reservoirs that are not conducive to a fully-developed, patterned waterflood.	Armstrong Energy Corporation; Keltic Wall Services
08123-10 lectrical Power Generation from Produced Water: Field Demonstration of Ways to Reduce Operating Costs of Small Producers	Gulf Coast Green Energy	$229, 796 Apr 2012	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
08123-12 Evaluation and Modeling of Stratigraphic Control on the Distribution of Hydrothermal Dolomite Reservoir Away from Major Fault Planes	Western Michigan University	$393,369 July 2012	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

Project	Recipient	Program Funding/ Completion Date	Deliverable	Other Participants
08123-16 Development Strategies for Maximizing East Texas Oil Field Production	Bureau of Economic Geology, The University of Texas at Austin,	$700,000 Oct 2012	Exploration of short to midterm strategies for maximizing recovery from East Texas Oil Field.	Danmark Energy LP; John Linder Operating Co. LLC
08123-19 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 Mar 2012	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
2009 Funding Year				
09123-03 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
09123-09 Enhanced Oil 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

Project	Recipient	Program Funding/ Completion Date	Deliverable	Other Participants
09123-11 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
09123-14 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 CO_2 on-site at small producer fields	J & L Allen Inc.; American Pioneer Ventures; New Mexico Institute of Mining and Technology
09123-18 Characterization of Potential Sites for Near Miscible CO_2 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 CO_2 flood	Tertiary Oil Recovery Project; University of Kansas; Kansas Geological Survey; Carmen Schmitt, Inc.
09123-20 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

Project	Recipient	Program Funding/ Completion Date	Deliverable	Other Participants
2010 Funding Year				
10123-03 Game Changing Technology of Polymeric-Surfactants for Tertiary Oil Recovery in the Illinois Basin	Power, Environmental, Energy Research Institute (PEER Institute)	$624,000 24 months	Engineering calculations and an economic analysis that provide a basis for field implementation of a PS injection project in an oil field located in the Illinois Basin, yielding additional recovery from the existing resource	MidAmerican Energy LLC
10123-05 Predicting Porosity and Saturations from Mud Logs and Drilling Information Using Artificial Intelligence with Focus on a Horizontal Well	Correlations Company	$578,266 36 mo	Optimized neural networks that will allow estimation of pseudo-porosities and -saturations from mud logs, increasing the effectiveness of horizontal well completions	Lynx Petroleum, Armstrong Energy Corporation, Read & Stevens, Inc, Harvey E. Yates Company, New Mexico Bureau of Geology & Mineral Resources
10123-17 Identifying and Developing Technology for Enabling Small Producers to Pursue the Residual Oil Zone (ROZ) Fairways of the Permian Basin, San Andres	The University of Texas of the Permian Basin	$859,270 36 mo	Delineation of the ROZ "fairways" in the Permian Basin of Texas and New Mexico and development of technology for finding the higher quality portions of the ROZ resource recoverable with CO_2 EOR.	Timberline Oil and Gas , Legado Resources, ER Operating, Tabula Rosa, and KinderMorgan, and The Enhanced Oil Recovery Institute, Petroleum Technology Transfer Council, Midland College's Petroleum Professional Development Center, and The Applied Petroleum Technology Academy, Midland

***** All awards made to consortia with prime listed as awardee and others listed as participants*

Acronyms	
AADE	American Association of Drilling Engineers
AAPG	American Association of Petroleum Geologists
ASWCMC	Appalachian Shale Water Conservation and Management Committee
AUV	Autonomous Underwater Vehicles
BOD	Board of Directors
BOEPD	Barrels Oil Equivalent Per Day
BSWCMC	Barnett Shale Water Conservation and Management Committee
CBM	Coalbed Methane
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
HIPPS	High Integrity Pressure Protection System
HPHT	High Pressure/High Temperature
HTC	Houston Technology Center
IADC	International Association of Drilling Contractors
IOGCC	Interstate Oil and Gas Compact Commission
IOR	Improved Oil Recovery
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

Acronyms	
KMD	Knowledge Management Database
LNG	Liquefied Natural Gas
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
NORM	Naturally Occurring Radioactive Material
NPC	National Petroleum Council
NRDC	National Resources Defense Council
O&G	Oil and Gas
OCI	Organizational Conflict of Interest
OCS	Outer Continental Shelf
OESC	The Department of Interior Ocean Energy Safety Advisory Committee
OGIP	Original Gas In Place
OTC	Offshore Technology Conference
OIPA	Oklahoma Independent Petroleum Association
ORD	National Energy Technology Laboratory Office of Research and Development
PAC	Program Advisory Committee
PGC	Potential Gas Committee
PPG	Preformed Particle Gel
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

Acronyms	
S&ES	Safety and Environmental Sustainability
SEAB	Department of Energy Subcommittee on Natural Gas of the Secretary of Energy Advisory Board
SEG	Society of Exploration Geophysicists
SeTES	Self-Teaching Expert System
SME	Subject Matter Expert
SOE	Secretary of Energy
SPAC	Small Producer Advisory Committee
SPE	Society of Petroleum Engineers
SSSV	Subsurface Safety Valves
TAC	Technical Advisory Committee
TCF	Trillion Cubic Feet
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TRL6	Technology Readiness Level 6
UCR	Unconventional Resources Program
UDAC	Ultra-Deepwater Advisory Committee
UDW	Ultra-Deepwater Program
URTAC	Unconventional Resources Technology Advisory Committee
WSCOGA	West Slope Colorado Oil & Gas Association
xHPHT	Extreme High Pressure/High Temperature
YPE	Young Professionals in Energy

Appendix C: Federal Advisory Committee Comments

This appendix is comprised of the final reports of findings and recommendations from the Ultra-Deepwater Advisory Committee, and from the Unconventional Resources Technology Advisory Committee

The Ultra-Deepwater Advisory Committee

Advisory Committee to The Secretary of Energy

November 02, 2012

The Honorable Steven Chu
Secretary of Energy
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

RE: 2013 Draft Annual Plan
Findings and Recommendations

Dear Mr. Secretary:

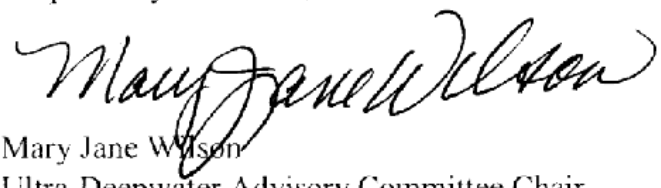
On behalf of the Ultra-Deepwater Advisory Committee (UDAC), I am pleased to offer our insights on proposed elements within the 2013 Draft Annual Plan. As our country is moving towards energy independence, we are encouraged by the intergovernmental agency and industry cooperation focused upon health and safety. This success is aided by results from and technologies enabled through the Ultra Deep Water (UDW) Program.

The UDW Program to date has conducted important research projects that would not have been accomplished without the Section 999 funding. The public/private partnership cooperation between the National Energy Technology Laboratory (NETL) and the Research Partnership to Secure Energy for America (RPSEA) has been successful in identification of those research projects. The RPSEA ability to establish and bring together the industry/stakeholder working groups has been instrumental in the success of the program. The ability of these working groups to advise on the direction of the research could not have been accomplished by any one group (i.e. industry, government, public) individually. This is a model to be fostered in future efforts.

The momentum built to date should be continued. The volunteer working groups have unique expertise which has been invaluable to the Department of Energy in these efforts. These working groups should be maintained. They have provided the champions of the topics and will provide the road maps to commercialization of the research. Much of this research while applicable to UDW is also now available to other harsh and sensitive environments.

As this program sunsets, the UDAC recommends that the human aspects of operations in hazardous environments be an area of focus. Reducing risk of contamination through design, monitoring, and containment during all aspects of exploration, production, and abandonment in UDW will require further work. In addition, the UDAC recommends that a concerted effort to commercialize the research be made for the benefit of the public.

Respectfully submitted,



Mary Jane Wilson
Ultra-Deepwater Advisory Committee Chair

ULTRA-DEEP WATER ADVISORY COMMITTEE FINDINGS AND RECOMMENDATIONS

November 2012

TABLE OF CONTENTS

Page No.

i

RESEARCH AND DEVELOPMENT FINDINGS AND RECOMMENDATIONS

The R&D Program Subcommittee of the UDAC notes that the *2013 Annual Plan* has continued to take into account safety and environment in several aspects of the proposed program. The Program Subcommittee is largely in agreement with the suggestions for research topics contained in the *2013 Annual Plan*. In the UDAC report on the *2012 Annual Plan*, there was acknowledgement that there has been an overall, redirection of research topics towards safety and accident prevention. To date, the emphasis on safety is almost solely focused on the engineering solutions, which while important, will not provide the total solution.

Finding #1 It was stated in the UDAC report to the *2012 Annual Plan* that the human factor is important in safety.

However, the *2013 Annual Plan* does not adequately consider this significant topic. Only one solicitation involving human factors was closed in September 2012 (2011 TA 5101).[1]

The research program has focused on technical issues and the expert advice helping guide the program has come from physical scientists and engineers. The Macondo incident as well as research[2] at Los Alamos National Lab sponsored by DOE on risk assessment highlights the importance of the human factor in safety and the prevention of oil spills in deep water. The President's National Oil Spill Commission[3] Report to the President found:

" ... As a result of our investigation, we conclude:

- The explosive loss of the Macondo well could have been prevented; and
- The immediate causes of the Macondo well blowout can be traced to a series of identifiable mistakes made by BP, Halliburton, and Transocean that reveal such systematic failures in risk management that they place in doubt the safety culture of the entire industry."

The findings of this work support the need for a greater emphasis on the "human factor" by the research program.

Recommendation #1

We recommend further input from experts on human behavior in hazardous operating conditions to increase the emphasis in areas of human interaction. Models can be found in training or simulator programs utilized by nuclear and aviation industries. Effective implementation will

---

[1] 2011 UDW001 RFP, "Human Factors Evaluation of Deepwater Drilling, Including Literature Review"

[2] Minutes of UDAC September 26, 2012, "Gulf of Mexico ultra Deep Water Drilling Risk Management Study: Integrated Risk and Technology Assessment for Spill Prevention "
http://www.fossil.energy.gov/programs/oilgas/advisorycommittees/ultradeepwater.html [3] National

Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling p.vii
(www.oilspillcommission.gov)
require that the 2013 Annual Plan be modified to give this area higher priority. Possible areas of focus might include:

- *Engage an expert to prepare a survey of studies on human behavior in hazardous operating environments, (while this may be included in the 2011 solicitation 5101, there is no follow on in the 2012 or 2013 plans);*

- *Continued work on instruments and data analysis (expert systems) to improve decision making capability; and*

- *Initiate work on hazards and risk analysis from a human perspective: training methods such as those used in the nuclear submarine and nuclear materials handling activities in the USN and DOE National Labs might be adaptable for UDW operations.*

Finding #2 The *2013 Annual Plan* lacks content regarding expert (case based) systems that alert operating personnel to potential hazards before they occur, which provide recommendations to mitigate potential risk.

Recommendation #2

Determine the present scope of expert (case based) systems, and then identify benefits and limitations as well as other applications (such as cementing, completions, wellbore design, etc.) that would reduce the risk when operating in deepwater.

Finding #3 The safe and environmentally responsible operation of oil and gas production throughout the entire life cycle of a field requires the containment of hydrocarbons to the reservoir, production casing, flow lines, and surface facilities.

Not only hydrocarbon flow should be controlled, but also that of any injected fluids or gas. Barriers in both the wellbore vicinity and the subsurface should be identified and facilities should be designed accordingly. Adequate monitoring systems to detect out of zone flow are lacking.

There is funded research on the metallurgy of pipes and on cements in the Complementary Research program but no research topic areas exist in the *2013 Annual Plan* for addressing containment. There is funded research in reservoir characterization but little to no attention paid to borehole stability and characterizing the overburden for potential paths of leakage and areas of abnormal pressure. Technology is lacking for adequate monitoring of hydrocarbon production and this is particularly true in UDW environments.

Recommendation #3

Consideration should be given to issues related to the containment of hydrocarbons throughout

the entire lifecycle of an oil or gas field. Redirect funds to emphasize fluid control issues. Possible areas of focus might include:

- *Mitigate leakage in and around the boreholes from reservoir fluids and gas as well as any injected liquids and materials;*

- *Long term borehole stability;*

- *Establish plugging and abandoning technology for long term containment of hydrocarbons; and*

- *Long term monitoring systems (i.e. down hole and well head pressure sensors, time lapse seismic surveying, sea bed monitoring, etc.).*

Expand the research on reservoir characterization to include overburden characterization as well. Technology and methods for geological and geomechanical characterization of the subsurface from sea bed to the reservoir should be emphasized.

Finding #4 Recent storms in the GOM have shown the design criteria for UDW drilling and production, and storage vessels may be inadequate in large wave conditions.

Mitigating the impacts of severe weather is needed for safe UDW operations. Damage from unexpected storms poses a risk for vessel damage, human safety, and oil spills.

Recommendation #4

Continued research associated with identifying suitable vessel designs for drilling and production, including FPSOs, will enable development in harsh weather environments.

SUNSET FINDINGS AND RECOMMENDATIONS

As Section 999 comes to a close, the meaningful accomplishments should not be taken for granted. It is recommended that the research be made public through DOE conferences and reports and to the extent possible, the research, which has been fruitful, be commercialized.

Finding #1 While the period of research was short, the progress was meaningful to date, and much can still be accomplished.

Recommendation #1

The research should continue to be archived, searchable, and freely accessible to the general public. The files should include the original numerical data in usable formats.

Finding # 2 Research, particularly when it is centered around technologies as was the case in this program, must be implemented quickly to maximize the benefit due to the dynamic nature of technology development.

Recommendation #2

DOE continue to champion the marketing effort, as exemplified by the annual Ultra-Deepwater Technology Conference, toward potential commercialization to provide maximum opportunity for the results of the research to be utilized for the benefit of the public.

Finding # 3 The structure, management, and selection of research [organization?] that was developed by RPSEA and NETL of industry, NGO, and government participation was a robust methodology.

Recommendation #3

Working groups and methodologies developed by RPSEA continue after sunset to facilitate technology transfer.

Finding # 4 While not all the topics proffered in the RPSEA setting resulted in RFP's for the program, the ideas of over 900 participants are represented in the records.

Recommendation #4

A compendium of the research ideas proffered by RPSEA should be distributed to a wide variety of universities and made available to industry and to the public. This will provide a springboard for creative people to launch additional research programs.

Finding # 5 High priority projects have been, and will continue to be, identified by RPSEA through project awards.

The procedure that has been developed by RPSEA and NETL has proven to be solid. However, the procurement process is slow.

Recommendation #5

The Secretary should continue the program as currently designed through project completion. DOE works with RPSEA to ensure that high-priority projects are fully allocated.

Finding # 6 The intention of the Program has been to invest in areas where industry would not, perhaps resulting in "islands of knowledge."

In funded projects aimed at reducing risks in the UDW, there lacks a comprehensive understanding of how the individual components fit together. The risk and the consequences are addressed in the individual components of drilling and engineering design but not of the overall system.

Recommendation #6

We recommend that the Department of Energy review the research results produced by the Program and how the results advance the state-of-the-art into the overall system of drilling and

production. The final report should address progress made and gaps remaining for safe and reliable UDW development.

Finding # 7 There is no reported measure of the effectiveness of the UDAC recommendations.

Recommendation

It is recommended that the Department of Energy include a brief summary in the last meeting of the UDAC on the impact of actions that have taken place based on any recommendations made by the UDAC so that the UDAC can better assess its effectiveness.

ADVISORY COMMITTEE MEMBERS

Dr.	George	Cooper*	University of California, Berkeley
Mr.	Elmer P.	Danenberger, III*	Offshore Consultant
Dr.	Quenton R.	Dokken	Gulf of Mexico Foundation
Dr.	Hartley	Downs	Baker Hughes Incorporated
Dr.	Douglas J.	Foster	ConocoPhillips
Dr.	Luc T.	Ikelle*	Texas A&M University
Mr.	James D.	Litton*	Litton Consulting Group, Inc.
Mr.	William C.	New	New Industries, Inc.
Mr.	D. Stephen	Pye*	Consultant
Dr.	Nagan	Srinivasan	Deepwater Structures, Inc.
Ms.	Mary Jane	Wilson*	WZI Inc.
Dr.	Lesli	Wood*	Bureau of Economic Geology University of Texas at Austin

*Special Government Employee

Unconventional Resources Technology Advisory Committee

Advisory Committee to The Secretary of Energy

November 1, 2012

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 *2013 Annual Plan* for the *Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research Program.*

- We find this program has been remarkably successful in meeting its objectives.

- Research into oil and gas resources is still needed to meet the future demand for domestic energy. We strongly recommend continuing the *Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research Program* beyond the current 2014 termination date. It is important that technology transfer and public outreach regarding the program's research results continue.

- We continue to seek efficient development and production technologies that increase oil and gas supplies while reducing environmental and safety impacts.

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 *2013 Annual Plan* consistent with the guidance outlined in our report.

Respectfully submitted,

Jessica J. Cavens, Chair

Unconventional Resources Technology Advisory Committee

Comments and Recommendations 2013 Annual Plan

November 2012

TABLE OF CONTENTS

1.0 INTRODUCTION

The Unconventional Resources Technology Advisory Committee (URTAC) was formed in accordance with provisions of Title IX, Subtitle J, 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 999D(a) 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 in July, 2012. Key milestones for the Committee included:

- Committee members received the initial Draft 2013 Annual Plan on September 18, 2012. Committee members met on September 25, 2012 in Houston, Texas. The agenda included a status update and overview of the onshore elements of the Section 999 Complementary Research Program by NETL, and an overview of the Section 999 Program cost-shared research portfolio by RPSEA. The Chair appointed sub-groups to work on sections of the plan.
- During the period from September 18th through October 24th, 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 24th and 25th, 2012 in Houston, Texas to receive sub-group reports and to draft the final recommendations of the Committee.
- The Committee met via teleconference on November 1, 2012 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 999H 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 collected by the Department of the Interior. 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-administered 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 *2013 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 and technology transfer.

For the 2013 Annual Plan, the Committee has the following comments:

- Due to the time frame necessary for field demonstration projects to yield reliable scientific data and to develop innovative solutions required to continue to develop affordable clean energy from unconventional reservoirs, URTAC recommends continuing the RPSEA program beyond the current 2014 termination date.
- Long-term R&D is valuable and necessary. This often cannot be done by independent producers who are responsible for a large portion of the current oil and gas development in the United States. Subtitle J of the Energy Policy Act of 2005 has provided steady funding for the long-term cooperative research required to make progress toward safe and efficient development of the gas shale resource base. We believe this approach to be much more efficient than intermittent funding which depends on annual appropriations.
- Technology transfer associated with the Subtitle J research program has been extremely valuable in achieving production, environmental, and safety goals. If Subtitle J program concludes, it is important that technology transfer and public outreach regarding the program's research results continue beyond the sunset date.
- Refocus the R&D component of Subtitle J to include other unconventional resources such as tight oil, and oil shale. Also include projects on increasing reservoir recovery in existing reservoirs.
- Research should be conducted to improve well construction that ensures long-term well bore integrity during and beyond the operational life of the well. Laboratory and/or field techniques that simulate long term barrier integrity are important. Focus areas may include: sealants/materials, equipment, accessories, installation processes, verification/monitoring, etc.
- Pursue research and communication among multiple government agencies and industry that addresses air quality concerns specific to the exploration and production of natural gas from shale deposits and other unconventional resources.

- Improving safety and minimizing environmental impacts is synergistic with improving operational efficiency and reducing the cost of oil and gas production. Providing sound science contributes to the optimum development of a domestic energy supply while enhancing the safety of its operation, and protecting the environment. Technical innovations that support all of these goals should be more rapidly adopted.

3.0 TOPICAL REPORTS

The Advisory Committee developed their analysis of the 2013 Annual Plan through a series of meetings and sub-groups (as outlined in Section 5.0: Sub-Group Topics and Member Assignments). There are five areas of findings and recommendations:

Policy
Research & Development
Technology Transfer and Public Outreach
Environmental & Safety
Appendix

- Program Review Subcommittee Report

Treatment of Non-Consensus

All findings and recommendations reached consensus.

3.1 POLICY FINDINGS AND RECOMMENDATIONS

Finding: **SUNSET**

The landscape in Unconventional Resources is such that:

- A long-term balanced and sustainable energy supply for the United States is needed; Long-term field research projects and attendant basic research projects are needed to yield reliable scientific data;
- Continuity of research funding is necessary to achieve maximum benefits;
- There is a strong need to address continued public concerns and perceived challenges; there is a need to educate and train a skilled workforce to ensure continuity; and Innovative solutions are required to continue to develop affordable clean energy from unconventional reservoirs.

Recommendation:

- The advisory committee again proposes continuation of the program beyond the current 2014 termination date. The existing Subtitle J model, or a similar program, should be authorized for another 10 years.
- Features of the program that should be preserved include maximizing hydrocarbon recovery, safety and environment, public/private collaboration, and technology transfer. Areas that may require additional modification include responsibility for the award/approval process and more resources dedicated to technology transfer.
- A sub-committee has been established to provide specific recommendations at a later date.
- In the event that the program reaches conclusion, the value of the program should be continued through the recommendations located in the Technology Transfer and Outreach section.

Finding: **ENSURE THAT OTHER PETROLEUM RESOURCES ARE INCLUDED**

The focus on unconventional gas resources has resulted in significant advances in the production of this resource. While there are challenges that remain to be addressed, there are other unconventional resources that would greatly benefit from the research, development and technology transfer of the DOE R&D programs.

Under the current program, only a limited number of projects address oil reservoirs. Focusing on R&D projects in these areas would help reduce dependence on imported foreign crude oil.

Some examples are:

- The Monterey unconventional shale formation in California: The DOE Subtitle J research program has not focused on any West Coast resource during this program; yet one of the largest reservoirs is located in California.
- Identifying bypassed oil in older fields; developing improved recovery methods.

An increase in recovery efficiency in existing reservoirs by just 10 percent would greatly add to the oil reserves base at minimal cost.

Recommendation:

DOE should:

- Refocus the R&D component of the Subtitle J program to include other unconventional resources such as tight oil, and oil shale.
- Enhance the Subtitle J funding beyond unconventional resources to include projects on increasing reservoir recovery in existing reservoirs.

3.2 RESEARCH AND DEVELOPMENT FINDINGS AND RECOMMENDATIONS

The three major reasons for continuing to recommend research are to:

- Influence the current solicitation that will be funded between now and September 30, 2014.
- Suggest research topics for the Subtitle J program that would be extended beyond the Sunset. The committee strongly recommends extension beyond the Sunset.
- Provide guidance on potential research topics for additional DOE R&D programs.

Finding: SAFETY AND ENVIRONMENTAL SUSTAINABILITY

As stated in the 2013 Annual Plan Executive Summary, "This plan reflects the program's focus on safety and environmental sustainability that was initiated in the last plan… Onshore, research on Unconventional Resources focuses on protecting groundwater and air quality, understanding rock and fluid interactions, and integrated environmental protection, including water treatment technologies and water management."

We find this overarching objective is synergetic with improving operational efficiency and reducing the cost of oil and gas production. A few of many examples are:

- Reduction of fresh water demand for hydraulic fracturing reduces the environmental impacts of obtaining and transporting water while reducing the cost of its provision.
- Reduction of fugitive methane emissions reduces the greenhouse gas footprint of hydrocarbon production while potentially minimizing loss of valuable product, thereby increasing efficiency and reducing costs.

We further find that technical innovations that improve safety and minimize environmental impacts will be more rapidly adopted by industry if they also improve operational efficiency and/or reduce costs.

***Recommendation*:**

DOE should:

- Direct RPSEA to associate operational efficiency improvements and cost reduction with safety and environmental objectives:
  - In preparing the RFP; and
  - In determining the evaluation criteria.

***Finding*: FUNDAMENTAL RESEARCH NEEDS**

Understanding the fundamentals of fluid flow in gas shale and tight oil formations, and the interaction of hydraulic fractures with rock, are required to develop realistic reservoir simulators that use "hard data"[1] measured and collected during the operation instead of current practices of using interpretive "soft data"[2] to match production history and predict production performance. Such models are essential for the safe, efficient and environmentally responsible production and recovery.

Past research has resulted in valuable insights into the fundamentals of storage and fluid flow in the matrix of the shale reservoirs. Issues requiring further investigation are: the impact of the hydraulic fracturing on the rock matrix; the disposition of injected water; the relationship of microseismic events to production; the interactions between natural fracture networks; the rock fabric and induced fractures. Successful predictive models will facilitate optimization of hydraulic fracturing and well spacing in order to maximize production and recovery with minimum environmental footprint.

***Recommendation*:**

DOE should:

- Encourage proposals that contribute to the fundamental understanding of storage and fluid flow characteristics of fractured shale reservoirs, and the development, testing, and validation of shale-specific models.
- Encourage proposals that incorporate measured field data into the development, testing, and validation of predictive models that optimize hydraulic fracturing and well construction, in order to maximize hydrocarbon recovery with minimum environmental impact.
- Encourage research to characterize induced fracture networks through the coupling of measurements, such as microseismic and production data.

[1] **Hard Data** refer to the field measurements. This is the data that can readily be, and usually is, measured during the operation. As far as hydraulic fracturing is concerned, variables such as fluid type and amount, proppant type and amount, proppant concentration, injection and breakdown pressure, injection rates and ISIP are considered to be "Hard Data".

[2] **Soft Data** refer to variables that are interpreted, estimated or guessed. Parameters such as hydraulic fracture half length, height, width and conductivity as well as Stimulated Reservoir Volume (SRV) are used as tweaking parameters during the history matching process and cannot be measured directly.

Finding: GEOPHYSICAL RESEARCH

Novel geophysical imaging technologies have the potential to better define the characteristics of stratigraphic intervals. The ability to define these characteristics offers benefits such as: the possibility of improving productivity, reducing the potential of communication between aquifers and production/saltwater zones, mapping shallow subsurface zones, and reducing the possibility of induced seismic activity.

***Recommendation*:**

DOE should:

- Pursue novel geophysical imaging techniques that better detect natural fractures and subtle faults, and that help define spatial positions, geometrical shapes, and volumetric sizes of stratigraphic intervals.

Finding: VARIATIONS IN ROCK MECHANICS AND COMPLETION TECHNIQUES

The differences between plays are largely based upon unique mineral content due to the origins of sediments and tectonic history. Natural fracturing imprints along with stress environments affect how these reservoirs respond to stimulation. These combine to create variations in the way rocks behave requiring a wide variety of completion techniques. Dissemination of information regarding development techniques relative to local rock, fluid, and geologic properties will help to minimize waste associated with trial and error in development ramp-up.

***Recommendation*:**

The DOE should:

- Support projects which summarize and categorize the key characteristics unique to various basins to illustrate key similarities and differences in rock, fluid properties geological framework and current development and completion methodologies.

Finding: WELL INTEGRITY INCLUDING CEMENTING AND ACCELERATED TESTING

The number of wells in the US continues to grow. In all phases of a well's life 'barrier integrity' is important for proper producing zone isolation, protecting fresh or treatable subsurface water zones, surface waters and air quality. Well integrity primarily comes from the initial well construction and at times relies on multiple barriers between zones, pressure containment, corrosion protection, and flow isolation.

Wellbore design requires a proper barrier during well construction that includes: sealants, installation process and verification/monitoring. Past research and development has been focused on the tensile and compressive strength of cements and their relationship to pressure and temperature. Little research concerned with longevity issues has been done. Some monitoring and testing methods required by regulators can damage the well's working barriers. Pressure tests can cause a failure of the casing / cement barrier. Remedial or repair cement jobs have low success rates and typically must be performed multiple times. Typical cements may not be the best sealant for such repair jobs. New research may develop materials and installation methods that can be adopted by industry and regulators to improve lifetime performance.

***Recommendation*:**

DOE should:

- Pursue research to improve well construction that ensures long-term well bore integrity during and beyond the operational life of the well. Laboratory and/or field techniques that simulate long term barrier integrity are important. Research areas may include: sealants/materials, equipment, accessories, installation processes, verification/monitoring, etc.

Finding: AIR QUALITY

Emission inventories of reactive hydrocarbons, NOx, SOx, and radionuculides on site at various shale gas productions sites are highly uncertain. Reactive hydrocarbons, NOx, and SOx are precursors to ozone, and Particulate Matter (PM)[3], and air toxics. These emissions react in the atmosphere to form gas phase compounds that may endanger human and ecological health, and PM that affects health, visibility, and climate. Measurement protocols for these species at exploration and production sites have not been established. Consequently, measurements are not taken at fixed times or for fixed periods and without knowledge of the production process. Carefully designed sampling protocols that are tailored to shale gas applications are non-existent. As a result, uncertainties in emissions are large.

3 Particulate matter, also known as particle pollution or PM, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, soot or black carbon, metals, and soil or dust particles. EPA regulates particles that are smaller the 10 micrometers and larger than 2.5 micrometers (PM-10) and those that are smaller than 2.5 micrometers (PM-2.5).

Recommendation:

DOE should:

- Pursue research and communication among multiple government agencies and industry that addresses air quality concerns specific to the exploration and production of natural gas from shale deposits and other unconventional resources. Such research may include:
    - Sampling protocols and measurement guidelines
    - State-of-the-art modeling studies to separate the effects of local emission from upwind sources in determining air quality at production sites
    - A study of the benefits and limitations of different emissions reduction strategies
    - Acquire field data and analyze the overall greenhouse gas footprint of the natural gas lifecycle

Finding: **DETERMINE METRICS AND PROGRAM VALUE**

The Subtitle J research program has significant value that has encouraged exploitation of unconventional fossil fuel resources. In order to make a tangible assessment, quantitative metrics need to be developed and applied. The use of incremental production, or royalties from production on Federal lands, as sole measures of program success, is inadequate. We find that metrics like these are unduly narrow in light of the mandate from DOE for Subtitle J activities to improve the environmental sustainability and safety of exploration and production operations. These metrics do not adequately capture the value of many long term research projects and the educational value of the program.

Recommendation*:*

DOE should:

- Pursue a research project to develop appropriate metrics. The request for proposal could be formulated to attract proposals from the economics or business school communities, or others who have developed quantitative metrics for R&D programs.

3.3 TECHNOLOGY TRANSFER AND OUTREACH PROGRAM FINDINGS AND RECOMMENDATIONS

Finding: TECHNOLOGY TRANSFER IS CRITICAL

Technology transfer associated with the Subtitle J program has been extremely valuable in achieving production, environmental, and safety goals. However, the Subtitle J program is approaching its end date of September 30, 2014. It is important that technology transfer and public outreach regarding the program's research results continue beyond the sunset date.

***Recommendation*:**

The DOE should:

- Summarize the results and learnings of each research and development project.
- Continue to disseminate results from the research and development projects.
- Engage in technology transfer that is both passive (using the DOE Knowledge Base Data Management System) and active with continued workshops and symposiums.

Finding: BROADEN TECHNOLOGY TRANSFER

For the Subtitle J program to be effective it is necessary that the research be used by the oil and gas industry and the public at large. Often, material was presented to industry groups from the perspective of the researchers without regard to how it might be received. Many producer groups are more interested in learning about applied solutions in the near term rather than basic research and long term applications.

***Recommendation*:**

DOE should:

- Widen geographic audience by holding workshops in various regions of the country.
- Select research content to stimulate interest of the intended audience.
- Publicize the workshops and present material in a format that is appropriate to the audience.
- Work with producer groups (such as trade associations, lunch groups, and the Petroleum Technology Transfer Council) when workshops are developed so that it will focus on areas of specific interest to the producing community.
- Expand workshops to better include government, regulatory agencies, and citizen groups to discuss a broad range of topics including environmental and safety concerns.
- Develop a clear message of the value of the project.

- Showcase the "best of the best" to a larger more public audience. This should be part of a continuing DOE program.

3.4 ENVIRONMENTAL AND SAFETY FINDINGS AND RECOMMENDATIONS

Finding: SMALL PRODUCER PROGRAM

Small producers have played a significant role in the development of petroleum resources. However, the cost of meeting Environmental and Safety (E&S) requirements in operations threatens to become a barrier to entry for small producers to develop new resources. This is especially true of the operational cost of developing unconventional resources.

The 2013 Plan states that "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." The plan recommends that the upcoming solicitation focus on ways to "reduce cost and improve efficiency of well interventions and drilling".

Recommendation:

DOE should:

- Solicit projects that seek to identify Best Management Practices (BMPs) for small producers that can help reduce compliance costs while improving operational E&S performance.
- Solicit projects that will demonstrate technologies to reduce the burden of E&S compliance on small producers without compromising safety including Best Available and Safest Technologies (BAST).

Finding: SMALL PRODUCERS LACK REGULATORY RESOURCES

Small producers and other stakeholders lack resources for becoming aware of newly released regulations, and understanding complex regulations. This makes compliance problematic for small producers.

***Recommendation*:**

DOE should:

- Provide resources to facilitate real-time understanding of complex and evolving regulatory frameworks.
- Work proactively with relevant agencies.

***Finding*: UNCONVENTIONAL NATURAL GAS RESOURCES PROGRAM**

Understanding the environmental impacts of upstream oil and gas operations is difficult. Operations differ from play to play and even within plays. Much research to date has suffered from aggregation error which loses the nuances of regional and operational differences. As a result, many reports of environmental impacts are inadequate and/or misleading.

The 2013 Plan addresses E&S issues in unconventional operations through an extensive list of research topics on environmental impacts but does not consider how to systematically quantify impacts based on the unique characteristics of each basin.

Recommendation:

DOE should:

- Pursue projects that identify potential E&S impacts and mitigation strategies that recognize regional aspects.
- Include projects that systematically quantify play-specific air and water quality impacts of current operations. Understand the factors leading to the impacts, and develop methods to reduce them.

4.0 COMMITTEE MEMBERS

Title	Last Name	First Name	Employer	City	State
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.	BlackRidge Resource Partners LLC	Lexington	KY
Mr.	Dwyer	James P.	Baker Hughes	Houston	TX
Mr.	Hall	J. Chris	Drilling & Production Co.	Torrance	CA
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.	Mordick	Briana	Natural Resources Defense Council	Washington,	DC
Dr.	Martin	John P.	JP Martin Energy Strategy, LLC	Saratoga Springs	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,	Irving	TX
Mr.	Oglesby	Kenneth D.	Acorn Resources, Inc.	Tulsa	OK
Mr.	Sparks	Don L.	Discovery Operating, Inc.	Midland	TX

5.0 SUB-GROUP TOPICS AND MEMBER ASSIGNMENTS

At the September 25th, 2012 meeting in Houston, Texas the following Subgroups and Schedule were established for developing the Subgroup analyses and reports. At the Committee meeting in Houston, Texas on October 24th and 25th the Subgroup reports were reviewed and incorporated into this final report.

Six Sub-Group Areas of Analysis and Member Assignments:

Policy
Dwyer (chair), Brown, Daugherty, Hall, Lewis, Mohaghegh, Oglesby, Sparks

Technology Transfer and Public Outreach
Lewis, (chair), Hall, Daugherty, Dwyer, Mason, Camp

Environmental & Safety
Martin (chair), Hardage, Harju, Kleinberg, Mordick,

Research and Development
Brown (chair), Dwyer, Hardage, Kleinberg, Mohaghegh, Nilson, Oglesby, Sparks

Program Review
Hall (chair), Dwyer, Kleinberg, Nilson

Editing
Dwyer (chair), Cavens, Hall, Mason

6.0 APPENDIX A: PROGRAM REVIEW SUBCOMMITTEE REPORT

A sub-committee of the URTAC has attended the RPSEA Unconventional Project Review Meetings as well as some of the workshops given to producers. It was determined that many if not all of the project results are contributing to the efficient and environmentally sound production of unconventional resources.

- The projects span the range of exploration, production, and environmental subjects. The balance of projects reflects the real needs of stakeholders, including small and large producers, service companies, communities, and environmental advocates. The projects are also balanced with respect to short-term versus long-term vision.
- Many of the projects that might be nominally classified as production-oriented also have significant environmental benefits. For example, improvements in drilling and formation stimulation translate directly into reduced environmental impacts (land use, water use, water disposal, etc.). Thus, the present program is substantially in line with the
- Department of Energy's emphasis on environmental protection.
- Perhaps one of the greatest benefits of the Subtitle J programs is the direct exposure of undergraduate and graduate students to the real needs and capabilities of the oil and gas industry since they are directly involved in many of the projects. It has been widely noted that the workforce that came into the industry in the 1970's and 1980's is now retiring.
- The vitality of the domestic energy industry requires an infusion of young, well-trained scientists and engineers. Almost all the sponsored projects have a significant educational component, bringing together industry, academic workers, students, resources, and data. We believe these training opportunities alone justify the cost of this program.
- The technical information as presented was very good. The presentations stimulated excellent interaction among those attending in the form of discussions and questions. There was very good interaction between researchers and the producing community.
- The investment is worthwhile to the stakeholders, specifically in the outreach and public dissemination efforts carried out through the Technology Transfer mechanisms.
- Many of the projects are tied to in-field activities and weren't just limited to "laboratory research"; thus, there is good oil and gas producer involvement, which is very important.
- The presentations allowed for excellent collaboration among the many presenters, providing valuable feedback, input and even sharing of materials to facilitate the on-going research efforts.

- While many of the workshops were excellent, some did not attract the number of producers that should have attended. This is believed to be both the result of how the workshops were described in publicity materials and how the material was presented.
- The workshops are an essential element of the Technology Transfer component of the program. They are essential in order to reach out to the producing community with valuable information that has resulted from the R&D conducted by the program. This is especially important for small to mid-sized companies who otherwise might not be aware of the information that is being provided.

Recommendations based on the findings of this Subcommittee have been incorporated into recommendations of other portions of this report.