Interagency Coordinating Committee on Oil Pollution Research: FY 2014-2015 Activities

Biennial Report to Congress

June 01, 2016

U. S. Coast Guard

This page was intentionally left blank

Message from the U.S. Coast Guard Chief, Office of Marine Environmental Response Policy

The *Oil Pollution Act of 1990* requires the Chairman of the Interagency Coordinating Committee on Oil Pollution Research to submit biennial reports on the Interagency Committee's activities. The U.S. Coast Guard chairs the Interagency Committee, and has done so since its inception. The Interagency Committee first reported to Congress in 1994 and this report responds to the latest Congressional requirements.

The Interagency Committee released its updated Oil Pollution Research and Technology Plan for Fiscal Years 2015-2021 on September 29, 2015, the first revision to the Plan since 1997. Release of the Plan marked the culmination of a comprehensive multi-year effort to document the current state of oil pollution research, establish current Federal oil pollution research priorities, and initiate a six-year revision cycle for the Plan.

The Interagency Committee and its 15 member agencies continued its high level of activity over the past two years including conducting and sponsoring more than 212 oil pollution related research projects and publishing more than 378 reports, papers, and other documents. It continued to conduct outreach to industry, academia, research institutions, state governments, and other nations to promote coordinated and collaborative research.

Pursuant to Congressional requirements, this report is being provided to the following members of Congress:

The Honorable John Thune
Chairman, Senate Committee on Commerce, Science, and Transportation

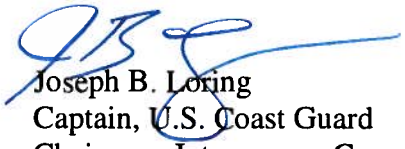
The Honorable Bill Nelson
Ranking Member, Senate Committee on Commerce, Science, and Transportation

The Honorable Bill Shuster
Chairman, House Committee on Transportation and Infrastructure

The Honorable Peter DeFazio
Ranking Member, House Committee on Transportation and Infrastructure

I am happy to answer any further questions you may have, or your staff may contact the Coast Guard's Senate Liaison Office at (202) 224-2913 or House Liaison Office at (202) 225-4775.

Sincerely,



Joseph B. Loring
Captain, U.S. Coast Guard
Chairman, Interagency Coordinating Committee
on Oil Pollution Research

This page is intentionally blank.

Interagency Coordinating Committee on Oil Pollution Research: FY 2014-2015 Activities

Table of Contents

This page is intentionally blank.

I. Executive Summary

Title VII of the *Oil Pollution Act of 1990* (OPA 90) (Pub. L. No. 101-380) established the Interagency Coordinating Committee on Oil Pollution Research (referred to as the "Interagency Committee") to "coordinate a comprehensive program of oil pollution research, technology development, and demonstration among the federal agencies, in cooperation and coordination with industry, universities, research institutions, state governments, and other nations, as appropriate" and to "foster cost-effective research mechanisms, including the joint funding of research." This report discusses Interagency Committee activities carried out in fiscal years (FY) 2014 and 2015, as well as activities proposed for FY 2016 and 2017.

The Interagency Committee released its FY 2015 - 2021 Oil Pollution Research and Technology Plan (OPRTP) in September 2015. This multi-year effort included a detailed analysis of more than 900 research needs, evaluations of the needs using surveys of 280 subject matter experts, and extensive internal reviews. This effort resulted in the Interagency Committee deciding on 150 priority research needs within 25 Standing Research Areas (SRAs), which are common research themes. The Interagency Committee also conducted outreach with several non-federal entities to promote the concepts in the plan and encourage these entities to also focus on the priority needs.

Federal Agencies of the Interagency Committee continued to oversee an increasing number of research projects related to prevention of, preparedness for, and response to oil spills. Chapter IV lists some of the member research initiatives and collaborations. Appendix A lists 378 publications that were generated from member agencies and their funded research, while Appendix B describes 211 member projects that were active during the reporting period.

Interagency Committee members participated in numerous workshops and conferences that have included both international and domestic subject matter experts working on various oil pollution issues. Most notably, several member agencies sponsored and took leadership roles in planning and conducting major conferences including the International Oil Spill Conference, the Clean Gulf and Clean Pacific Conferences, and the Offshore Technology Conference. These conferences and workshops are a vital component of the Interagency Committee's abilities to stay abreast of the latest research initiatives.

The Interagency Committee has substantial plans for future initiatives during the FY2016-2017 period. Most prominent will be conducting outreach to promote use of the OPRTP within federal agencies, state and non-governmental organizations, industry, academia, other research organizations, and international partners. The Interagency Committee will establish a mechanism to track research toward the research priorities as a tool to facilitate future updates of the OPRTP. The Interagency Committee members will also continue sponsorship and planning responsibilities for the next International Oil Spill Conference in 2017. In addition, the Interagency Committee will continue working with the National Academy of Sciences and other research programs to support restoration from the BP *Deepwater Horizon* oil spill; identify and promote Arctic research; and continue outreach to non-federal stakeholders.

II. Legislative Requirement

This report responds to the language set forth in Section 7001(e) of the *Oil Pollution Act of 1990* (Pub. L. No. 101-380), as per the following:

> **SEC. 7001. OIL POLLUTION RESEARCH AND DEVELOPMENT PROGRAM.**
>
> "(e) BIENNIAL REPORTS - The Chairman of the Interagency Committee shall submit to Congress every 2 years on October 30 a report on the activities carried out under this section in the preceding 2 fiscal years, and on activities proposed to be carried out under this section in the current 2 fiscal year period."

III. Background and Legacy Obligations

Purpose of the Interagency Committee

Section 7001(a) of OPA 90 established the Interagency Coordinating Committee on Oil Pollution Research (Interagency Committee). The purpose of the Interagency Committee is twofold: (1) to prepare a comprehensive, coordinated federal OPRTP; and (2) to promote cooperation with industry, universities, research institutions, state governments, and other nations through information sharing, coordinated planning, and joint funding of projects.

Membership
The 15 Interagency Committee members, representing independent agencies, departments, and department components, include:

Department of Commerce (DOC) represented by:

- National Oceanic and Atmospheric Administration (NOAA)
- National Institute of Standards and Technology (NIST)

Department of Energy (DOE)

Department of the Interior (DOI) represented by:

- Bureau of Safety and Environmental Enforcement (BSEE)
- Bureau of Ocean Energy Management (BOEM)
- U.S. Fish and Wildlife Service (USFWS)

Department of Transportation (DOT) represented by:

- Maritime Administration (MARAD)
- Pipeline and Hazardous Materials Safety Administration (PHMSA)

Department of Defense (DoD) represented by:

- U.S. Army Corps of Engineers (USACE)
- U.S. Navy (USN)

Environmental Protection Agency (EPA)

National Aeronautics and Space Administration (NASA)

Department of Homeland Security (DHS) represented by:

- U.S. Coast Guard (USCG)
- Federal Emergency Management Agency (FEMA)
    - U.S. Fire Administration (USFA)

U.S. Arctic Research Commission (USARC)

Oil Pollution Research and Technology Plan Revision

The Interagency Committee made a major stride in addressing oil pollution research needs with the release of its revised OPRTP in September 2015. This revision marks the first coordinated federal OPRTP since the Interagency Committee released the 1997 OPRTP. Its release also

established a new baseline on the nation's research needs. This document will be used by federal agencies to inform their research funding decisions. It will also serve as a valuable reference tool for agencies and organizations involved in oil pollution research.

OPRTP Background: Section 7001(b) of OPA 90 required the Interagency Committee to prepare an OPRTP. The Interagency Committee prepared the original OPRTP to define the roles of each federal agency involved in oil spill research and development and to identify subject areas that needed attention. The original OPRTP was submitted to Congress in April 1992 and revised in April 1997 based on an OPA 90 mandated review by the National Research Council's Marine Board. The 1997 version of the OPRTP identified 21 research areas divided into three levels of priority and served as a strategic planning document for the Interagency Committee to communicate and coordinate research needs.

Updated OPRTP Process: Although OPA 90 did not explicitly require successive updates to the original plan, the Interagency Committee reexamined the 1997 OPRTP Plan in late 2009 and decided that an update was necessary to address changing technologies and new oil pollution risks. Consequently, the Interagency Committee began a comprehensive examination of the current state of the science for oil pollution research to formulate a new version of the OPRTP. The revision process concluded during the reporting period with a detailed analysis of research needs, establishing research priorities, and documenting the plan.

During the reporting period, the Interagency Committee conducted a systematic and thorough review of more than 900 identified oil pollution research needs and consolidated the list into approximately 570 needs. These needs were categorized using the new "Oil Pollution Research Categorization Framework" into 25 SRAs within four research Classes- (1) Prevention, (2) Preparedness, (3) Response, and (4) Injury Assessment and Restoration. The Interagency Committee organized an R&T Workgroup that conducted the following activities during the reporting period to complete the planning process:

- Recruited 280 subject matter experts covering all 25 SRAs and surveyed them to evaluate the relative merits of the research needs in their areas of expertise.
- Analyzed and evaluated the relative merits of the research needs using input from the survey of subject matter experts.
- Identified the three highest priority research needs for each SRA, or subcategory of an SRA and presented the list to the full Interagency Committee, which approved the research priorities.
- Developed a comprehensive listing of key organizations involved in oil pollution research and their roles. This documentation included Interagency Committee member agencies as well as entities from federal agencies, state agencies, academic organizations, non-governmental organizations, industry, and international entities.
- Compiled the formal OPRTP, which was reviewed and unanimously approved by the full Interagency Committee.

Future Revisions: Publication of the updated OPRTP initiates a new cycle of research planning for the Interagency Committee. In the future, the OPRTP will be revised every six years to include a retrospective analysis of completed research and accomplishments over the previous six years and a forecast of new research needs for the upcoming six-year period. The Interagency Committee chose a six-year revision period to provide time that is realistically needed by the global research community to make measureable strides in oil pollution research

or to identify new research needs. This timeframe was also chosen to align updates of the OPRTP with future submissions of Interagency Committee Biennial Reports to Congress. *Oil Pollution Research and Development Program.*

Guided by Section 7001(c) of OPA 90, the Interagency Committee monitors, supports, and publicizes a variety of oil pollution research and development initiatives with industry, universities, research institutions, state governments, and other entities. Several ventures were completed in the first decade of the Interagency Committee's existence, while others continue to progress through the current reporting period. The status of several key initiatives listed in Section 7001(c) is discussed below:

1) *Oil pollution technology research* – The cornerstone of the Interagency Committee's role and activities is the research funded, monitored, conducted, and coordinated by its members. Chapter IV of this report includes highlights of several research initiatives of Interagency Committee member agencies. The selected initiatives illustrate a small sample of the diverse research coordinated by the Interagency Committee. Appendix A lists some of the numerous papers, reports, and other publications by the members and researchers funded by the member agencies. Appendix B describes specific projects overseen by member organizations on the Interagency Committee during FY 2014 and FY 2015 or planned through FY 2017.

2) *Demonstration Projects* - Section 7001(c)(6) directed that Port Oil Pollution Minimization Demonstration Projects be conducted in New York, New Orleans, and Los Angeles/Long Beach. The *Great Lakes Oil Pollution Research and Development Act of 1990* (Pub. L. No. 101- 380) amended OPA 90 to include a fourth demonstration in ports of the Great Lakes. Demonstration Projects were held in New Orleans (December 1994) and New York (October 1995). After the first two projects were completed, the USCG determined that they were cost prohibitive and the Interagency Committee agreed that the objectives for the Demonstration Projects requirement could be met through other means.[1] Since 1995, the objectives have been addressed through interagency participation in and support for regularly scheduled domestic and international oil spill conferences including: the International Oil Spill Conference (triennial), Interspill (triennial), Spillcon (triennial), and the Clean Pacific and Clean Gulf Conferences (biennial and annual). These domestic and international conferences present both technical programs and equipment tradeshows that present the latest issues, products, and technologies available for oil spill and hazardous materials response, spill prevention, marine salvage, cleanup and remediation, professional services, and regulatory compliance.

   The Interagency Committee conducted the following activities during the reporting period to maintain its commitment to meet the requirement of section 7001(c)(6):

   - The USCG, BSEE, EPA, and NOAA served as key members of the 2014International Oil Spill Conference (IOSC) Executive Committee and Program Committee. These Committees delivered a robust conference program that included 45 sessions with papers selected through a peer review process from 299 submitted abstracts. Authors from member agencies delivered more than 70 papers and posters at the conference.

[1] Interagency Committee Biennial Report to Congress for FY 2001 & 2002

- BSEE managed planning for on-water demonstrations of oil pollution prevention and cleanup systems including UAV surveillance and cutting edge response technology.
- NOAA organized a series of 12 short courses to provide attendees with opportunities to improve their knowledge.
- The Executive Committee and Program Committee are currently organizing the 2017 IOSC, which will include an additional on-water demonstration if site conditions and budgets allow.

3) *Simulated Environmental Testing* – Section 7001(c)(7) directed agencies of the Interagency Committee to ensure the long-term use and operation of Ohmsett - the National Oil Spill Response Research & Renewable Energy Test Facility. BSEE continues to operate and maintain Ohmsett, which is located an hour south of New York City, in Leonardo, New Jersey. Ohmsett provides independent and objective performance testing of full-scale oil spill response equipment and marine renewable energy systems (wave energy conversion devices), and improves technologies through research and development. It is the largest outdoor saltwater wave/tow tank facility in North America and is the only facility where full-scale oil spill response equipment testing, research, and training can be conducted in a simulated marine environment using real oil under controlled environmental conditions (waves and oil types).

   Ohmsett is used for two primary and essential functions related to national oil spill response planning:

   - *Full-scale equipment testing* - It is estimated that 95 percent of the quantitative performance data on mechanical equipment used by the USCG, EPA, USN and private industry (both domestic and international) is obtained through Ohmsett.

   - *Responder training* - Ohmsett is one of the few facilities in the world where oil spill responders can be trained under various controlled environmental conditions using real oil. Training provided at Ohmsett ensures responders are educated about oil pollution operations in advance of an incident.

   Ohmsett experienced significant damage during 2012's Hurricane/Super-storm Sandy. One storage building was completely destroyed, and a second building was heavily damaged. Significant amounts of testing and training materials that were stored in the destroyed buildings were lost. Salt water infiltrated many electrical components requiring repair or replacement of those items. Limited tank operations resumed a month after the storm and within a year, the tank was fully operational and most of the damaged equipment was replaced or repaired. BSEE used supplemental funding for both a replacement warehouse, which is being built by the National Park Service, and for the Naval Facilities Engineering Command (NAVFAC) to harden the facility against future storms by raising assets damaged during Sandy and using barriers in front of critical assets to protect against future storm surge.

   BSEE has undertaken several projects to enhance the scientific data collection capabilities of Ohmsett. During FY 2014 new sensor systems were added that allow for near-real-time data interpretation in regard to the thickness of oil on the surface of the tank water, and the quantification of the ice coverage within an ice field. During FY 2015, studies were conducted to enhance the capabilities of the facility's wave maker to produce breaking waves at a specified location, translate the energy produced by

breaking waves within the tank to the ocean environment, and understand the impact of the chemicals in the tank water (chlorine, zinc, etc.) upon dispersant effectiveness testing and how that might translate to open ocean dispersant application.

4) *Regional Research Grant Program* - Section 7001(c)(8) authorized a Regional Research Program. The objective of the Regional Research Program is to "coordinate a program of competitive grants to universities or other research institutions, or groups of universities or research institutions, for the purposes of conducting a coordinated research program related to the regional aspects of oil pollution, such as prevention, removal, mitigation, and the effects of discharged oil on regional environments." Funding for the program was authorized for each of the FYs from 1991 through 1995. The last reports prepared by the universities and institutions selected under this program were published in 1997.[2]

[2] U.S. Coast Guard 1995 Oil Pollution Research Grant Publications: Parts 1 &2. Final Report. John A. Volpe National Transportation Systems Center, Cambridge, Massachusetts. August 1997.

IV. Interagency Committee Activities

The Interagency Committee pursued several different activities during this reporting period. These activities addressed Government Accountability Office (GAO) recommendations[3,4] and emerging and continuing oil pollution research needs.

Organizational Changes

Expanding Membership – The Interagency Committee membership remains at 15 independent agencies, departments, and department components. In FY2015, the Interagency Committee reached out to the U.S. Geological Survey (USGS) to explore the Survey's interest in participating in the Interagency Committee's activities. The USGS is currently participating in an observer role. The Interagency Committee is also reaching out to other agencies that could provide expanded capabilities related to human health effects of oil pollution. In addition, the Interagency Committee is also reaching out to Environment Canada and Transport Canada to explore opportunities for these agencies to participate on an ad hoc basis.

Leadership Changes – In June 2015, the Interagency Committee welcomed CAPT Joseph Loring as the new Chair replacing CAPT Claudia Gelzer. During the reporting period, Ms. Lori Medley of BSEE served as the Vice Chair in accordance with the Interagency Committee's rotating Vice Chair position. Dr. Robyn Conmy of EPA will assume the role of Vice Chair during the FY2016-2017 reporting period.

Workgroups – The Interagency Committee's R&T Plan Workgroup operated throughout the reporting period to guide development of the OPRTP. The R&T Plan Workgroup met frequently to evaluate research needs and provide recommendations to the full Interagency Committee on proposed priorities and content of the OPRTP. In June 2015, the Interagency Committee established an Intentional Release Permitting Workgroup to evaluate issues related to obtaining permits for release of small amounts of oil into the environment for research purposes.

Staff Resources – The USCG, as Interagency Committee Chair, continued to support a full-time Executive Director position to provide the Interagency Committee with expanded organizational, coordination, and outreach capabilities.

Interagency Committee Meetings

The Interagency Committee formally met 11 times during FYs 2014 and 2015. These gatherings included quarterly and special meetings of the membership and engagements with the Prince William Sound Regional Citizen's Advisory Council (PWSRCAC) and the International Tanker Owners Pollution Federation (ITOPF):

- December 11, 2013 – Washington, DC: Quarterly Meeting
- March 12, 2014 – Washington, DC: Quarterly Meeting
- March 27, 2014 – Washington, DC: Meeting with PWSRCAC
- May 21, 2014 – Washington, DC: Meeting with ITOPF

[3] Government Accountability Office, Federal Oil and Gas: Interagency Needs to Better Coordinate Research on Oil Pollution Prevention and Response. GAO-11-319, March 2011

[4] Government Accountability Office, Oil Dispersants: Additional Research Needed, Particularly on Subsurface and Arctic Applications. GAO-12-585. May 2012

- June 18, 2014 – Washington, DC: Quarterly Meeting
- September 17, 2014 – Washington, DC: Quarterly Meeting
- January 21-22, 2015 – Washington, DC: Quarterly Meeting
- April 1, 2015 – Washington, DC: Quarterly Meeting
- April 26, 2015 – Washington, DC: Meeting with PWSRCAC
- June 10, 2015 – Washington, DC: Quarterly Meeting; and
- September 29, 2015 – Washington, DC: Quarterly Meeting

The agendas for these meetings are available on the Interagency Committee's website, www.uscg.mil/iccopr. During the quarterly meetings, the Interagency Committee shared information on recent research projects, identified new research issues, listened to presentations from other government agencies, industry, and academia, and developed strategies for future initiatives. The meetings with PWSRCAC and ITOPF provided opportunities for Interagency Committee members to share information with these organizations and to hear their issues and perspectives on research needs.

Internal Collaboration

A standing agenda item in each quarterly meeting is a research update from each of the 15 member organizations. These updates prompted increased collaboration within the membership. The updates foster new ideas and opportunities for joint agency projects or suggestions on new initiatives.

The USCG Research, Development, Test and Evaluation (RDT&E) Program collaborated over the past two years with BSEE by holding yearly meetings to identify priorities and coordinate research. The RDT&E Program supported the BSEE contracting process by assisting in the evaluation of White Papers and Broad Agency Announcements (BAA) in multiple spill response topic areas. Funds were transferred from BSEE to the RDT&E Program to support oil spill surveillance and response topics and these projects are provided in Appendix B of this report. BSEE also provided an unmanned underwater vehicle for demonstrations in the Great Lakes and the Arctic Circle off of the Coast Guard Cutter HEALY.

BSEE collaborated with NOAA on several projects to enhance computer software's ability to support oil spill responders. One project that has become fully-functional during this reporting period is the enhancement of the Environmental Response Management Application (ERMA) for the Arctic region. Reconfiguring this application to meet the needs of responders in the remote marine Arctic environment will be a critical tool in effectively preparing for, responding to, and mitigating situations where limited assets, personnel, and facilities exist. Arctic ERMA contains information such as the extent and concentration of sea ice, locations of ports and pipelines, and vulnerable environmental resources for spill responders to make rapid, science-informed response decisions. ERMA facilitates the display of real-time data feeds such as weather, ship locations/movements, and other oceanographic information. In FY 2015, BSEE began work on another collaborative effort that will assist in the ingestion of existing Geographic Response Plan (GRP) and/or Area Contingency Plan resource protection data into GIS systems such as ERMA. Additionally, BSEE is developing models to more accurately represent spills in a cold weather/arctic environment from potential well blowouts as well as shipping and oil transport accidents. The focus is on spills in cold waters where sea ice may be present, and blowouts in the U.S. Arctic region.

During this reporting period, the Interagency Committee continued to engage in discussions on the potential benefits of, and concerns associated with intentional oil discharges into U.S. waters for testing purposes. An intentional release of oil in U.S. waters, particularly a subsea discharge test, may provide useful research data when clear research needs, methods, and goals, combined with responsible cleanup and monitoring plans, have been established. Field tests may be justified when laboratory or other simulated settings (e.g., test tanks) cannot address specific research needs and no other open water research projects have addressed them. Experiments in large test tanks (i.e., Ohmsett) provide opportunities to simulate real environmental conditions and bridge the gap between laboratory and actual field experiments; however, they cannot completely replicate actual field conditions. The Interagency Committee will continue working with policy makers and permitting authorities to explore field testing opportunities.

Examples of formal collaborations between member agencies include:

DOE/BSEE Memorandum of Collaboration (MOC) - The DOE Office of Fossil Energy and BSEE continue to operate under a MOC signed on August 22, 2013 that coordinates the ongoing efforts of the two agencies on offshore research and technological improvement projects. Through this collaboration, BSEE and DOE work together to develop technology that ensures safe, sustainable offshore production of oil and natural gas. The group established a Steering Committee and three Subcommittees: Cementing Subcommittee, Materials Subcommittee and Arctic Subcommittee. These Subcommittees bring together experts from DOE and BSEE to coordinate their research and explore synergies.

Federal Multiagency Collaboration on Unconventional Oil and Gas Research - In response to the President's *Blueprint for a Secure Energy Future*, the DOE, DOI, and the EPA signed a memorandum of agreement in April 2012 to formalize the collaboration. Under the agreement, the three agencies are working together to address the highest priority challenges and research questions associated with safely and prudently developing unconventional shale gas and tight oil reserves. The topic areas of collaboration include Resource Base, Water Availability, Ecological Effects, Air Quality, Induced Seismicity, Water Quality, and Human Health. In these areas, each agency has individual expertise and core competencies that can influence the effective implementation of R&D. In this collaboration, emphasis is placed on a complementary approach that avoids duplication and takes advantage of these inherent strengths. On July 18th, 2014 the Steering Committee finalized and released the "Federal Multiagency Collaboration on Unconventional Oil and Gas Research - A Strategy for Research and Development."

DOE/PHMSA Collaboration on Crude Oil Properties - The DOE Office of Fossil Energy and DOT-PHMSA collaborated on a study to identify the actions needed to obtain a science-based understanding of outstanding questions associated with the production, treatment, and transportation of various types of crude oil, including Bakken crude oil. The agencies asked Sandia National Laboratories to prepare the March 2015 report entitled *Literature Survey of Crude Oil Properties Relevant to Handling and Fire Safety in Transport.* The Sandia report was an important step in developing a more complete understanding of outstanding scientific questions associated with the properties of various types of crude oil. It identified gaps in important crude oil characterization data; uncertainty and a lack of uniformity regarding how best to sample, test and analyze crude oil to ensure that its properties are accurately determined; and deficiencies in the understanding of how crude oil properties affect its potential for accidental ignition, combustion, and explosion.

DOE and DOT-PHMSA also asked Sandia to prepare recommendations to address these gaps. Sandia prepared a comprehensive *Crude Oil Characterization Research Sampling, Analysis, and Experiment (SAE) Plan,* which contains recommendations on research needed to improve understanding of transport-critical crude oil and especially tight crude oil properties, including identifying the most appropriate sampling and testing methods for crude oils; sampling, testing and compilation of data on different crude oils using those methods; initial combustion testing to identify relationships between a particular chemical or physical property of crude oil, or combination of such properties, and combustion properties; and possible full-scale combustion tests. After considering this Plan, DOE and DOT have decided to support selected portions of the effort described in the Sampling, Analysis and Experiment (SAE) Plan.

External Collaboration

The Interagency Committee did not limit itself to internal collaboration among the membership. It pursued coordination and collaboration with several external oil spill related programs, particularly in the Gulf of Mexico and Arctic regions, through participation in joint meetings, forums, and workgroups.

The Interagency Committee continued working with the National Academy of Science's Gulf Research Program (GRP) as they developed their strategy for implementation of the 30-year oil system safety research program funded by a $500 million endowment from BP and Transocean criminal settlements stemming from the BP *Deepwater Horizon* oil spill. The settlement agreements require NAS to seek the recommendations of the Interagency Committee, including members BOEM and BSEE, at least annually on administration of the program.

The Interagency Committee external collaboration activities also included presentations at the following meetings of key organizations with research programs:

- January 6, 2014 – Via Conference Call: The Vice-Chair, Executive Director, and an Interagency Committee member participated in a Pacific States/British Columbia Task Force meeting to provide an annual update on oil pollution research activities. The USCG and BSEE were represented.

- April 2, 2014 – Conference Call: Presented an overview of Interagency Committee activities and research planning efforts to a USCG and Florida Institute of Oceanography forum on incorporating research into spill response.

- May 5-8, 2014 – Savannah, GA: The Executive Director presented a paper on the history and current activities of the Interagency Committee during the International Oil Spill Conference. Several other members of the Interagency Committee also presented papers and posters on research topics at the conference.

- June 5, 2014 – Washington, DC: The Executive Director met with the National Response Team (NRT) and made a presentation on the National Research Council's report "Responding to Oil Spills in the U.S. Arctic Marine Environment."

- June 30, 2014 – Conference call: Interagency Committee members from the USCG and NOAA participated in an informal information exchange with Norwegian representatives regarding oil pollution research.

- July 8, 2014 – Via Conference Call: Presented an overview of Interagency Committee activities and research planning concepts to the PWSRCAC's Science Advisory Committee.

- September 3-4, 2014 – New Orleans, LA: The Executive Director and representatives from six other Interagency Committee agencies participated in the NAS Gulf Research Program workshop on environmental monitoring opportunities for the GRP.

- September 22, 2014 – New Orleans, LA: The Executive Director participated in the NAS Gulf Research Program workshop on human health and community resilience opportunities for the GRP.

- September 23, 2014 – New Orleans, LA: The Executive Director presented an update on Interagency Committee research and technology planning activities to the annual meeting of the Industry Technical Advisory Committee (ITAC). The Interagency Committee Chair presented an update on USCG oil spill response activities.

- November 4, 2014 – Stavanger, Norway: The Executive Director presented information on Interagency Committee member research and development activities and Interagency Committee R&T Plan development to a Norwegian interagency committee organized to enhance Norwegian oil pollution response capabilities and research.

- November 12-13, 2014 – Washington, DC: The Interagency Committee Chair, Executive Director, and members from NOAA participated in a two-day workshop between the USCG, NOAA, and the Norwegian Coastal Administration and Norwegian Ministry of Transport to share information on oil pollution research and response. The Executive Director presented information on Interagency Committee member research and development activities and Interagency Committee R&T Plan development.

- January 6, 2015 – Conference Call: The Executive Director and representatives of EPA, BSEE, and NOAA participated in the Pacific States-British Columbia Oil Spill Task Force meeting. The Executive Director presented information on the Interagency Committee activities.

- February 20, 2015 – Houston, TX: The Interagency Committee Executive Director and EPA representative presented information on Interagency Committee activities and met with the GoMRI Board of Directors to discuss the R&T planning process and opportunities for the Interagency Committee and GoMRI to work together to promote research.

- February 26, 2015 – Alameda, CA: The Interagency Committee Executive Director participated in the California Office of Spill Prevention and Response (CA OSPR) and Chevron Technology Conference and presented information on Interagency Committee and the R&T planning process.

- March 24-26, 2015 – Amsterdam, Netherlands: Representatives of the USCG, BSEE, and NOAA presented six papers at the Interspill Conference.

- April 30, 2015 – Webinar: Representatives of the Interagency Committee participated in the Federal Interagency Preparedness Initiatives in Crude by Rail Transport webinar.

- June 19, 2015 – Conference Call: The Interagency Committee Executive Director participated in the first meeting of the Canada-United States Working Group on Maritime Transportation of Hydrocarbons and Their By-Products to provide information on Interagency Committee activities.

- July 8, 2015 – Alexandria, VA: The Interagency Committee Executive Director participated in a USCG and American Salvage Association meeting to discuss oil pollution issues related to marine salvage.

- August 11-12, 2015 – Anchorage, AK. Representatives of the USCG and BSEE participated in an Oil Spill Technology Adoption Workshop sponsored by OSRI to better understand how oil spill response technologies advance from the research and development phase to widespread adoption and application to improve oil spill response.

- September 15-17, 2015 – Washington, DC. Representatives of the USCG, BSEE, MARAD, and EPA participated in the Arctic Council Emergency Preparedness, Prevention and Response (EPPR) MOSPA 2015 Exercise Workshop to discuss research activities and make plans for an Arctic response exercise.

Individual members of the Interagency Committee serve on different committees, forums, and teams with a nexus to oil spill research. Their participation in these other committees brings an increased awareness of the Interagency Committee and provides the other committees with a wider perspective on oil spill research interests. Examples of the Interagency Committee participation in outside activities include:

National Response Team (NRT) and its Science and Technology (S&T) Committee – Eight of the Interagency Committee agencies, and several individual representatives, are also members of the NRT, which provides opportunities for the two organizations to share information and perspectives on common issues. This joint participation enables these Interagency Committee members to also collaborate with the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH), which are not Interagency Committee members, but serve important roles during oil spill response and recovery.

The NRT's S&T Committee, a forum for the NRT to fulfill its research and development responsibilities, is chaired by an Interagency Committee member from NOAA. Other representatives serving on both committees are from the USCG, EPA, and BSEE. This joint membership has enabled the Interagency Committee and the S&T Committee to share research information and leverage their resources to address critical needs.

Gulf Coast Ecosystem Restoration Council – The Chair of the Interagency Committee also serves as the DHS representative on the Gulf Coast Ecosystem Restoration Council. The Interagency Committee interests are represented in the Council by senior official representatives from the EPA, the Departments of Commerce (Chair) and the Interior, and USCG.

Gulf Restoration Science Programs Ad Hoc Coordination Forum – This Forum was established by NOAA and the Gulf of Mexico University Research Collaborative (GOMURC) to promote communication between and integration of restoration science programs. The Team conducts bi-monthly webinars to exchange information on programs and activities. The Interagency Committee Executive Director represents the Interagency Committee on the Forum.

Federal Oil Spill Team for Emergency Response Remote Sensing (FOSTERRS) – NOAA, NASA, and USGS organized and formed FOSTERRS in 2015 as an interagency working group to facilitate the sharing of remote sensing capabilities and to discuss improvements in disaster response using remote sensing. Specifically, FOSTERRS seeks to connect agency information on airborne and space borne asset's availability, limitations, capabilities and performance, and ancillary data needs to stakeholders and responders. It also reaches out to the larger community involved in marine disaster response and the development and implementation of remote sensing best practices.

Environmental Committee on Offshore Energy Resources - In June 2015, BOEM announced an agreement to have the National Academies establish a new standing committee on environmental science and assessment for offshore energy and mineral resources. The committee will provide independent information on issues relevant to BOEM's environmental studies and assessment activities and support discussions on relevant issues. The committee's services will be provided under a three-year contract with the National Research Council (NRC), the operating arm of the National Academy of Sciences (NAS) and the National Academy of Engineering (NAE). Topics and activities the committee or sub-committees may explore include: strategic approaches to environmental monitoring to assess ecosystem health and mitigation effectiveness; stakeholder discussions on controversial issues; reviews of proposed BOEM studies; high level reviews and expert advice on gaps and priorities for research; technical input related to BOEM's environmental programs; enhancing understanding of innovation in science and technology; and if warranted, NRC studies on specific topics.

Joint Industry Task Forces – During this reporting period, three different domestic and international Joint Industry Task Forces that are focusing on new oil pollution research initiatives were in various stages of progress and are of great interest to the Interagency Committees. These task forces are:

- Joint Industry Oil Spill Preparedness & Response Task Force (OSPR JITF) and resulting API Research Workgroups.
- Arctic Oil Spill Response Technology Joint Industry Programme.
- International Association of Oil and Gas Producers (OGP) - Oil Spill Response Joint Industry Project (OSR-JIP).

These industry-led and industry–financed programs were initiated to tackle numerous research gaps identified from the BP *Deepwater Horizon* oil spill and potential energy exploration in the Arctic. In addition to monitoring the general progress of these organizations, the Interagency Committee has been asked to provide some direct support. For example, the Interagency Committee provided subject matter experts from its member organizations to support several of the API Workgroups formed from the OSPR JITF, including:

- API *In-Situ* Burn Technical Working Group
- API Subsea Dispersant Injection Workgroup
- API Remote Sensing Technical Working Group
- API Alternative Response Technology (ART) Working Group

Other Workgroups and Forums – Individual members of the Interagency Committee participate in a number of other external workgroups and other forums that provide valuable information on different issues related to the oil pollution research. These workgroups include:

- ASTM F-20 Committee on Hazardous Substances and Oil Spill Response
- International Maritime Organization (IMO) Technical Group under Marine and Environmental Protection Committee (MEPC)
- Prince William Sound Oil Simulants Workgroup
- CRRC Dispersant Workgroup
- CRRC Submerged Oil Workgroup
- Oil Spill Recovery Institute (OSRI) Technology Adoption Workshop

Collaboration on Arctic Issues

The Interagency Committee member agencies have several responsibilities to meet the requirements of the National Strategy for the Arctic Region (NSAR) and the Implementation Plan for the National Strategy for the Arctic Region (NSAR IP). The Interagency Committee member agencies sponsored independent assessments of Arctic research needs, participated in organizations addressing Arctic issues, and incorporated recommendations into the Interagency Committee's research priorities. Examples of the collaboration on Arctic issues are:

Assessment of Arctic Spill Response Capabilities - Interagency Committee members USCG, BSEE, BOEM, NOAA, and USARC, along with three other organizations requested that the National Research Council of the National Academy of Sciences conduct a study of the current capabilities to respond to oil spills in the Arctic. The Council issued their report, "Responding to Oil Spills in the Arctic Marine Environment" in July 2014. The report had four main sections: 1) Environmental Conditions and Natural Resources in the U.S. Arctic; 2) Arctic Oil Spill Response Research; 3) Operations, Logistics, and Coordination in an Arctic Oil Spill; and, 4) Strategies for Response and Mitigation. Each section described the current state of knowledge or capabilities of the U.S. response organizations and made recommendations for an effective prevention, preparedness, and response system.

NPC Arctic Potential Report – In 2013, the Secretary of Energy commissioned the National Petroleum Council (NPC) to conduct a comprehensive study considering the research and technology opportunities to enable prudent development of U.S. Arctic oil and gas resources. Subject matter experts from the Interagency Committee and its member agencies provided input and reviews of portions of the products from the study. The NPC in July 2015 released the report, "Arctic Potential: Realizing the Promise of U.S. Arctic Oil and Gas Resources." The Executive Summary was released in March 2015. The report includes extensive information on the state of knowledge on Arctic technologies and operations, spill prevention and response capabilities, and the ecological and human environment.

Plan for Incorporation of National Academy of Sciences Arctic Spill Response Assessment – In November 2014, the Interagency Committee in collaboration with the National Response Team, issued a plan to incorporate the recommendations of the National Research Council into federal activities. The Plan addressed each applicable recommendation and described the activities member agencies were conducting to address the recommendations.

State of the Science for Dispersant Use in Arctic Waters Workshop - The December 2013 Spill of National Significance (SONS) exercise for the Arctic senior federal agency leadership identified the need for a definitive evaluation of the state of the science of dispersants and dispersed oil (DDO).Workgroup formation and project scoping occurred throughout 2014 and a workshop was held in January 2015 to evaluate the state of science and remaining uncertainties for dispersant use in

Arctic waters. . The workshop was organized into five groups: Efficacy and Effectiveness, Physical Transport and Chemical Behavior, Degradation and Fate, Toxicity, and Public Health and Food Security. Follow-on meetings and work continues to finalize the workshop's summary report.

Arctic Executive Steering Committee (AESC) Participation – The White House formed the AESC in 2015 by Executive Order 13689 to provide guidance to executive departments and agencies and enhance coordination of Federal Arctic activities, including research activities. Representatives from Interagency Committee member agencies USACE, USARC, USCG, BSEE, BOEM, DOE, EPA, MARAD, NASA, USN, and, NOAA contribute to the AESC activities through their agency or department official on the AESC.

Arctic Research and Technology Evaluations – The USCG continued to provide opportunities for Arctic and cold water research. As part of the annual Arctic Shield Exercises, USCG researchers collaborate with researchers from other federal agencies, academia, industry, and international organizations to evaluate technology under Arctic field conditions. Arctic Shield evaluations were conducted in 2014 and 2015. The USCG also conducts technology evaluations in the Great Lakes where conditions approximate those of the Arctic. In addition, the USACE's Cold Regions Research and Engineering Laboratory (CRREL) conducts research both in their laboratory facilities and field tests in Alaska and other cold regions.

Arctic Council Emergency Preparedness, Prevention, and Response (EPPR) Working Group – Interagency Committee member agencies NOAA, USCG, BSEE, BOEM, and EPA are active participants in oil spill and emergency prevention, preparedness, and response initiatives in the EPPR Working Group, which is currently chaired by a NOAA representative. A recent project led by NOAA, the Arctic Environmental Response Management Application (ERMA), is a GIS mapping platform to assist in oil spill response by providing information on all response assets and threatened environmental resources. BSEE is leading a project to develop an inventory of spill response assets throughout the Arctic. The USCG is leading an effort to develop an EPPR Arctic oil spill exercise in 2016 and hosted a planning workshop in 2015. Other projects include updating the Operational Guidelines in support of the Agreement on Marine Oil Pollution Preparedness and Response, and finalizing the Guide to Oil Spill Response in Snow and Ice Conditions" (https://oaarchive.arctic-council.org/handle/11374/403).

Interagency Arctic Research Policy Committee (IARPC) – The U.S. Interagency Arctic Research Policy Committee (IARPC) consists of 15-plus agencies, departments, and offices across the Federal government. Established by Congress through the Arctic Research and Policy Act, IARPC is chaired by the National Science Foundation. Representatives of the USCG, BOEM, BSEE, DOE, NASA, and NOAA participate as part of the IARPC staff.

Coast Guard Arctic Strategy Initiatives – The USCG has developed a series of initiatives to implement its Arctic Strategy, which was released in May 2013. Four of these initiatives have direct bearing on the interests of the Interagency Committee:

- *Initiative 1: Enhance Arctic Operations and Exercises* – The USCG has been conducting Operation Arctic Shield annually since 2010 as a tactical activity that includes the deployment of aircraft, cutters, and personnel to the Arctic region to improve operational capabilities. It also serves as a platform for conducting oil pollution-related research in the Arctic.
- *Initiative 9: Support a Center for Arctic Study and Policy (CASP)* – The USCG opened the CASP on September 19, 2014 as a center for thought leaders on Arctic policy and operations. Research products from CASP will be used by national Arctic policy makers.

- *Initiative 13: Strengthen Marine Environmental Response in the Arctic* – Under this initiative, the USCG is conducting programmatic reviews of area planning in Alaska and working with international partners to improve response capabilities.

Member Research and Technology Initiatives

Member organizations of the Interagency Committee managed and funded a number of new and on-going research projects during this reporting period: Appendix (A) lists 378 publications and Appendix (B) summarizes 212 research projects. The publications include scientific papers, journal articles, and reports by member agencies, their staff, or funded researchers. The research projects are categorized according to the SRAs identified in the OPRTP's Oil Pollution Research Categorization Framework. While the appendices detail research projects funded and managed by Interagency Committee members, the Interagency Committee also monitors a variety of oil spill research projects conducted or funded by other non-Committee entities.

In addition to the specific research projects and publications described in the appendices, some of the member organizations have prepared broad research strategies and initiatives that are being coordinated with the Interagency Committee.

1) *NOAA Environmental Response Management Applications (ERMA)* – NOAA continued its updating and improvements to the Environmental Response Management Application (ERMA®), an online mapping tool that integrates both static and real-time data, such as Environmental Sensitivity Index (ESI) maps, ship locations, weather, and ocean currents, in a centralized, easy-to-use format for environmental responders and decision makers. Developed by NOAA and the University of New Hampshire with the EPA, USCG, and DOI, ERMA provides environmental resource managers with the data necessary to make informed decisions for environmental response. NOAA has developed ERMA tools for the following regions: Atlantic, Gulf of Mexico, Deepwater Horizon Response, Caribbean, Great Lakes, New England, Pacific Northwest, Pacific Islands, and Southwest. Through funding from BSEE, NOAA also developed an ERMA for the Arctic, with separate software interfaces for first responders and the public.

2) *PHMSA/NAS Diluted Bitumen Studies* – PHMSA commissioned the National Academy of Sciences to conduct two separate studies of diluted bitumen (dilbit) transport by pipeline. The first study, "Effects of Diluted Bitumen on Crude Oil Transmission Pipelines" provided an analysis of whether any increase in the risk of a release exists for pipeline facilities transporting diluted bitumen. The results of the first study were released in 2014. The second study, "Effects of Diluted Bitumen on the Environment: A Comparative Study," is evaluating whether the spill properties of diluted bitumen differ sufficiently from those of other liquid petroleum products to warrant modifications of spill response plans, spill preparedness, or clean-up regulations. The completion of the second study is anticipated for early in FY 2016.

3) *DOE/BSEE Memorandum of Collaboration* - The DOE Office of Fossil Energy and BSEE continue to operate under a MOC signed on August 22, 2013 that coordinates the ongoing efforts of the two agencies on offshore research and technological improvement projects. Through this collaboration, BSEE and DOE work together to develop technology that ensures safe, sustainable offshore production of oil and natural gas. The group established a Steering Committee and three Subcommittees: Cementing Subcommittee, Materials Subcommittee and Arctic Subcommittee. These Subcommittees bring together experts from DOE and BSEE to coordinate their research and explore synergies.

4) *Federal Multiagency Collaboration on Unconventional Oil and Gas Research* - In response to the President's *Blueprint for a Secure Energy Future*, the DOE, DOI, and the EPA signed a memorandum of agreement in April 2012 to formalize their collaboration. Under the agreement, the three agencies are working to address the highest priority challenges and research questions associated with safely and prudently developing unconventional shale gas and tight oil reserves. The topic areas of collaboration include Resource Base, Water Availability, Ecological Effects, Air Quality, Induced Seismicity, Water Quality, and Human Health. In these areas, each agency has individual expertise and core competencies that can influence the effective implementation of R&D. In this collaboration, emphasis is placed on a complementary approach that avoids duplication and takes advantage of these inherent strengths. On July 18th, 2014 the Steering Committee finalized and released the "Federal Multiagency Collaboration on Unconventional Oil and Gas Research - A Strategy for Research and Development."

5) *DOE/PHMSA Collaboration on Crude Oil Properties* - The DOE Office of Fossil Energy and DOT-PHMSA collaborated on a study to identify the actions needed to obtain a science-based understanding of outstanding questions associated with the production, treatment, and transportation of various types of crude oil, including Bakken crude oil. The agencies asked Sandia National Laboratories to prepare the March 2015 report entitled *Literature Survey of Crude Oil Properties Relevant to Handling and Fire Safety in Transport.* The Sandia report was an important step in developing a more complete understanding of outstanding scientific questions associated with the properties of various types of crude oil. It identified gaps in important crude oil characterization data; uncertainty and a lack of uniformity regarding how best to sample, test and analyze crude oil to ensure that its properties are accurately determined; and deficiencies in the understanding of how crude oil properties affect its potential for accidental ignition, combustion, and explosion.

   DOE and DOT-PHMSA also asked Sandia to prepare recommendations to address these gaps. Sandia prepared a comprehensive *Crude Oil Characterization Research Sampling, Analysis, and Experiment (SAE) Plan*, which contains recommendations on research needed to improve understanding of transport-critical crude oil and especially tight crude oil properties, including identifying the most appropriate sampling and testing methods for crude oils; sampling, testing and compilation of data on different crude oils using those methods; initial combustion testing to identify relationships between a particular chemical or physical property of crude oil, or combination of such properties, and combustion properties; and possible full-scale combustion tests. After considering this Plan, DOE and DOT have decided to support selected portions of the effort described in the Sampling, Analysis and Experiment (SAE) Plan.

6) *BSEE Oil Spill Response Research (OSRR) Program* – For more than 25 years, BSEE (and former organizations) has aggressively maintained a comprehensive, long-term research program dedicated to improving oil spill response options. The major focus of the program is to improve the methods and technologies used for oil spill detection, containment, treatment, recovery and cleanup. The OSRR program is a cooperative effort bringing together funding and expertise from research partners in government agencies, industry and the international community. BSEE's Oil Spill Response Division's Response Research Branch (RRB) manages the funding for numerous research projects chosen to meet selected major topics each year.

7) *BSEE's preparation for an oil spill response in the Alaskan Arctic* – BSEE's research program continues to focus on enhancing the technology, processes, and procedures employed in responding to a marine oil spill. With the increase in interest and activities related to oil and gas exploration and production in the Alaskan Arctic, BSEE placed an increased emphasis on the ability to launch an expedient, efficient, and effective response in arctic conditions. BSEE conducted a comparison of commercially available dispersants in February 2014 to evaluate the efficacy of chemical dispersants in arctic environments. Additionally, recognizing the restricted logistical support in the Alaskan Arctic, BSEE continues to work on a project designed to assess the temporary storage options for oil recovered during a spill. As a result, new projects were initiated with the goal of reducing the amount of hazardous waste generated by an offshore oil response. BSEE is exploring options to enhance response operations during periods of low light, such as those encountered in the Arctic winter, and new methods to detect and map oil in and under ice. Finally, BSEE continues to study the impact of ice mechanics on the ability to conduct *in situ* burns of oil, and develop new technology that will burn crude oil more efficiently and result in less residual particulate matter in the air and on the surface of the water. The capability will be especially important in the Arctic because recent research has indicated that *in situ* burning of oil is the most practical response technique on a year-around basis due to the harsh operating conditions.

8) *BSEE's Technology Readiness Level (TRL) initiative* – During this reporting period BSEE implemented a project to define the TRLs for oil spill response technologies. TRLs have been in use for many years by agencies such as NASA and DOE. Once they are established within the oil spill response community they will not only define stage-gates for the development of new technologies, but also provide a metric to determine the readiness of these technologies to be deployed during an actual spill response. These TRLs would have been a valuable tool to assist with verifying the potential contributions of the hundreds of un-proven technologies that proposed to assist in the Deepwater Horizon response.

9) *Effective Recovery System Potential (ERSP) Calculator* - BSEE continued to develop and refine the ERSP calculator, which uses a systems approach to compute a reasonable response standard based on an operator's entire system (pumps, storage capacity, transit time, etc). BSEE developed the ERSP as a planning tool for estimating the potential for mechanical recovery of spilled oil by an advancing skimming system. In November 2013, the National Research Council completed an independent review of the ERSP and made several recommendations to improve the calculator.

10) *Department of Energy's Upstream Research* – The DOE works to ensure America's energy security and prosperity by addressing energy and environmental challenges with research and technology solutions. This includes ensuring the responsible development of America's oil and natural gas resources through research and development that improves the safety and environmental performance of oil and natural gas exploration and production.

    In its research program, DOE works toward developing technology that addresses the risks and environmental impacts/challenges associated with onshore and offshore oil and gas resource development. The offshore research portfolio is primarily dedicated to oil spill prevention, while the onshore research portfolio is focused on reducing the environmental footprint of oil and gas exploration and production activities. The

offshore research portfolio has focused on the areas of (1) geologic uncertainty; (2) subsea systems reliability; (3) surface systems and umbilicals; and (4) drilling and completions. Areas of focus for the onshore research portfolio include (1) resource characterization, (2) water quality and availability, (3) air quality, and (4) induced seismicity.

Through its National Energy Technology Laboratory, DOE continues to conduct laboratory, field, and modeling-based research on offshore oil spill prevention and onshore unconventional oil and gas, focusing on more fundamental research questions in these areas. DOE's offshore and onshore research activities are working to build the scientific understanding and assessment tools necessary to develop confidence in the safe and environmentally sustainable development of domestic oil and gas resources.

11) *Enhanced BOEM Environmental Information Systems* – BOEM, in collaboration with NOAA's Office for Coastal Management, used the latest geospatial science and database technology to reinvent the Environmental Studies Program Information System (ESPIS) to streamline the search, discovery, and retrieval of more than 40 years of environmental science. This enhanced system enables BOEM and others who are preparing NEPA environmental reviews to find study reports with more precision by searching expanded metadata of BOEM-funded ocean research. Regional Planning Bodies can geo-reference study data more easily. Industry, academia and the NGO community will find archived study results from past decades to compare with the latest BOEM research. This enhancement built upon the success of the BOEM/NOAA collaboration on MarineCadastre.gov, an integrated marine information website that includes a national viewer, a data registry, planning tools, a map gallery, example uses, and technical support products.

12) *The DOE Quadrennial Technology Review* - In FY 15, DOE prepared and released the 2015 Quadrennial Technology Review (QTR 2015). The QTR 2015 examines the most promising research, development, demonstration, and deployment (RDD&D) opportunities across energy technologies to effectively address the nation's energy needs. Specifically, this analysis identifies the important technology RDD&D opportunities across energy supply and end use in working toward a clean energy economy in the United States. The insight gained from this analysis provides essential information for decision makers as they develop funding decisions, approaches to public-private partnerships, and other strategic actions over the next five years. The QTR 2015 is supported by technology assessments, which provide a more in-depth discussion of a technology area. Four of these technology assessments were focused on "Offshore Safety and Spill Prevention" "Unconventional Oil and Gas," "Gas Hydrates Research and Development," and "Natural Gas Delivery Infrastructure." Please visit http://energy.gov/quadrennial-technology-review-2015-omnibus to access all the QTR 2015 materials.

13) *DOE SubTER* - SubTER (Subsurface Technology and Engineering Research, Development, & Demonstration) is an integrated platform across the DOE offices involved in subsurface activities to address crosscutting and grand challenges associated with the use of the subsurface for energy extraction and storage purposes. This initiative is about next generation approaches to engineering subsurface reservoirs with improved safety and efficiency. The involved DOE Offices include: Fossil Energy; Energy Efficiency and Renewable Energy/Geothermal Technologies; Advanced Research Projects Agency- Energy; Nuclear Energy; Electricity; Environmental Management; Energy Policy and Systems Analysis;

Energy Information Administration; Congressional and Intergovernmental Affairs; and Science. The SubTER Crosscut identifies common research, development, and demonstration (RD&D) and policy challenges across DOE and enables programs to work together toward solutions through effective funding leverage and collaborative structure. The SubTER effort is primarily focused on four topic areas: (1) wellbore integrity; (2) subsurface stress and induced seismicity; (3) permeability manipulation; and (4) new subsurface signals (including identification and correction of problems for effective well control). Please visit http://energy.gov/sites/prod/files/2016/04/f30/Ch.7-SI-Subsurface-Science-Technology-Engineering.pdf for additional information on Subsurface Science, Technology, and Engineering.

14) *DOT/PHMSA's Pipeline Research* - PHMSA's Pipeline Safety Research Program is rather unique within the Interagency Committee as the sole agency charged with conducting "Pipeline Systems" research. During this reporting period, DOT/PHMSA registered commercialization into the market on one technology development research project addressing hazardous liquid pipeline challenges. This is reported below with further information about the net improvement available from the public project page.

- Subsurface Multi-Utility Asset Location Tool https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=490
- A Quantitative Non-destructive Residual Stress Assessment Tool for Pipelines https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=441

New research projects awarded by PHMSA in 2014 and 2015 are developing needed technology and expanding the knowledge base on several critical hazardous liquid pipeline challenges including leak detection, threat prevention and anomaly detection/characterization. These initiatives are reported in the appendix to this biennial report.

Finally, late in 2013, PHMSA launched a new facet of its overall research program focused on university research. The Competitive Academic Agreement Program (CAAP) is intended to spur innovation through enabling an academic research focus on high risk and high pay-off solutions for wide ranging pipeline safety challenges. The CAAP is different in focus, execution and reporting than PHMSA's core program on Pipeline Safety Research. It is intended to potentially deliver desired solutions that can be a "handed-off" to further investigations in CAAP or in PHMSA's core research program that employs partnerships with a variety of public/private organizations. One goal in this strategy would be to validate proof of concept of a thesis or theory potentially all the way to commercial penetration into the market.

Another goal for CAAP is to expose graduate and PhD research students to subject matter common to pipeline safety challenges for illustrating how their engineering or technical discipline is highly desired and needed in the pipeline field. The pipeline industry and federal/state regulators are all experiencing low numbers of entry level applications to positions that are engineering or technically focused. Public conferences, meetings and journals have identified similar shortfalls. The ultimate benefits from this goal would be to reflect new talent in all aspects of pipelining similar to how programs at other Federal Agencies and non-profit organizations have provided talent to other industries over time. Initiatives related to hazardous liquids are reported in the appendix to this biennial report.

Program Website: https://primis.phmsa.dot.gov/rd/index.htm
CAAP Website: https://primis.phmsa.dot.gov/rd/universitypartners.htm

15) *BOEM's Environmental Studies Program* – BOEM continued to conduct its Environmental Studies Program, which was authorized under the Outer Continental Shelf Lands Act. BOEM and its predecessors collected much of the available baseline environmental information on the Outer Continental Shelf (OCS) for the past 40 years. Working cooperatively with NOAA, USFWS, and other agencies, the Environmental Studies Program (ESP) provides critical environmental data to support responsible oil and gas production decisions and provides pre-spill baseline data that can be used in the event of oil spills. The breadth of information collected stretches from the composition of the seafloor and below, to the birds that fly over the water and almost everything in between. Beyond the basic understanding of the environment, information to determine the important social and economic effects of OCS energy development is also collected.

    BOEM's Hanna Shoal Ecosystem Study is a five-year investigation of the biological, chemical, and physical properties that define this unique ecosystem. Resulting data will help inform decision makers about future policies and activities that could potentially affect the region. This study extends to 2008-2011 Chukchi Sea Offshore Monitoring in Drilling Area (Chemical and Benthos) (COMIDA CAB) study.

    BOEM continued other environmental studies reported in the FY2012-2013 Biennial Report to Congress. These studies include:

    - The Aerial Surveys of Arctic Marine Mammals (ASAMM) study, a partnership with NOAA
    - Atlantic Marine Assessment Program for Protected Species (AMAPPS)
    - Gulf of Mexico ESP includes studies of sperm whales, chemosynthetic communities, and deepwater corals susceptible to damage due to oil and gas exploration
    - The Flower Garden Banks (FGB) Long-Term Monitoring Program at the FGB National Marine Sanctuary
    - The Multi-Agency Rocky Inter-tidal Network, or MARINe, monitors more than 100 sites along the Pacific coast from Canada to Mexico and 32 rocky inter-tidal sites on the mainland shore adjacent to OCS production facilities.

16) *Marine Arctic Ecosystem Study (MARES)* – MARES is an integrated ecosystem research initiative coordinated and planned by BOEM in conjunction with its federal and private sector research partners: USARC, USCG, USGS, U.S. Integrated Ocean Observing System, Marine Mammal Commission, National Science Foundation, NOAA, Office of Naval Research, and Shell Oil Company. The MARES study is taking place under the National Ocean Partnership Program (NOPP), which brings together federal agencies, academia, industry, and non-governmental organizations to support ocean research. The MARES stems from increased attention in the Arctic region to climate change, energy development, and sustainability. Information gained will aid government, industry, and communities in making decisions related to regulations, resource management, economic development and environmental protection issues.

17) *NOAA/CRRC Training and Workshops* – The CRRC is a partnership between NOAA's Office of Response and Restoration (ORR) and the University of New Hampshire (UNH) and its Environmental Research Group. The Center was created in 2004 by a Memorandum of Agreement between NOAA and UNH when NOAA ORR wanted to partner with a research-oriented university to create a center to address its research needs in spill response, recovery and restoration. Through the partnership, NOAA and CRRC

have accomplished a number of oil pollution and environmental disaster response research coordination objectives. Together, NOAA and CRRC sponsored or hosted several oil spill workshops and training during the reporting period, including:

- Data Management Strategy Workshop. (December 10-11, 2013, Seattle, WA)
- An Information Exchange & Collaboration on Data Management for Environmental Disasters. (January 29, 2014, Mobile, AL)
- Environmental Disasters Data Management Workshop (EDDM). (September 16-17, 2014, Shepherdstown, WV)
- State-of-Science for Dispersant Use in Arctic Waters (January 5-9, 2015, Seattle, WA); this is ongoing with regular web meetings until each of the five topic papers are finalized.
- CAMEO Stakeholder's Workshop. (April 15-16, 2015, Mobile, AL)

The CRRC also coordinates three working groups that have met at least once per year during this reporting period. The Dispersant Working Group, Submerged Oil Working Group, and Environmental Disasters Data Management (EDDM) Working Groups are comprised of representatives from several of the Interagency Committee agencies (USCG, EPA, NOAA, BSEE, and BOEM) as well as State agencies, international organizations, industry, and academia.

18) *Oil-in-Ice Recovery Demonstration Exercises* – The USCG Research and Development Center (RDC) is conducting an on-going series of demonstrations and exercises to develop and validate equipment and techniques that can be used successfully to detect, track, and recover oil in ice-filled waters under all conditions. The demonstrations and exercises involve deployment of small unmanned aerial vehicle (UAV) systems, unmanned underwater vehicles (UUVs), remotely operated vehicles, tethered observation balloons, ice radar systems, and different skimmer systems. Key activities of an oil spill response in the Arctic that were tested included: ability to search above and below an ice floe; ability to detect spilled oil; ability to produce data to be used to plot the safest course to the spilled oil; ability to deploy a brush skimmer to recover the spilled oil; and ability to monitor the recovery operation (above and below the ice) to ensure complete recovery. In 2014, the CGC HEALY suppored a Technology Demonstration cruise focused on the ice conditions well off the North Slope of Alaska. As this project has been ongoing for several years, the exercises and demonstrations of technology undertaken in 2014 built upon findings and lessons learned from a similar cruise which took place in 2013. Results have been recorded through videos as well as conference papers. The following Interagency Committee agencies have participated in one or more of the exercises: USCG, NOAA, BSEE, and USN.

19) *Remote Sensing Spills of Opportunity* – The USCG RDC, in collaboration with BSEE, conducted remote sensing tests over the Santa Barbara, California, oil seeps in May 2015. The on-going seeps in the Santa Barbara Channel were used to test various remote sensing equipment, mostly focused on inherent USCG radar, infrared and visual capabilities. Before the tests began, the Refugio Oil Spill occurred in the Channel, which provided additional opportunities to test remote sensing equipment. BSEE provided some funding and NOAA, US Army's Night Vision and Electronic Sensors Directorate, and the state of California also provided assistance with personnel.

20) *BP Deepwater Horizon Natural Resource Damage Assessment (NRDA)* - NOAA, EPA, USDA and the DOI, along with other State resource agencies, are natural resource trustees for the Deepwater Horizon NRDA. (On April 4, 2016, a consent decree resolving civil claims, including NRDA, against BP was entered in Federal court.) Over the course of the NRDA process, the trustees assessed and quantified the nature and extent of the injuries to natural resources (and the services they provide) caused by the release of the oil and other substances, and associated response actions for the purpose of restoring injured resources and impacts of lost public use. The trustees developed a comprehensive, integrated, ecosystem restoration plan based upon their conduct of over 200 studies on natural resources within the Gulf of Mexico that were affected by the oil spill, including the categories of marine mammals, turtles, birds, benthic resources, water column including fish and invertebrates, nearshore marine ecosystem, and human use. On October 5, 2015, immediately after the close of this biennial reporting period, the Deepwater Horizon Trustees released the Deepwater Horizon Oil Spill Draft Programmatic Damage Assessment and Restoration Plan (PDARP) and Draft Programmatic Environmental Impact Statement (PEIS), which allocates funds from a proposed settlement with BP of up to $8.8 billion for natural resource injuries stemming from the spill. The draft plan, now final , allocates funds to meet five restoration goals, and across 13 restoration types designed to meet these goals. The restoration types address a broad range of ecosystem level impacts, with funds being allocated across restoration areas, including coastal and nearshore habitats and in open waters. Together, these efforts will restore wildlife and habitat and increase recreational opportunities in the Gulf. For additional information please visit http://www.gulfspillrestoration.noaa.gov/.

21) *BP Deepwater Horizon NRDA Data Sharing* – NOAA developed the Data Integration Visualization Exploration and Reporting (DIVER) tool to integrate and make available data primarily generated during the Deepwater Horizon NRDA into a centralized data warehouse and query tool. NRDA data in DIVER are available to the general public and are accessed through a query and mapping interface called DIVER Explorer (https://dwhdiver.orr.noaa.gov/). Data currently available include validated information such as sampling locations and concentrations of contaminants in tissue, sediment, oil, and water, visual observations, photographs, telemetry and oceanographic data. To provide additional context to the NRDA data, the site also includes historical (pre-2010) contaminant chemistry data for the onshore area of the Gulf of Mexico, as well as contaminant chemistry data collected during the Response efforts. Data can be viewed onscreen or downloaded in a variety of formats. NOAA is incorporating additional field and laboratory data into the DIVER tool as it is collected, analyzed, and validated. Substantial additional information was made available in DIVER following the release of the Draft Programmatic Damage Assessment and Restoration Plan (PDARP), and the DIVER data collectively represents approximately over 20,000 trips to the field to collect data, more than 100,000 environmental samples collected, with a sum total of 13 million publically available records. The DIVER application has the capacity to bring in and standardize environmental data from across the Gulf of Mexico to provide an on-line ecosystem-wide environmental data repository.

22) *Science Partnerships Enabling Rapid Response (SPERR).* Representatives of the USCG, NOAA, and EPA served as Core Advisors to the SPERR project. The project is a collaboration between the Center for Ocean Solutions and ChangeLabs at Stanford University funded by the Packard Foundation. The goal of the project is to promote effective scientific collaboration and enable rapid information exchange between government agency responders and non-governmental scientists from multiple relevant

disciplines. The project resulted in a proposal to create a Science Action Network (SAN) designed as a network of 13 Regional Academic Hubs, each associated with a Federal emergency response region. Through the Hubs, non- governmental scientists from academic institutions, professional societies, and scientific NGOs can develop and fund disaster-relevant collaborative research initiatives. During a disaster response effort, government agencies can access Hub members' scientific expertise in a rapid, streamlined manner. At the close of the biennium, the Stanford centers were collaborating with the Coastal Response Research Center in seeking partners and funding to conduct a regional pilot of the SAN.

23) Arctic Waterways Safety Committee (AWSC). The USCG is providing a framework for this maritime committee. The committee is established based solely on the collective group of stakeholders to include representatives from local and tribal governments, subsistence hunter co-management groups, advocacy organizations, the maritime industry, and community members. - See more at: www.arcticwaterways.org.

24) *NIST's Marine Environmental Specimen Bank* – NIST continued to maintain the biological specimens it has since 1979 when it established the National Biomonitoring Specimen Bank (NBSB) in Gaithersburg, MD. In 2001, NIST established the Marine Environmental Specimen Bank (Marine ESB) facility in Charleston, SC, and continues to cryogenically bank well-documented environmental specimens collected as part of other agency marine research and monitoring programs. Other agency programs collaborating with NIST and providing specimens include: the NOAA National Marine Mammal Tissue Bank (NMMTB), the NOAA National Status and Trends Mussel Watch Project, the USFWS Seabird Tissue Archival and Monitoring Project (with supplemental funding from the North Pacific Research Board), and the USFWS American Peregrine Falcon Monitoring Plan. Specimens in the collection include marine mammal tissues, mussels and oysters, fish tissues, seabird eggs, and peregrine falcon eggs and feathers. The Marine ESB is an important resource of research materials that are used to document geographic and temporal trends in "new" pollutants, changes in transport and accumulation of "old" pollutants in the environment, and study temporal changes in marine animal health through application of future new analytical and biochemical techniques.

25) *NOAA Airborne Chemical Measurements Quantifying Blowout Leak Rates* – NOAA research used airborne hydrocarbon measurements from chemically-instrumented aircraft to calculate accurate offshore blowout leak rates and environmental distributions in the *Deepwater Horizon* disaster in the U.S. Gulf of Mexico in 2010, and in the 2012 *Elgin* rig blowout in the UK North Sea in 2012. This capability was briefed to the ICCOPR Committee at the Quarterly Meeting in September 2014. NOAA continues to evaluate the feasibility of a future operational quick-response airborne chemical measurement capability for incident response, with applications to both offshore and onshore blowout leak rate assessment as recently demonstrated by quantifying the Aliso Canyon underground storage facility leak rate in near-real time. – See more at: http://esrl.noaa.gov/csd/projects/alisocanyon.html.

Member Participation in Workshops and Conferences

Each year a variety of workshops and conferences are held that address various facets of the petroleum industry and oil pollution research. The Interagency Committee monitors these to stay abreast of the latest topics and issues that support on-going and future research initiatives. The

Interagency Committee's member organizations participate in or directly sponsor many of these workshops and conferences. To increase the communication and networking benefits across the oil pollution research community, the Interagency Committee has devoted a specific area of its website to tracking and publicizing these conferences and workshops, including their associated website links and basic support documents.

In this reporting period, several workshops, conferences, and other forums addressed oil spill research needs or provided participants with opportunities to expand their capabilities to address oil spills. The Interagency Committee maintained a visible presence in several of these events by sponsoring, planning, and participating in the events. Key forums in which the Interagency Committee participated include:

1) *2014 International Oil Spill Conference (IOSC)* – During the reporting period, the USCG, EPA, NOAA, and BSEE, with staff on the Executive Committee, played key roles in planning for the 2014 IOSC in partnership with the API. The USCG chaired the Program Committee, which solicited and evaluated a record number of 399 abstracts for papers and posters in 38 topic areas covering diverse topics such as oil spill modeling, dispersant use policies and applications, arctic issues, and cutting-edge response technologies. BSEE managed planning for on-water demonstrations of oil pollution prevention and cleanup systems including UAV surveillance and cutting edge response technology. NOAA designed a suite of 12 short courses on oil pollution issues. EPA organized a film festival and photography contest to garner additional interest from conference participants.

   Since 1973, the USCG and EPA have managed the IOSC alongside the API. NOAA and BSEE joined later and the current IOSC permanent sponsorship team consists of seven domestic and international organizations, four of whom are members of the Interagency Committee. The goals of the IOSC are: "To promote an international exchange of information and ideas dealing with spill prevention, planning, response and restoration processes, protocols and technology" and "To promote international sharing of best practice as it relates to management of the varied impacts of oil spills and their aftermath."

   The IOSC is part of the "triennial conference series," which is also comprised of its European and Australian counterparts known as Interspill and Spillcon, respectively. All three conferences are major venues for hosting the latest oil pollution research communications and technology displays. In 2005, the conference organizers agreed to work on a three-year cycle to avoid overlap and reduce the travel/financial burden of government and industry participants.

2) *2015 Interspill Conference* – On March 24-26, 2015, representatives of the USCG, BSEE, EPA, and NOAA participated in this conference, which is one of the three primary international oil spill conferences.

3) *Offshore Technology Conference 2015* – On May 4-7, 2015, the DOE participated in the Offshore Technology Conference (OTC), the largest oil and gas sector trade show in the world. DOE spill prevention research was presented during the technical sessions and at the DOE-National Energy Technology Laboratory (NETL) exhibit booth. DOE leadership participated in a panel titled "Global Energy Outlook: North America Challenges and Opportunities."

4) *Offshore Technology Conference 2014* **–** On May 5-8, 2014, the DOE and BSEE participated in the Offshore Technology Conference (OTC), the largest oil and gas sector trade show in the world. DOE research was presented during the technical sessions and at the DOE-NETL exhibit booth. During the conference, DOE organized and led a 2-panel forum on spill prevention. This forum was titled "Energy Security and Economic Prosperity: Oil Spill Prevention." The first panel focused on Federal efforts to prevent oil spills. During this panel, DOE presented from a technical perspective and BSEE presented from a regulatory viewpoint. The second panel was focused on industry efforts, including future technology, for spill prevention. The speakers on the second panel included representatives from a domestic producer, an international producer, a service company, and an equipment manufacturing company.

5) *Federal Multiagency Collaboration on Unconventional Oil and Natural Gas Research Workshop* - On January 28-29th, 2015, a workshop on Federal Multiagency Collaboration on Unconventional Oil and Natural Gas Research was held at the U.S. Geological Survey National Center in Reston, Virginia. The workshop was held to discuss joint collaborative research of the Federal Multiagency Collaboration on Unconventional Oil and Natural Gas, a group that includes DOE, DOI, and the EPA. This workshop was successful in sharing research results and identifying potential areas of coordination on future research efforts. More specifically, the workshop participants addressed individual agency accomplishments, direction for collaborative research, and the progress or modifications of objectives to particular collaborative projects. This workshop enhanced the coordination and collaboration of DOE, DOI, and EPA research on topics including Resource Base, Water Availability, Ecological Effects, Air Quality, Induced Seismicity, Water Quality, and Human Health.

6) *RPSEA 2015 Ultra-Deepwater (UDW) Technology Conference* **–** On September 9-10, 2015, DOE participated in the RPSEA Ultra-Deepwater Technology Conference. This year, it was co-hosted by RPSEA and Society of Petroleum Engineers' Gulf Coast Section Technology Transfer Committee. On the first day of this conference, a DOE-NETL representative gave a keynote speech on *Technologies for The Age of Offshore Risk Reduction*, highlighting the contributions of the DOE offshore spill prevention research portfolio. Throughout the conference, presentations on DOE research communicated progress and results of projects that are working towards assessing and mitigating the risks associated with offshore drilling and production operations.

7) *2014 Clean Gulf Conference* – BSEE, USCG, and NOAA participated in this conference on December 2-4, 2014 in San Antonio, Texas.

8) *2013 Clean Gulf Conference* –BSEE and the Gulf States, in association with the USCG, co-hosted this conference conducted on November 12-14, 2013 in Tampa, Florida. BSEE, USCG, and NOAA participated in the conference.

9) *2015 Clean Pacific Conference* – In Vancouver, British Columbia, Canada on June 16-18, 2015, representatives of the USCG, BSEE, and NOAA participated in this conference wide range of prevention, preparedness and response topics, with a focus on the growth in crude transportation across the West.

10) *2014 Gulf of Mexico Oil Spill and Ecosystem Sciences Conference* – On January 26-29, 2014, the USCG, EPA, BSEE, BOEM, NOAA, NASA, USN, and USFWS participated in this annual conference organized by the Gulf of Mexico Research Initiative (GoMRI),

which included more than 900 registrants. Participants from Interagency Committee agencies were included as authors of 19 papers and 20 posters. Representatives of NOAA and EPA serve on the Executive Committee. Partners and sponsors include Interagency Committee member agencies NOAA and EPA. The conference included "An Information Exchange and Collaboration on Data Management for Environmental Disasters: Kick-Off Meeting" to initiate a working group to consider data management issues.

11) *2015 Gulf of Mexico Oil Spill and Ecosystem Sciences Conference* – In February 2015, the USCG, EPA, BSEE, BOEM, NOAA, and USFWS participated in an annual GoMRI conference, which included more than 1,000 registrants. Partners and sponsors include Interagency Committee member agencies NOAA, BOEM, and EPA. The representatives participated in these associated workshops:

- State-of-Science on Dispersants and Dispersed Oil; Environmental Disasters Data Management Working Group;
- Gulf Science and Restoration Programs Update and Panel Discussion;
- Science Partnerships Enabling Rapid Response (SPERR):
- Design Session for Improving Scientific Collaboration during Oil Spill Crises

12) *Government/Industry Pipeline R&D Forum* – On August 6-7, 2014, PHMSA sponsored the Government/Industry Pipeline R&D Forum in Arlington, VA. This two-day event occurs periodically to generate a national research agenda that fosters solutions for the many challenges with pipeline safety and protecting the environment. The forum allows public, government, and industry pipeline stakeholders to develop a consensus on the technical gaps and challenges for future research. It also reduces duplication of programs, factors on-going research efforts, leverages resources and broadens synergies. The national research agenda coming out of these events aligns with the needs of the pipeline safety mission, makes use of the best available knowledge and expertise, and considers stakeholder perspectives.

13) *Hazardous Materials R&D Forum* – On April 16, 2015, PHMSA hosted the 2015 R&D forum with three goals in mind: inform the public and industry of our proposed research projects and projects that have recently begun; provide an opportunity for interested industry representatives to present their recommendations to PHMSA; and provide a forum where research projects and the overall program can be discussed and prioritized. Participants provided input into seven projects addressing Safe Transportation of Energy Products, including crude oils and other hazardous liquids.

14) *2014 International Oil Spill Response Seminar and Exercise* – A BSEE representative participated in the seminar in Bergen, Norway to describe oil spill planning and preparedness in U.S. territorial waters. The representative highlighted current BSEE research and explained BSEE and operator requirements for oil spill planning and preparedness. The representative observed the Oil on Water Exercise offshore at the Frigg oil field in the North Sea where various oil spill response equipment operated during a field release of oil. The exercise is conducted annually.

15) 2015 International Oil Spill Response Seminar and Exercise – A representative from the USCG participated in the 2015 International Oil Spill Response Seminar and Exercise conducted in the former Frigg oil field approximately 100 nautical miles northwest of

Stavanger, Norway. As with the 2014 event, the representative explained current U.S. oil pollution activities. NASA also used this exercise as an opportunity to test its Unmanned Aerial Vehicle Synthetic Aperture Radar (UAVSAR) remote sensing capabilities with calibrated discharges of petroleum and vegetable oil.

16) *International Forum on Group V (Non-buoyant) Heavy Oils* – USCG, NOAA, and EPA representatives participated in this forum conducted September 9-10, 2014 in Detroit, Michigan.

17) *The 6th Symposium on the Impacts of an Ice-Diminishing Arctic on Naval and Maritime Operations* – This symposium, conducted on July 14-15, 2015 in Washington, DC, was co-hosted by USARC and the National Ice Center, a multi-agency operational center operated by the USCG, NOAA, and the USN. The symposium addressed the changing Arctic sea ice environment and the current and future implications on maritime operations, including how the changes could affect oil spill risks.

18) *Washington Best Achievable Protection Conference* – On May 20-21, 2015, representatives of NOAA, BSEE, and the USCG participated in this conference to discuss technologies available for oil spill response.

19) *Pacific States/British Columbia Oil Spill Task Force Oil Spill R&D Project Workgroup* – On January 6, 2014, and January 6, 2015, representatives of the USCG, BSEE, EPA, and NOAA participated in a workgroup conference call with representatives from oil spill programs in Canada, Alaska, California, Oregon, and Washington. These meetings enabled the participants to share information on their oil spill research and development projects.

20) *PHMSA Pipeline Risk Modeling Methodologies Public Workshop* - On September 9-10, 2015, PHMSA, partnering with the National Association of Pipeline Safety Representatives (NAPSR), held a public workshop to discuss risk modeling methodologies of gas transmission and hazardous liquid pipelines and non-pipeline systems. It focused on improving risk modeling approaches and techniques for pipeline and non-pipeline systems to advance pipeline risk models.

21) *PHMSA Emergency Response to Bakken Crude Oil Stakeholder Engagement Meeting* – On February 10, 2014, PHMSA held a meeting to get input on the level of interaction between crude oil shippers and local emergency planning agencies and the level of capabilities of these agencies for response to a rail incident.

22) *PHMSA Lessons Learned Roundtable* - On May 29, 2014, PHMSA and the Virginia Department of Fire Programs conducted a Roundtable where representatives from Alabama, North Dakota, and Virginia presented lessons learned from the response, aftermath, and actions subsequent to the incidents in those states. They identified key factors having a direct effect on the successful outcome of managing a crude oil transportation incident.

23) *FEMA/USFA Coffee Break Training: Hazardous Materials Series* – To promote improved human response capabilities, the USFA provides one-page training bulletins for busy fire and emergency medical services personnel with busy daily schedules who often do not have time to attend valuable skill-enhancing training sessions. These one-page training notices provide technical training and administrative tips on a variety of topics.

Each notice includes a photograph or drawing that illustrates the point of the training lesson. They also include links to additional information on the topic. Coffee Break Bulletins specific to hazardous materials issued during the reporting period were:

- Bakken Crude in Transportation (June 23, 2014)
- Petroleum Crude Oil Transportation and Response Considerations (October 27, 2014)
- Petroleum Crude Oil: Preincident Planning (November 3, 2014)
- Petroleum Crude Oil: Principles of Successful Incident Management (November 10, 2014)
- Petroleum Crude Oil: Railroad Safety Procedures (November 17, 2014)
- Petroleum Crude Oil: Hazard Assessment and Risk Evaluation (November 24, 2014)
- Petroleum Crude Oil: Implementing Response Objectives (December 1, 2014)

24) *Oil Spill Recovery Institute (OSRI) Technology Adoption Workshop* - August 11-12, 2015. Representatives of BSEE, NOAA, and the USCG participated in this workshop in Anchorage, AK. This workshop focused on identifying the impediments of bringing new technology into oil spill responses. The workshop sought to elicit different perspectives on challenges associated with the advancement of oil spill response technologies from research and development through commercialization. All locations for spills were addressed with the Arctic regions given the higher priority. Participants included federal and state government, oil production and oil response industry and academics.

25) *American Geophysical Union Fall Meeting 2013* – On December 9-13, 2013, representative of BSEE conducted a town hall forum that described BOEM's Environmental Studies Program and addressed funding opportunities of applied science at BOEM. An EPA representative presented a poster on ocean science.

26) *2014 NRT Worker Safety and Health (WS&H) Technical Conference* – On October 28-29, 2014, EPA hosted this National Response Team Technical Conference to provide a forum to discuss current trends and topics, share information, and improve the safety and health for workers related to oil and hazardous material response and recovery. EPA, USACE, and USCG personnel participated.

27) *Industry Quality Partnership Meetings* – Several Interagency Committee agencies regularly participate in quality partnership meetings with industry groups including: American Petroleum Institute's Spill Advisory Group, the Association of Petroleum Industry Cooperative Managers (APICOM), the Spill Control Association of America (SCAA), and the American Salvage Association (ASA).

Website and Other Outreach

The Interagency Committee continued to provide information through its website. During the reporting period, the Interagency Committee migrated the content to a new URL location at: www.uscg.mil/iccopr. The USCG hosts and updates the content to provide up-to-date announcements of research news, meetings and conferences, and links to documents or sources of information useful to the research community. Member agencies continued using their websites as tools to convey information on research initiatives to partners and the public. The Interagency Committee website contains links to these member sites.

Several member agencies have newsletters that highlight agency activities, including oil spill-related research. Examples include the BOEM Ocean Science quarterly newsletter, BSEE's semi-annual Ohmsett Gazette, USARC Arctic Daily Update by e-mail, the USFWS Fish & Wildlife News, and several NOAA programmatic newsletters.

V. Future Activities

The Interagency Committee recognizes that oil spills will continue to be a hazard as long as oil is used as a fuel and feedstock source. The United States continues to recover from major spills such as the BP *Deepwater Horizon* and Enbridge Pipeline oil spills, as well as other spills around the country. Although great strides were made in oil spill research during the FY 2014 and 2015 period, there is still much work to be done to address lessons learned from these spills and meet the challenges of emerging hazards. Therefore, the Interagency Committee will continue to move forward to promote research and development in the four research classes: Preparedness, Prevention, Response, and Injury Assessment & Recovery. Future initiatives include:

1) *Oil Pollution Research and Technology Plan Maintenance* –The Interagency Committee will use its Oil Pollution Research Categorization Framework as a tool to track and measure research progress within the government, academia and industry. The Interagency Committee will release revised versions of the OPRTP every six years to reflect conditions and needs at that time. Should significant changes occur in research needs between revisions, the Interagency Committee will consider issuing a supplement or other interim document.

2) *Intentional Release Permitting* – The Interagency Committee's Intentional Release Permitting Workgroup will continue working with policy makers and permitting authorities to explore field testing opportunities. Field tests may be justified when laboratory or other simulated settings (e.g., test tanks) cannot address specific Research Needs and no other open water research projects have addressed the need.

3) *National Academy of Sciences Gulf Research Program* – The Interagency Committee will continue to work closely with NAS as it implements the 30-year NAS Gulf Research Program (GRP) "focused on human health and environmental protection including issues relating to offshore oil and hydrocarbon production and transportation in the Gulf of Mexico and on the United States' outer continental shelf." The NAS GRP was established under Guilty Plea Agreements reached by the U.S. Department of Justice with BP Exploration & Production, Inc. and Transocean Deepwater Inc. to settle criminal charges stemming from the BP *Deepwater Horizon* oil spill. A key provision in both agreements is that, at least once a year, NAS must seek the recommendations of the Interagency Committee, BSEE, and BOEM concerning the administration of the NAS GRP. The Interagency Committee will continue working closely with the NAS GRP as they implement their research program.

4) *Support the 2017 International Oil Spill Conference (IOSC)* – The Interagency Committee will continue to support development of the 2017 IOSC to be held in Long Beach, CA on May 15-18, 2017 and future IOSC events. Four Interagency Committee members - USCG, EPA, BSEE, and NOAA - are permanent members of the Conference's Managing Executive Committee. The IOSC has a 45-year proven track record for maximizing communications within the oil spill research community. Therefore, the Interagency Committee leverages the IOSC to meet many of its Title VII obligations and use it as a communications hub for international and domestic researchers.

5) *Arctic Research Needs* – The release of reports or Arctic issues by the National Research Council and the National Petroleum Council provide the Interagency Committee with valuable information on current Arctic Research needs. The priority research needs in the OPRTP cover many of the research needs identified in these studies. Member organizations of the Interagency Committee will continue addressing their own issues and responsibilities associated with activities in the arctic using these priority research needs as a guide. Consequently, the perspectives of the member organizations will help shape the Interagency Committee's continuing understanding of, and communications related to, cold weather research.

6) *Continued Outreach to Non-Federal Stakeholders* – The Interagency Committee will continue to proactively reach out to non-federal stakeholders to gain insights into additional research needs, share research results and ideas, and to promote advancements in the state of oil pollution research and technology. The Interagency Committee will continue its practice of inviting speakers from state industry programs, industry and academia to present information on their research during quarterly meetings. In addition, many members of the Interagency Committee will continue participating in IOSC, other conferences, workshops, and other forums as a means to reach out to industry and academic experts from around the world.

7) *Addressing Emerging Issues and Challenges* – The Interagency Committee will continue to monitor the state of the art in oil spill prevention and response and in the conditions that create oil spills risks. Offshore drilling operations are moving into deeper waters on the OCS, which poses additional challenges for responding to a subsea release. Oil production and shipping in the Arctic Ocean is increasing as the levels of sea ice diminish thereby increasing the risk of spills in remote areas where response efforts could be challenging. Oil production patterns are also changing as technology has enabled greater production from tar sands and from shale source rock. Inland spill risks may also be increasing as the transport of crude oil via pipeline and railcars has increased.

   The Interagency Committee members will continue to monitor these and any other emerging trend to consider their effects and make appropriate recommendations for research to address the associated challenges. The Oil Pollution Research Categorization Framework will provide a tool to facilitate tracking of research progress and help identify emerging trends in research needs. In any event, the 15 member organizations have the breadth of skills and expertise needed to identify and coordinate the needed research to address the associated oil spill risks.

VI. List of Acronyms

ADIOS	Automated Data Inquiry for Oil Spills
AR	Augmented Reality
AMAPPS	Atlantic Marine Assessment Program for Protected Species
API	American Petroleum Institute
ART	Alternative Response Technology
ARTES	Alternative Response Tool Evaluation System
ASAMM	Aerial Surveys of Arctic Marine Mammals
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATON	Aids to navigation
AUV	Autonomous Underwater Vehicle
AWSC	Arctic Waterways Safety Committee
BAA	Broad Agency Announcement
BFT	Baffled Flask Test
BOEM	Bureau of Ocean Energy Management
BOEMRE	the former Bureau of Ocean Energy Management, Regulation and Enforcement
BOP	Blowout Preventer
BOEM	Bureau of Ocean Energy Management
BP	British Petroleum
BSEE	Bureau of Safety and Environmental Enforcement
BTFM	Bacti-Twist Filter Media
BTEX	Benzene, toluene, ethyl benzene, and xylenes
CAFE	Chemical Aquatic Fate and Effects
CAAP	Competitive Academic Agreement Program
CCoast Guard	Canadian Coast Guard
CEDRE	Center of Documentation, Research and Experimentation on Accidental Water Pollution
CETAP	Cetacean and Turtle Assessment Program
CNT	Carbon Nanotubes
CORN	Coordinated Oil-spill Response Network
CRRC	Coastal Response Research Center
CRREL	US Army Cold Regions Environmental Laboratory
CT	Coil Tubing
DE	Dispersant Effectiveness
DFO	Department of Fisheries and Oceans Canada
DHIC	Digital Holographic Imagery Camera
DHS	U.S. Department of Homeland Security
DIVER	Data Integration Visualization Exploration and Reporting
DMAC	Data Management and Access Committee
DOC	U.S. Department of Commerce
DoD	Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOR	Dispersant-to-Oil Ratio
DOT	U.S. Department of Transportation
DTox	Dispersant and Chemically Dispersed Oil Toxicity Database
DWH	Deepwater Horizon
DWH-IR	Deepwater Horizon Institutional Repository

EA	Effervescent Atomizers
EDRC	Effective Daily Recovery Capacity
EEMS	Excitation Emission Matrix Spectroscopy
EPA	U.S. Environmental Protection Agency
ERD	Environmental Research Division
ERMA®	Environmental Response Management Application
ERSP	Estimated Recovery System Potential
ERW	Electrical resistance weld
ESB	Environmental Specimen Bank
ESP	Environmental Studies Program
EVOS	Exxon Valdez oil spill
FAME	Fatty Acid Methyl Ester
FEMA	Federal Emergency Management Agency
FBA	Flow-Blurring Atomizers
FFA	Free Fatty Acids
FGB	Flower Garden Banks
FIT	Florida Institute of Technology
FOIA	Freedom of Information Act
FPSO	Floating, Production, Storage and Offloading
FY	Fiscal Year
GAO	U.S. Government Accountability Office
GNOME	General NOAA Operational Modeling
GOM	Gulf of Mexico
GoMRI	Gulf of Mexico Research Initiative
GOMURC	Gulf of Mexico University Research Consortium
GOODS	GNOME Online Oceanographic Data Server
HIPPS	High-integrity pressure protection system
HPHT	High Pressure High Temperature
IATAP	Interagency Alternative Technology Assessment Program
ICIFT	Intelligent Casing-Intelligent Formation Telemetry
IMO	International Maritime Organization
IOSC	International Oil Spill Conference
ISB	In situ burning
IWG-OP	Interagency Working Group on Ocean Partnerships
JIP	Joint Industry Project
JITF	Joint Industry Task Force
LISST	Laser In-Situ Scattering Transmissometry
MAOP	Maximum Allowable Operating Pressure
MARAD	Maritime Administration
MARINe	Multi-Agency Rocky Inter-tidal Network
MEPC	IMO Marine and Environmental Protection Committee
MMHSRP	Marine Mammal Health and Stranding Response Program
MMS	the former Minerals Management Service
MSDC	Modular Stacked Direct Current
MSP	Maximum Source Pressure
NAS	National Academy of Sciences
NASA	National Aeronautical and Space Administration
NBSB	National Biological Specimen Bank
NCP	National Contingency Plan
NESDI	Navy Environmental Sustainability Development to Integration Program
NIOSH	National Institute for Occupational Safety and Health

NIST	National Institute of Standards and Technology
NMFS	NOAA's National Marine Fisheries Service
NMMTB	National Marine Mammal Tissue Bank
MWM	Meandering Winding Magnetometer
NOAA	National Oceanic and Atmospheric Administration
NOPP	National Oceanographic Partnership Program
NRC	U.S. National Research Council
NRDA	Natural Resource Damage Assessment
NRMRL	National Risk Management Research Laboratory
NRT	National Response Team
NSWCCD	Naval Surface Warfare Center Carderock
NTIS	National Technical Information Service
NVESD	Night Vision and Electronic Sensors Directorate
OCIO	Office of Chief Information Officer
OCS	Outer Continental Shelf
OEM	Office of Emergency Management
OMA	Oil Mineral Aggregate
OPA 90	Oil Pollution Act of 1990 (Public Law 101-380)
OPeNDAP	Open-source Project for a Network Data Access Protocol
OPRTP	Oil Pollution Research and Technology Plan
ORD	EPA's Office of Research and Development
ORR	NOAA's Office of Response and Restoration
OSHA	Occupational Safety and Health Administration
OSPR JITF	Oil Spill Preparedness and Response Joint Industry Task Force
OSRO	Oil Spill Removal Organizations
OSSE	Observing System Simulation Experiment
OSTP	White House Office of Science and Technology Policy
OWS	Oil/Water Separators
PAHs	Polycyclic aromatic hydrocarbons
PBC	Prudhoe Bay Crude
PDI	Phase Doppler Interferometry
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIGPEN	Proactive Infrasonic Gas Pipeline Evaluation Network
PNU	Polymer Nanotube Umbilical
PWSRCAC	Prince William Sound Regional Citizen's Advisory Council
R&D	Research and Development
RCPC	Reverse-Circulation Primary Cementing
RDC	U.S. Coast Guard Research & Development Center
RDT&E	Research, Development, Test & Evaluation
ROV	Remotely Operated Vehicle
RULET	Remediation of Underwater Legacy Environmental Threats
S&T	Science and Technology
SAB	EPA's Science Advisory Board
SAG	API's Spill Advisory Group
SERDP	Navy Strategic Environmental Research and Development Program
SLARP	Slug Loading & Response in Pipelines, Risers and Jumpers
SLC	South Louisiana Crude Oil
SRA	Standing Research Area
SWA	Surface Washing Agent
TAC	Technical Advisory Committee
THP	Thermal Hydrate Preventer

TRL	Technology Readiness Level
UAV	Unmanned Aerial Vehicle
UAVSAR	Unmanned Aerial Vehicle Synthetic Aperture Radar
UMCES	University of Maryland Center For Environmental Science
UME	Unusual Mortality Event
UNH	University of New Hampshire
USACE	U.S. Army Corps of Engineers
USARC	U.S. Arctic Research Commission
USCG	U.S. Coast Guard
USFA	U.S. Fire Administration
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geologic Service
USN	U.S. Navy
VOC	Volatile Organic Compounds

VII. Appendices

(A) Interagency Committee Member Publications

(B) Interagency Committee Member Projects

This page is intentionally blank.

Interagency Committee Member Publications

Adams, J., J. Felis, J. W. Mason, and J. Y. Takekawa. 2014. Pacific Continental Shelf Environmental Assessment (PaCSEA): aerial seabird and marine mammal surveys off northern California, Oregon, and Washington, 2011-2012. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Pacific OCS Region, Camarillo, CA. OCS Study BOEM 2014-003. 266 pages. March 2014

Allik, Toomas H., Roberta E. Dixon, Lenard V. Ramboyong, Mark Roberts, Thomas J. Soyka, George Trifon, and Lori Medley. 2014. *Novel Electro-Optic Imaging Technologies for Day/Night Oil Spill Detection*. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 299609.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-299609.1

Ambrose, R. 2015. *Robotic Solutions for Exploration, Earth and Space*. Offshore Technology Conference 2015, May 2015

Andarawis, Emad. 2014. 11121-5503-01, PHASE 1 FINAL PRESENTATION: Intelligent BOP RAM Actuation Sensor Systems; Ultra-Deepwater Drilling, Completions and Interventions TAC meeting June 4, 2014, Greater Fort Bend Economic Development Council Boardroom, Sugar Land, TX

Andarawis, Emad. 2014. "Phase 1 Final Report, 11121-5503-01, Intelligent BOP RAM Actuation Sensor System," 25 Sep, 2014

Antony, A., V. Vinayan, S. Holmes, D. Spernjak, S. J. Kim, and J. Halkyard, "VIM Study for Deep Draft Column Stabilized Floaters," OTC-25837-MS, Offshore Technology Conference, Houston, Texas, USA, 4–7 May, 2015

Antony, Arun, "Phase 1 Study Final Report: Vortex Induced Motion Study for Deep Draft Column Stabilized Floaters, RPSEA 11121-5404-03," 29 May, 2015

Antony, Arun, "Vortex Induced Motion Study for Deep Draft Column Stabilized Floaters Phase 1 Final Presentation Materials, 11121-5404-03, RPSEA TAC Meeting, 6 Apr., 2015

Antony, A., V. Vinayan, S. Holmes, D. Spernjak, S.J. Kim, and J. Halkyard. 2015. *VIM Study for Deep Draft Column Stabilized Floaters*. Offshore Technology Conference 2015. May 2015

Aten, Brandon. 2015. *Oil Sampling Policy*. Interspill 2015 Conference Proceedings March 25, 2015

Athie, G., J. Sheinbaum, A. Romero, J. Candela, and J. Ochoa. 2014. Measurements in the Yucatan-Campeche area in support of the Loop Current dynamics study. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2014-669. 159 pp. November 2014

Austin, Diane, B. Marks, K. McClain, T. McGuire, B. McMahan, V. Phaneuf, P. Prakash, B. Rogers, C. Ware, and J. Whalen. 2014. Offshore oil and *Deepwater Horizon*: Social Effects on Gulf Coast Communities, Volume I. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2014-617. 266 pp. June 24, 2014

Austin, Diane, S. Dosemagen, B. Marks, T. McGuire, P. Prakash, and B. Rogers. 2014. Offshore oil and *Deepwater Horizon*: Social Effects on Gulf Coast Communities, Volume II. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2014-618. 205 pp. June 2014

Ayers, Ray R., and Cesar J. Del Vecchio, Paul V. Devlin, and William Head, "Effects of Fiber Rope - Seabed Contact On Subsequent Rope Integrity," OTC 25136-MS, Offshore Technology Conference, Houston, TX, 5-8 May, 2014 [do not release to public]

Ayers, Ray R., Cesar Del Vecchio, and Charles A. Miller, "Final Report: Effects of Fiber-Rope/Seabed Contact on Subsequent Rope Integrity," RPSEA Doc. No.: 10121.4406.01.Final, Doc. No.: 1751572-EN-RP-01 (Rev B)10121-4406-01, 30 Oct., 2014

Bachman MJ, JM Keller, KL West, and BA Jensen. 2014. Persistent organic pollutant concentrations in blubber of 16 species of cetaceans stranded in the Pacific Islands from 1997 through 2011. Science of the Total Environment 488:115-123.

Baled, O. H., D. Xing, H. Katz, D. Tapriyal, I. K. Gamwo, Y. Soong, B. A. Bamgbade, Y. Wu, K. Liu, M. McHugh, and R. M. Enick. 2014. Viscosity of n-Hexadecane, n-Octadecane and n-Eicosane at Pressures up to 243 MPa and Temperatures up to 534 K. Journal of Chemical Thermodynamics 2014, 72, 108–116.

Baguley, J.G., P. A. Montagna, C. Cooksey, J. L. Hyland, H.W. Bang, C. Morrison, A. Kamikawa1, P. Bennetts, G. Saiyo, E. Parsons, M. Herdener, and M. Ricci. 2015. Community response of deep-sea soft-sediment metazoan meiofauna to the Deepwater Horizon blowout and oil spill. Marine Ecology Progress Series, 528: 127–140. doi:10.3354/meps11290. May 28.

Balmer, B.C., et al. 2015. Persistent organic pollutants (POPs) in blubber of common bottlenose dolphins (Tursiops truncatus) along the northern Gulf of Mexico coast, USA.. The Total Environment, 527: 306-312. doi:10.1016/j.scitotenv.2015.05.016. May 14.

Balsley, Alexander, Kurt Hansen, and Michele Fitzpatrick. 2014. Detection of Oil within the Water Column. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2206-2217. **doi:** http://dx.doi.org/10.7901/2169-3358-2014.1.2206

Balsley, Alexander, 2015. Evaluation of Rutter Sigma S6 Ice Navigation Radar on USCGC Healy during Arctic Shield 2014.,(CG-D-13-15), US Coast Guard Research and Development Center, March, 2015.

Bamgbade, A. B.; Wu, Y.; Burgess, A. W.; Tapriyal, D.; Gamwo, I.; Baled, O. H.; Enick, M. R.; McHugh, A. M. HighTemperature, High-Pressure Volumetric Properties of Propane, Squalane, and Their Mixtures: Measurement and PCSAFT Modeling. Ind. Eng. Chem. Res. 2015, 54, 6804–6811.

Bamgbade, A. B., Y. Wu, A. W. Burgess, D. Tapriyal, I. Gamwo, O. H. Baled, M. R. Enick, and A. M. McHugh, 2015. Measurements and Modeling of High-Temperature, High-Pressure Density for Binary Mixtures of Propane with NDecane and Propane with N-Eicosane. J. Chem. Thermodynamics 2015, 84, 108–117.

Barker, Christopher H. 2014. Subsurface Oil and Waves in The Coastal Zone. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 300025. **doi:** http://dx.doi.org/10.7901/2169-3358-2014-1-300025.1

Barker, Chris. 2015. *New Developments in the General NOAA Operational Modelling Environment (GNOME)*. Interspill 2015 Conference Proceedings March 24, 2015.

Bauer, Jennifer R., and Kelly Rose. 2015. Variable Grid Method: an Intuitive Approach for Simultaneously Quantifying and Visualizing Spatial Data and Uncertainty. Transactions in GIS 2015, 19, 377–397.

Bejarano, A. and A. Mearns. 2015. Improving environmental assessments by integrating Species Sensitivity Distributions into environmental modeling: Examples with two hypothetical oil spills. DOI:10.1016/j.marpolbul.2015.01.022

Bejarano, Adriana C., Valerie Chu, Jeff Dahlin, and Jim Farr. 2014. Development and Application of DTox: A Quantitative Database of the Toxicity of Dispersants and Chemically Dispersed Oi. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 733-746.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.733

Belore, R., S.L. Ross Environmental Research Ltd. 2014. *Dispersant Effectiveness Testing at Ohmsett Using Aircraft Application Dosages*. Herndon, VA: Bureau of Safety and Environmental Enforcement.

Bemis, B. E., R.B. Spies, D.D. Hardin and J.A. Johnson. 2014. Determining the Potential Release of Contaminants into the Marine Environment from Pacific OCS Shell Mounds. Prepared by Applied Marine Sciences, Inc. for the U.S. Department of the Interior, Bureau of Ocean Energy Management. Camarillo, CA. OCS Study BOEM 2013P208. 33 pages + Appxs. March 24, 2014

Benggio, Bradford, Debra Scholz, Dave Anderson, Joseph Dillon, Greg Masson, Lindy Nelson, Daniel Odess, and Elizabeth Petras. 2014. Addressing the Uncertainty and Requirements for Oil Spill Response Consultations. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1881-1898.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1881

Benggio, Bradford, LCDR Kimberly Chesteen, Jason DeSantis, Richard Knudsen, and CAPT John Slaughter. 2014. Tidal Inlet Protection Strategies for Oil Spill Response; Concepts, Testing, and Considerations. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 287225.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-287225.1

Bodnar, Jill, Michele Jacobi, Ed Bock, Eric Doucette, Judd Muskat, and Todd Barr. 2014. Understanding the Keys to Effective Information Management and Situation Display During a Pollution Response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1596-1606. **doi:** http://dx.doi.org/10.7901/2169-3358-2014.1.1596

Booth, Sara, and Rhianna Macon. 2014. *Action, not Alarm: Preparing for Oil Sands Response at the Local Level*. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 417-425.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.417

Boswell, Ray, DOE-NETL. 2014. Developments in Marine Gas Hydrate Exploration. Offshore Technology Conference. doi:10.4043/25192-MS

Bouvier-Brown NC, Carrasco E, Karz J, Chang K, Nguyen T, Ruiz D, Okonta V, Gilman JB, Kuster WC, de Gouw JA. 2014. A portable and inexpensive method for quantifying ambient intermediate volatility organic compounds. Atmospheric Environment 94:126-133.

Bowechop, Chad, Andrew Connor, Scott Knutson, Heather A. Parker, and LCDR Lance Lindgren. 2014. Makah Indian Tribe – U.S. Coast Guard Memorandum of Agreement A Model for Meaningful Tribal-Federal Engagement. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 300663.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-300663.1

Braund, Stephen R., Braund & Associates. 2013. Aggregate Effects Research and Environmental Mitigation Monitoring of Oil Industry Operation in the Vicinity of Nuiqsut: History and Analysis of Mitigation Measures, Final Report. Prepared for the U.S. Department of the Interior, Alaska OCS Region, Anchorage, AK. Technical Report No. BOEM 2013-212. December 2013

Braund, Stephen R. & Associates. 2013. COMIDA: Impact Monitoring for Offshore Subsistence Hunting, Wainwright and Point Lay, Alaska. US Dept. of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region. Anchorage, Alaska. OCS Study BOEM 2013-211. 298pp. December 31, 2013

Breslow SJ. 2014. A Complex Tool for a Complex Problem: Political Ecology in the Service of Ecosystem Recovery. Coastal Management 42(4):308-331.

Brette F, Machado B, Cros C, Incardona JP, Scholz NL, Block BA. 2014. Crude Oil Impairs Cardiac Excitation-Contraction Coupling in Fish. Science 343(6172):772-776.

Brewton, Rachel Aileen, Richard Fulford, and Robert J. Griffitt. 2014. Gene Expression and Growth as Indicators of Effects of the BP Deepwater Horizon Oil Spill on Spotted Seatrout (Cynoscion nebulosus). Journal of Toxicology and Environmental Health, Part A: Current Issues Volume 76, Issue 21, 2013 pages 1198-1209
DOI:10.1080/15287394.2013.848394

Brooks, J.M., C. Fisher, H. Roberts, B. Bernard, I. McDonald, R. Carney, S. Joye, E. Cordes, G. olff, E. Goehring. 2014. Investigations of chemosynthetic communities on the lower continental slope of the Gulf of Mexico: Volume I: Final report. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2014-650. 560 pp.

Brooks, J.M., C. Fisher, H. Roberts, B. Bernard, I. McDonald, R. Carney, S. Joye, E. Cordes, G. Wolff, E. Goehring. 2014. Investigations of chemosynthetic communities on the lower continental slope of the Gulf of Mexico: Volume II: Appendices. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2014-651. 442 pp.

Bureau of Ocean Energy Management (BOEM) Alaska Outer Continental Shelf Region. 2014. *Alaska Annual Studies Plan FY 2015*. October 2014.

Bureau of Safety and Environmental Enforcement and Genwest Systems, Inc. 2015. ERSP Calculator User Manual. February 2015

Burgess, W. A.; Tapriyal, D.; Gamwo, I. K.; Wu, Y.; McHugh, M. A.; Enick, R. M. New Group-Contribution Parameters for the Calculation of PC-SAFT Parameters for Use at Pressures to 276 MPa and Temperatures to 533 K. Ind. Eng. Chem. Res. 2014, 53, 2520–2528.

Campbell, Seth, Kevin L. Haskins, Benjamin Winn, Jesse Stanley, Leonard J. Zabilansky. 2014. Testing of Oil Skimmer Equipment Components for use in Arctic Environments. Bureau of Safety and Environmental Enforcement, Project #1026, http://www.bsee.gov/Technology-and-Research/Oil-Spill-Response-Research/Projects/Project1026/

Capo, Rosemary C., Brian W. Stewart, Elisabeth L. Rowan, Courtney A. Kolesar Kohl, Andrew J. Wall, Elizabeth C. Chapman, Richard W. Hammack, Karl T. Schroeder, "The strontium isotopic evolution of Marcellus Formation produced waters, southwestern Pennsylvania" International Journal of Coal Geology 126 (2014) 57–63

Casey, LCDR Drew and John Caplis. 2014. Improving Planning Standards for the Mechanical Recovery of Oil Spills on Water. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1772-1783.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1772

Chanton JP et al. . 2014. The rise and fall of methanotrophy following a deepwater oil-well blowout. Nature Geoscience 7(6):423-427.

Chapman, Elizabeth C. , Rosemary C. Capo, Brian W. Stewart, Robert S. Hedin, Theodore J. Weaver, Harry M. Edenborn,. 2013. "Strontium isotope quantification of siderite, brine and acid mine drainage contributions to abandoned gas well discharges in the Appalachian Plateau", Applied Geochemistry 31 (2013) 109–118.

Chassignet E.P., and A. Srinivasan, 2015. Data Assimilative Hindcast for the Gulf of Mexico. US Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2015-035. 46 pp.

Chen, Qin, "Subsea HVDC Connectors Technical Requirements Final Report: Subsea DC Connectors for Environmentally Safe and Reliable Powering of UDW Subsea Processing, 12121-6302-01," Document No. 12121.6302.01.01, RPSEA, 17 Feb., 2015

Chen, T.; Nutter, J.; Hawk, J. A.; Liu, X. Corrosion Fatigue Crack Propagation of Oil-grade Nickel-base Alloy 718. Part 2: Effect of Aging Treatment. Corros. Sci. 2015, 98, 280–290.

Chen, T.; Nutter, J.; Hawk, J. A.; Liu, X. Influence of Surface Modification on Pitting Corrosion Behavior of Oil-Grade Alloy 718, Part 2: Effects of Aging Treatment. Submitted to Corros. Sci., in review.

Chen, T.; Nutter, J.; Hawk, J.; Liu, X. Corrosion Fatigue Crack Propagation of Oil-grade Nickel-base Alloy 718. Part 1: Effect of Corrosive Environment. Corros. Sci. 2014, 89, 146-153.

Cherrier, J., J. Sarkodee-Adoo, T. P. Guilderson, and J. P. Chanton. 2014. Fossil Carbon in Particulate Organic Matter in the Gulf of Mexico following the Deepwater Horizon Event. *Environ. Sci. Technol. Lett.*, 2014, *1* (1), pp 108–112.
Doi: 10.1021/ez400149c.Publication Date (Web): December 3, 2013

Claisse J.T., D. J. Pondella, M. Love, and A. S. Bull. 2014. Biological productivity of fish associated with offshore oil and gas structures on the Pacific OCS. Vantuna Research Group, Occidental College, Los Angeles, California. BOEM Cooperative Agreement No. M12AC00003. April 2014

Composite Technology Development, Inc. 2013.. *Rapidly Deployable Thermal Hydrate Preventer for Oil Spill Mitigation*. Herndon, VA: Bureau of Safety and Environmental Enforcement.

Conley, S., G. Franco, I. Faloona, D.R. Blake, J. Peischl, and T.B. Ryerson (2016): Methane emissions from the 2015 Aliso Canyon blowout in Los Angeles, CA, Science, 351, 1317-1320, doi: 10.1126/science.aaf2348.

Conmy, Robyn N., Paula G. Coble, James Farr, A. Michelle Wood, Kenneth Lee, W. Scott Pegau, Ian D. Walsh, Corey R. Koch, Mary I. Abercrombie, M. Scott Miles, Marlon R. Lewis, Scott A. Ryan, J. Robinson, Thomas L. King, Christopher, R. Kelble, and

Jordanna Lacoste. Submersible Optical Sensors Exposed to Chemically Dispersed Crude Oil: Wave Tank Simulations for Improved Oil Spill Monitoring. Environmental Science & Technology 2014 48(3). 1903-1810

Conmy, R.N., P.G. Coble, J. Farr, A.M. Wood, R. Parsons, K. Lee, S. Pegau, I. Walsh, C. Koch, M. I. Abercrombie, M.S. Miles, M.R. Lewis, S. Ryan, B. Robinson, T. King, and J. Lacoste. 2014. Submersible Optical Sensors Exposed to Chemically-Dispersed Crude Oil: Wave Tank Simulations for Improved Oil Spill Monitoring. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 300156. **doi:** http://dx.doi.org/10.7901/2169-3358-2014-1-300156.1

Contreras, Elizabeth, Jin Huang, Roger S. Posusta, Deepak K. Sharma, Chao Yan, Paula Guraieb, Mason B. Thomson, and Ross C, Tomson, "Optical measurtement of uniform and localized corrosion of C1018, SS410, and Onconel 825 alloys using white light interferometry," Corrosion Science 87 (2014), pp383-91

Cormier, LT Annjea M. 2014. Crisis Response and Management Following Hurricane Sandy. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 299895. **doi:** http://dx.doi.org/10.7901/2169-3358-2014-1-299895.1

Davis, Scott, "Roadmap to Close the Technology Gaps: 12121-6403-01; Development of Advanced CFD Tools for the Enhanced Prediction of Explosion Pressure Development and Deflagration Risk on Drilling and Production Facilities," RPSEA, 19 Aug., 2015

Detweiler, George and Rand D. LeBouvier. 2015. *The Age of Unmanned Shipping.* The Coast Guard Journal of Safety & Security at Sea – Proceedings of the Marine Safety & Security Council. Summer 2015.

Dilmore, Robert, James I. Sams, Deborah Glosser, Kristin M. Carter, and Daniel J. Bain. 2015. Spatial and temporal characteristics of historical oil and gas wells in Pennsylvania: implications for new shale gas resources", Environ. Sci. Technol., Aug 2015.

Disenhof, C., M. Mark-Moser, and K. Rose. 2014. The Gulf of Mexico Petroleum System Foundation for Science-Based Decision Making. Journal of Sustainable Energy Engineering. 2014, 2, 225–236.

Dismukes, D. 2014. Onshore oil and gas infrastructure to support development in the Mid-Atlantic OCS Region. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2014-657. 360 pp.

Dollhopf, Ralph H., Faith A. Fitzpatrick, Jeffrey W. Kimble, Daniel M. Capone, Thomas P. Graan, Ronald B. Zelt, and Rex Johnson. 2014. Response to Heavy, Non-Floating Oil Spilled in a Great Lakes River Environment: A Multiple-Lines-Of-Evidence Approach for Submerged Oil Assessment and Recovery. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 434-448. **doi:** http://dx.doi.org/10.7901/2169-3358-2014.1.434

Doris, Inc. "Preliminary Design and Analysis of Topsides Report-FINAL, Low Cost Flexible Production System for Remote Ultra Deepwater Gulf of Mexico (GOM) Field Development: 10121-4404-03," Document No.: 10121-4404-03.10, 9 Jul., 2014

Doughty CL, AM Quattrini, and EE Cordes. 2013. Insights into the population dynamics of the deep-sea coral genus Paramuricea in the Gulf of Mexico **doi:** http://dx.doi.org/10.1016/j.dsr2.2013.05.023

Drury, LTJG Alice, Gary Shigenaka, and Mark Toy. 2014. Washington State Case Study and Guidance Developed on the Closing and Re-Opening of a Shellfishery Due to Oil

Contamination. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2273-2287.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.2273

Dyke, C., "Ultrahigh Conductivity Imbilicals: Polymer Nanotube Umbilicals," OTC 25340, 2014 Offshore Technology Conference, 5-8 May, 2014, Houston, TX

Dyke, Christopher, "Phase II Final Technical Report: 10121-4302-01, Ultra-High Conductivity Umbilicals: Polymer Nanotube Umbilicals," 17 Jul., 2014

Eastern Research Group, Inc. 2014. Measuring county-level tourism and recreation in the Gulf of Mexico region: Data, methods, and estimates. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2014-660. 58 pp. September 24, 2014

Eiler, J. H., Masuda, M. M., Spencer, T. R., Driscoll, R. J., & Schreck, C. B. 2014. Distribution, Stock Composition and Timing, and Tagging Response of Wild Chinook Salmon Returning to a Large, Free-Flowing River Basin. Transactions of the American Fisheries Society, 143(6), 1476-1507. doi:10.1080/00028487.2014.959997

Ellisor D, McLellan W, Koopman H, Schwacke L, McFee W, Kucklick J. 2013. The distribution and stratification of persistent organic pollutants and fatty acids in bottlenose dolphin (Tursiops truncatus) blubber. Science of the Total Environment 463:581-588.

Embry, Carl and 3D at Depth. 2014. High Resolution 3D Laser Imaging for Inspection, Inspection, Maintenance, Repair, and Operations: 09121.3300.06.Final. December 12, 2014

Fannin, J.M., M. Schafer, and W. Keithly. 2015. Assessing Impacts of OCS Activities on Public Infrastructure, Services, and Population in Coastal Communities Following Hurricanes Katrina and Rita. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study 2015-003. 268 pp. January 2015

Federici, C. & Mintz, J., CNA. 2014. *Literature Synthesis of Oil Properties and Their Impact on Spill Response Options*. Herndon, VA: Bureau of Safety and Environmental Enforcement

Feng, R.; Beck, J.; Lvov, S. N.; Ziomek-Moroz, M. Effects of Hydrogen Sulfide on the Corrosion Behavior of High Strength Steel in Alkaline Solutions. Electrochemical Society Transactions 2014, 61, 97–114.

Ferguson, Scott. 2014. Response V = Response Victory. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 284386.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-284386.1

Ferguson, Tracy, Steve Hanewich, Leonard Rich, and LT Danielle Shupe. 2014. Geographic Response Planning in the Chesapeake Bay. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 299452.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-299452.1

Fisher, C.R., P-Y Hsing, C.L. Kaiser, D.R. Yoerger, H.H. Roberts, W.W. Shedd, E.E. Cordes, T.M. Shank, S.P. Berlet, M.G. Saunders, E.A. Larcom, and J.M. Brooks. 2014. Footprint of Deepwater Horizon blowout impact to deep-water coral communities. Proceedings of the National Academy of Science. doi:10.1073/pnas.1403492111. July 28.

Fisher, Charles R., Amanda W.J. Demopoulos, Erik E. Cordes, Iliana B. Baums, Helen K. White, Jill R. 2014. Bourque Coral communities as indicators of ecosystem-level impacts of the Deepwater Horizon spill BioScience DOI: 10.1093/biosci/biu129

Fitzpatrick, Michele and Scott Fields. 2013.. Institutionalizing Emerging Technology Assessment Process into National Incident Response (CG-D-11-13). U.S. Coast Guard Research and Development Center. May 2012 - Updated October 2013

Fletcher, James. 2015. *21st Century Waterways Navigation: A Research and Development Center Initiative*. The Coast Guard Journal of Safety & Security at Sea – Proceedings of the Marine Safety & Security Council. Summer 2015.

Fukuyama AK, Shigenaka G, Coats DA. 2014. Status of intertidal infaunal communities following the Exxon Valdez oil spill in Prince William Sound, Alaska. Marine Pollution Bulletin 84(1-2):56-69.

Galginaitis, M. 2014. Monitoring Cross Island Whaling Activities, Beaufort Sea, Alaska: 2008-2012 Final Report, Incorporating ANIMIDA and cANIMIDA (2001-2007). U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Alaska Region, Anchorage, AK. OCS Study BOEM 2013-212. 208 pp. March 2014

Gamwo, I. K.; Tapriyal, D.; Enick, R. M.; McHugh, M. A.; Morreale, B. D. High Temperature, High Pressure Equation of State: Solidification of Hydrocarbons and Measurement of Krytox Oil Using Rolling-Ball Viscometer Validation; NETL-TRS5-2014; EPAct Technical Report Series; U.S. Department of Energy, National Energy Technology Laboratory: Morgantown, WV, 2014; p 48.

Garcia-Pineda O, MacDonald IR, Li XF, Jackson CR, Pichel WG. 2013. Oil Spill Mapping and Measurement in the Gulf of Mexico With Textural Classifier Neural Network Algorithm (TCNNA). Ieee Journal of Selected Topics in Applied Earth Observations and Remote Sensing 6(6):2517-2525.

Gelzer, CAPT Claudia C. 2015. *Marine Environmental Response Program.* Soundings, the Official Publication of the American Salvage Association. Spring 2015 edition. April 2015.

Gleason, Joseph J. 2014. Getting Big Results by Going Small - The Importance of Tabletop Exercises. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 114-123.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.114

Goodman, Benjamin T., Ross A. Davidson, Eric S. Sievert, Leslie Wood, and Vincent H. Homer. 2014. Initiating *In Situ* Burning of Difficult-to-Ignite Oil Spills via an Aircraft-Deployable Igniter System. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1821-1833.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1821

Gordon, Robert, and Reza Mostofi, "Ultra-Deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico, Final Technical Report," 10121-4405-02, RPSEA - Research Partnership to Secure Energy for America, Report No.: 15U502I-11, Rev. 2, Document No.: 15U5O2I-11, 31 Dec., 2014

Gorman, D., J. Farr, R. Bellair, W. Freeman, D. Frurip, A. Hielscher, H. Johnstone, M. Linke, P. Murphy, M. Sheng, K. van Gelder, and D. Viveros. 2013. Enhanced NOAA chemical reactivity worksheet for determining chemical compatibility. Proc. Safety Prog. doi: 10.1002/prs.11613.

Gray JL, Kanagy LK, Furlong ET, Kanagy CJ, McCoy JW, Mason A, Lauenstein G. 2014. Presence of the Corexit component dioctyl sodium sulfosuccinate in Gulf of Mexico waters after the 2010 Deepwater Horizon oil spill. Chemosphere 95:124-130.

Griffin, Weston, "Phase 1 Final Presentation: Statement of Requirements/Basis of Design," 28 Feb., 2014

Griffin, Weston, "Statement of Requirements/Basis of Design Final Report," 7 Mar., 2014

Guidon, Samantha and Celeste Leroux. 2014. Implementing U.S. Arctic Policy: An Analysis of Federal Recommendations. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1497-1511.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1497

Gunter, CDR Tim. 2014. Potential Impacts from a Worst Case Discharge from an United States Offshore Wind Farm. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 869-877.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.869

Guraieb, P, et. al., "Validation of the Activity Coefficients for Carbonates at Various High Pressure High Temperature (HPHT) and Total Dissolved Solids (TDS)," 2014 NACE Corrosion Conference, 9-12 Mar., 2014

Guraieb, P, et. al., "Validation of the Activity Coefficients for Carbonates at Various High Pressure High Temperature (HPHT) and Total Dissolved Solids (TDS)," 2014 NACE Corrosion Conference, 9-12 Mar., 2014

Guzzo ,Judith, Jeff Lemonds, Dani, Liu, Carbone, DeRose, Good, Koste, Del'Anno, Guida, Zinser, Almeida, Parodi, Tom Fraser, Bob Judge, Samhita Dasgupta, "Riser Lifecycle Monitoring System (RLMS) for Integrity Management, 11121-5402-01," Floating Facilities and Risers & Systems Engineering UDW TAC Meeting, 5 Jun., 2014, Sugar Land, TX

Guzzo, Judith, Dani, Lemonds, Liu, Carbone, Choudhury, DeRose, Dell'Anno, Good, Guida, Koste, Zinser, Almeida, Parodi, Zhao, Tom Fraser, Bob Judge, Samhita Dasgupta, and Mike Volk, "Riser Lifecycle Monitoring System (RLMS) for Integrity Management , Subcontract: 11121-5402-01," RPSEA Ultra-Deepwater Technology Conference, Norris City Center Conference Center, Houston, Texas, 4 Sep., 2014

Guzzo, Judith, Uttara Dani, Brandon Good, Jeff Lemonds, Shaopeng Liu, John Carbone, and Mike Volk. 2014. Phase I Preliminary Design Report – Final, 11121.5402, Riser Lifecycle Monitoring System for Integrity Management: Contract 11121-5402-01. November 18, 2014

Haines, Seth S., Patrick E. Hart, William W. Shedd, and Matthew Frye. 2013. Seismic Investigation of Gas Hydrates in the Gulf of Mexico: 2013 Multi-component and High-Resolution 2D Acquisition at GC955 and WR313.
doi: http://dx.doi.org/10.4043/25318-MS

Hall, Christopher J. and Leonard Zabilansky. 2014. Responding to Oil Spills Under Ice: Alaska Clean Seas' Cold Regions Research and Engineering Laboratory (CRREL) Training Course. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 300320. **doi:** http://dx.doi.org/10.7901/2169-3358-2014-1-300320.1

Hall, Gregory J., Glenn S. Frysinger, Christoph Aeppli, Catherine A. Carmichael, Jonas Gros, Karin L. Lemkau, Robert K. Nelson, and Christopher M. Reddy. *Oxygenated weathering products of Deepwater Horizon oil come from surprising precursors*. Marine Pollution Bulletin, Volume 75, Issues 1–2, 15 October 2013, Pages 140–149
http://dx.doi.org/10.1016/j.marpolbul.2013.07.048

Halliwell Jr., G.R., A. Srinivasan, V. Kourafalou, H. Yang, D. Willey, M. Le Hénaff, and R. Atlas. 2014: Rigorous Evaluation of a Fraternal Twin Ocean OSSE System for the Open Gulf of Mexico. J. Atmos. Oceanic Technol., 31, 105–130. doi: http://dx.doi.org/10.1175/JTECH-D-13-00011.1

Hamer, T., M. Reed, E. Colclazier, K. Turner and N. Denis. 2014. Nocturnal Surveys for Ashy Storm-Petrels (*Oceanodroma homochroa*) and Scripps's Murrelets (*Synthliboramphus scrippsi*) at Offshore Oil Production Platforms, Southern California. US Dept. of the Interior, Bureau of Ocean Energy Management, Pacific OCS Region, Camarillo, CA. OCS Study BOEM 2014-013. 62 pp.

Hammack, Richard W. William Harbert, Shikha Sharma, Brian W. Stewart, Rosemary C. Capo, Andy J. Wall, Arthur Wells, Rodney Diehl, David Blaushild, James Sams, and Garret Veloski, "An Evaluation of Fracture Growth and Gas/Fluid Migration as Horizontal Marcellus Shale Gas Wells are Hydraulically Fractured in Greene County, Pennsylvania", NETL Final Report, NETL-TRS-3-2014, September 2014.

Hannon, Stephen M., "Underwater Mapping," LiDAR News, Vol. 3, No. 1, 25-31, 2013

Hansen, Kurt, 2014, *Responding to Oil Spills in Ice*, International Oil Spill Conference Proceedings, May 2014, Vol 2014, No 1. Pp 1200-1214**,** **doi**: http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1200

Hansen, Kurt, 2014, *Sunken Oil Recovery System Recommendations*, 2014 International Oil Spill Conference, Savannah, GA International Oil Spill Conference Proceedings, May 2014, Vol 2014, No 1. Pp 1214-1223**, doi**: http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.2014

Hansen, Kurt. 2014. *Evaluating Equipment for responding to oil spills in ice*. In Proceedings of the AMOP Technical Seminar on Environmental Contamination and Response, Environment Canada, Halifax, NS.

Hansen, Kurt. 2015. *Monitoring Oil Spills Near an Ice Edge*. Interspill 2015 Conference Proceedings March 25, 2015

Hansen, Kurt A. *Arctic Technology Evaluation 2014 Oil-in-Ice Demonstration Report*, (CG-D-14-15), US Coast Guard Research and Development Center, March, 2015.

Hansen, Kurt, "Sunken Oil Recovery Systems: Federal Om-Scene Commander (FOSC) Recommendations, Group V Oil Forum, Detroit, MI Sept 9-10, 2014.

Hansen, Kurt, Mike Sprague, John Joeckel and Mark Rockley, *Response to Oil Sands Products Assessment*, (CG-D-X-15) US Coast Guard Research and Development Center, October, 2015

Harbert, W.; Benge, G.; Cunningham, E.; Lawrence, W.; DeBruijn, G.; Gardner, C. Field-Generated Foamed Cement: Initial Collection, Computed Tomography, and Analysis; NETL-TRS-5-2015; EPAct Technical Report Series; U.S. Department of Energy, National Energy Technology Laboratory: Morgantown, WV, 2015; p 48.

Hardy, Mark, and Carl Embry, "High Resolution 3D Laser Imaging for Inspection, Maintenance, Repair, and Operations: FINAL PRESENTATION, RPSEA Project 09121-3300-06," RPSEA Ultra-Deepwater Technology Conference, Norris Conference Center, Houston, Texas, 3-4 Sep., 2014

Harper, J.R., Morrow, K. 2014. *North Slope Coastal Imagery Site*. Herndon, VA: Bureau of Safety and Environmental Enforcement

Hartmann-Moore C, Lewis S, Morris M, Harper J, Lindeberg M, Saupe S, Stewart D. 2014. ShoreZone Mapping in Alaska and the Pacific Northwest (Poster). Alaska Marine Science Symposium, Anchorage, AK, Jan 2014

Haza, A.C., Özgökmen, T.M., Griffa, A., and Ryan, E. 2014. Implementation of Lagrangian Stochastic Models to Parameterize Submesoscale Transport for Tracking Oil Spills in the Gulf of Mexico, U.S. Department of the Interior, Bureau of Ocean Energy Management, BOEM 2014-053. Herndon, VA, February 2014.

Heffern K, Maselko J, Sreenivasan A, Garvin M. 2014. Effects of Polystyrene Ingestion on Growth of Pink Salmon (Poster). Alaska Marine Science Symposium, Anchorage, AK, Jan 2014

Helton, Doug and Vicki Loe. 2014. How to Better Manage Public Expectations and Information Concerning Oil and Chemical Spill Response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 300295.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-300295.1

Holder, E.L, R.N. Conmy, A.D. Venosa (2015) Comparative laboratory-scale testing of dispersant effectiveness of 23 crude oils using four different testing protocols. J. Environ. Protection. 6: 628-639.

Holesinger, Terry, et al., "Carbon Nanotube Composite Cables for Ultra-Deepwater Oil and Gas Fields," OTC 25370, 2014 Offshore Technology Conference, Reliant Center, Houston, TX., 5-8 May, 2014

Holland, Greg, "PHASE 2 FINAL PRESENTATION: Effect of Climate Variability and Change in Hurricane Activity in the North Atlantic, 10121-4802-01," RPSEA Metocean TAC Meeting, 6 May, 2014

Holland, Greg, and James Done, "Phase 2 Final Summary Report and Recommendations: Effect of Climate Variability and Change in Hurricane Activity in the North Atlantic," 10121.4802.01.Final2, RPSEA, 3 Aug., 2015

Houston Offshore Engineering "10121-4405-02 – Final Technical Report Appendix C1 - AIP FOR HOE'S PAIRED COLUMN DRY TREE SEMI, Approval in Principle of HOE's Paired Column Dry Tree Semi," RPSEA, Report No.: 15U5O2I-9, Rev. 2, Document No.: 15U5O2I-9, 30 Dec., 2014

Houston Offshore Engineering "10121-4405-02 – Final Technical Report Appendix C2 - DNV, Approval In Principle, HOE's Paired Column Dry Tree SemiSubmersible," Request by RPSEA, 14 Nov., 2014

Houston Offshore Engineering, "10121-4405-02 – Final Technical Report Appendix B1 - Technology Qualification of Riser Tensioner for Dry Tree Semi Concept," Houston Offshore Engineering, Report No.: 2014-0569, Rev. 0, Document No.: NA, 11 Aug., 2014

Hsing P-Y, B. Fu, E.A. Larcom, S.P. Berlet, T.M. Shank, A.F. Govindarajan, A.J. Lukasiewicz, P.M. Dixon, and C.R. Fisher. 2013. Evidence of lasting impact of the Deepwater Horizon oil spill on a deep Gulf of Mexico coral community. Elementa Science of the Anthropocene. December 4.

Huang, J., et al., "Corrosion Testing of Deepwater Tubing Materials under Extreme Pressure and Temperature Conditions" OTC 25193, 2014 Offshore Technology Conference, 5-8 May, 2014, Houston, TX

Huang, Jin, et. al., "Corrosion Behavior of Deepwater Oil Production Tubing Materials under Extremely High Temperature and High Pressure," 2014 NACE Corrosion Conference, 9-14 Mar., 2014

Huang, Jin, Paula Guraieb, Chao Yan, and Ross Tomson, "Study of pitting corrosion resistant alloys at extreme high temperature using electrochemical measurements," NACE-5620, NACE International Corrosion 2015 Conference & Expo, Kay Bailey Hutchison Convention Center, Dallas, TX, 15-19 Mar., 2015

ICCOPR. 2014. *Interagency Coordinating Committee on Oil Pollution Research: Fiscal Years 2012-2013 Activities*. June 25, 2014.

ICCOPR. 2015. *Oil Pollution Research and Technology Plan: Fiscal Years 2015-2021*. September 29, 2015.

Incardona J, Gardner L, Linbo T, Brown T, Esbaugh A, Mager E, Stieglitz J, French B, Labenia J, Laetz C, Tagal M, Sloan C, Elizur A, Benetti D, Grosell M, Block B, Scholz N Deepwater Horizon crude oil impacts the developing hearts of large predatory pelagic fish Proceedings of the National Academy of Sciences of the United States of America. 2014 vol: 111 (15) pp: E1510-8. DOI: 10.1073/pnas.1320950111

Incardona JP, Swarts TL, Edmunds RC, Linbo TL, Aquilina-Beck A, Sloan CA, Gardner LD, Block BA, Scholz NL. 2013. Exxon Valdez to Deepwater Horizon: Comparable toxicity of both crude oils to fish early life stages. Aquatic Toxicology 142:303-316.

Jacobson, John, "Final Product Presentation: Autonomous Underwater Inspection Using a 3D Laser," RPSEA DCI TAC Meeting, GFBEDC, Sugar Land, TX, 18 Nov., 2014

Jacobson, John, "Final Report: Autonomous Underwater Inspection Using a 3D Laser," 10121.4903.FINAL, 18 Nov., 2014

Jacobson, John, and Dan McLeod, “AUV Based 3D Laser Imaging,” Offshore Engineer, 56-8, Mar. 2014

Jellison, LT Kyle, LCDR Lushan Hannah, and Mr. JB Huyett. 2014. Hurricane Isaac Data Management Lessons Learned and Subsequent Plan Development. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1029-1040. **doi:** http://dx.doi.org/10.7901/2169-3358-2014.1.1029

Johnston, Michelle A., M.F. Nuttall, R.J. Eckert, J.A. Embesi, N.C. Slowey, E.L. Hickerson, and G.P. Schmahl. **2013**. Long-term monitoring at the East and West Flower Garden Banks National Marine Sanctuary, 2009–2010, volume 1: technical report. U.S. Dept. of Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, Louisiana. OCS Study BOEM 2013-214. 202 pp. December 2013

Johnston, Michelle A., M.F. Nuttall, R.J. Eckert, J.A. Embesi, N.C. Slowey, E.L. Hickerson, and G.P. Schmahl. **2013**. Long-term monitoring at the East and West Flower Garden Banks National Marine Sanctuary, 2009–2010, volume 2: appendices. U.S. Dept. of Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, Louisiana. OCS Study BOEM 2013-215. 372 pp. December 2013

Johnston, M.A., M.F. Nuttall, R.J. Eckert, J.A. Embesi, N.C. Slowey, E.L. Hickerson, and G.P. Schmahl. **2015**. Long-term monitoring at East and West Flower Garden Banks National Marine Sanctuary, 2011–2012, volume 1: technical report. U.S. Dept. of Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, Louisiana. OCS Study BOEM 2015-027. 194 p. June 2015

Johnston, Michelle A., M.F. Nuttall, R.J. Eckert, J.A. Embesi, N.C. Slowey, E.L. Hickerson, and G.P. Schmahl. 2015. Long-term monitoring at East and West Flower Garden Banks National Marine Sanctuary, 2011–2012, volume II: Appendices. U.S. Dept. of Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, Louisiana. OCS Study BOEM 2015-028. 416 p. June 2015

Jones, R., W. Lehr, D. Simecek-Beatty, R. Michael Reynolds. 2013. ALOHA® (Areal Locations of Hazardous Atmospheres) 5.4.4: Technical Documentation [PDF, 1.3 MB]. U.S. Dept. of Commerce, NOAA Technical Memorandum NOS OR&R 43. Seattle, WA: Emergency Response Division, NOAA. 96 pp.

Jozsef, LTM Aaron L., LT Scott R. Houle, LCDR Tedd B. Hutley, and MST1 Justin M. Sawyer. 2014. KIS Approach to Data Management for Oil and Hazardous Material Response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2295-2303.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.2295

Karl T. Schroeder, and Harry M. Edenborn, "Geochemical and Strontium Isotope Characterization of Produced Waters from Marcellus Shale Natural Gas Extraction", Environ. Sci. Technol. 2012, 46, 3545−3553

Keller JM, Balazs GH, Nilsen F, Rice M, Work TM, Jensen BA. 2014. Investigating the Potential Role of Persistent Organic Pollutants in Hawaiian Green Sea Turtle Fibropapillomatosis. Environmental Science & Technology 48(14):7807-7816.

Kelner, Eric, Phase 1 Final Summary Report and Recommendations: More Improvements to Deepwater Subsea Measurement," 28 Feb., 2014

Kimrey, LT Christopher and Mr. Doug Helton. 2014. Abandoned Vessel Authorities and Best Practices Guidance-A Review of NRT Work. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2053-2063.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.2053

Kimrey, LT Christopher M. and CDR Eric J. Doucette. 2014. Pollution Response in Post Disaster Recover – Best Practices From Hurricane Sandy. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1041-1049.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1041

Knutson, Scott, Craig Dougans, Gary Reiter, Don Rodden, and Erik Kidd. 2014. Canada-United States (Salish Sea) Spill Response Organizations: A Comparison. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 299-313.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.299

Ko, D. S. and Wang, D-P (2104) Intra-Americas Sea Nowcast/Forecast System Ocean Reanalysis to Support Improvement of Oil-Spill Risk Analysis in the Gulf of Mexico by Multi-Model Approach, Department of the Interior, Bureau of Ocean Energy Management, Herndon, VA. BOEM 2014-1003.

Koh, Carolyn, "Phase I Final Presentation: Hydrate Modeling & Flow Loop Experiments for Water Continuous & Dispersed Systems," 28 May, 2014

Koh, Carolyn, "Phase 1 Final Technical Report: Hydrate Modeling and Flow Loop Experiments for Water Continuous and Partially Dispersed Systems, 10121-4202-01," 15 Jul., 2014

Kolesar Kohl, Courtney A., Rosemary C. Capo, Brian W. Stewart, Andrew J. Wall, Karl T. Schroeder, Richard W. Hammack, and George D. Guthrie, "Strontium Isotopes Test Long-Term Zonal Isolation of Injected and Marcellus Formation Water after Hydraulic Fracturing", Environ. Sci. Technol. 2014, 48, 9867−9873

Kutchko, B., D. Crandall, J. Moore, C. Gieger, M. Gill, R. Spaulding, I. Haljasmaa, A. Mergaman, E. Rosenbaum, L. Dalton, National Energy Technology Laboratory; D. Mcintyre, W. Harbert, G. Benge, C.C. Buford, and J.M. Shine. 2015. *Assessment of Foamed Cement - Field Generated Pressurized Samples*. Offshore Technology Conference 2015. May 2015

Kutchko, B.; Moore, J.; Crandall, D.; Gill, M.; McIntyre, D.; Spaulding, R.; Strazisar, B.; Rosenbaum, E.; Haljasmaa, I.; Benge, G.; Cunningham, E.; DeBruijn, G.; Shine, J.; Gardner, C. 2014. Addendum 1 to Computed Tomography and Statistical Analysis of Bubble Size Distributions in Atmospheric-Generated Foamed Cement; NETL-TRS-2-2014; EPAct Technical Report Series; U.S. Department of Energy, National Energy Technology Laboratory: Morgantown, WV, 2014; p 20.

Kvaerner Field Development Inc "10121-4405-02 – Final Technical Report Appendix C3 - AIP FOR KVAERNER DEEPWATER DRY TREE SEMI, Approval in Principle of Kvaerner Deepwater Dry Tree Semi," RPSEA, Report No.: 15U5O2I-10, Rev. 2, Document No.: 15U5O2I-10, 30 Dec., 2014

Kvaerner Field Development Inc "10121-4405-02 – Final Technical Report Appendix C4 - DNV, Approval In Principle, Kvaerner's Deepwater Dry Tree SemiSubmersible," Request by RPSEA, 12 Nov., 2014

Kvaerner Field Development Inc., "10121-4405-02 – Final Technical Report Appendix B2 - Ultra-Deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico, Technology Qualification of Riser Tensioner for Dry Tree Semi Concept," Kvaerner Field Development Inc., Document No.:KFD-RP-ZZZ-0002, 30 Dec., 2014

Kvaerner Field Development Inc., "10121-4405-02 – Final Technical Report Appendix A1 - Ultra Deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico, Phase 2, Conceptual Design Report," HOE, H12122-G-RPT-GN-15001, 30 Dec., 2014 "10121-4405-02 – Final Technical Report Appendix A2 - RPSEA Project 10121-4405-02 Ultra-Deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico, Dry Tree Semi Conceptual Design Report," Kvaerner Field Development Inc., KFD-RP-ZZZ-0001, 30 Dec., 2014

Lamendella R, Strutt S, Borglin S, Chakraborty R, Tas N, Mason OU, Hultman J, Prestat E, Hazen TC and Jansson JK. 2014. Assessment of the Deepwater Horizon oil spill impact on Gulf coast microbial communities. *Front. Microbiol*. **5**:130. doi: 10.3389/fmicb.2014.00130

Lehr, William. 2014. Communicating Study Results of Scientific Teams in Large Spills. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1141-1148.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1141

Leifer, Ira, John Murray, Davida Streett, Timothy Stough, Ellen Ramirez, and Sonia Gallegos. 2015. The Federal Ocean Spill Team for Emergency Response Remote Sensing, FOSTERRS: Enabling remote sensing technology for marine disaster response

Leonard Jr., CDR Joseph J., LCDR Kerry G. Karwan, LCDR John Hahn, and Carl Gibeault. 2014. Exercising the Recovery Phase: Taking the Next Step. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 144-155. **doi:** http://dx.doi.org/10.7901/2169-3358-2014.1.144

Levine, Ed, John Tarpley, LTJG Alice Drury, LT Kyle Jellison, and LCDR John Lomnicky. 2014. Development of the NOAA Scientific Support Coordinator Training Guidebook. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1899-1909. **doi:** http://dx.doi.org/10.7901/2169-3358-2014.1.1899

Levine, J. S.; Haljasmaa, I.; Lynn, R.; Shaffer, F.; Warzinski, R. P. Detection of Hydrates on Gas Bubbles during a Subsea Oil/Gas Leak; NETL-TRS-6-2015; EPAct Technical Report Series; U.S. Department of Energy, National Energy Technology Laboratory: Pittsburgh, PA, 2015; p 44.

Li, Chunyan, Lawrence J. Rouse, Jr. 2014. Analysis of ocean current data from Gulf of Mexico oil and gas platforms. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2014-040. 141 pp. April 2014

Li R, Palm BB, Borbon A, Graus M, Warneke C, Ortega AM, Day DA, Brune WH, Jimenez JL, de Gouw JA. 2013. Laboratory Studies on Secondary Organic Aerosol Formation from Crude Oil Vapors. Environmental Science & Technology 47(21):12566-12574.

Lillycrop, Jeff and Brian Tetreault. 2015. *The U.S. Army Corps of Engineers: The future of navigation and 21st century waterways*. The Coast Guard Journal of Safety & Security at Sea – Proceedings of the Marine Safety & Security Council. Summer 2015.

Litz, Jenny A., Melody A. Baran, Sabrina R. Bowen-Stevens, Ruth H. Carmichael, Kathleen M. Colegrove, Lance P. Garrison, Spencer E. Fire, Erin M. Fougeres, Ron Hardy, Secret Holmes, Wanda Jones, Blair E. Mase-Guthrie, Daniel K. Odell, Patricia E. Rosel, Jeremiah T. Saliki, Delphine K. Shannon, Steve F. Shippee, Suzanne M. Smith, Elizabeth M. Stratton, Mandy C. Tumlin, Heidi R. Whitehead, Graham A. J. Worthy, Teresa K. Rowles. 2014. Review of historical unusual mortality events (UMEs) in the Gulf of Mexico (1990−2009): providing context for the multi-year northern Gulf of Mexico cetacean UME declared in 2010, Dis Aquat Org Vol. 112: 161–175, 2014 doi: 10.3354/dao02807

Long, Roy. 2014. Research effort aims to enhance cement integrity in deepwater. Offshore, December 12, 2014

Louisiana State University. 2014. *Development of a Real-time Monitoring Protocol for Assessing VOC Impacts on Response and Cleanup Workers' Safety During Dispersant Operations*. Herndon, VA: Bureau of Safety and Environmental Enforcement

Lu, Jennie, "Ultra-Deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico Phase 1, Final Presentation, 10121-4405-02," RPSEA Ultra-Deepwater Technology Conference, Norris Conference Center, Houston, TX, 2 Sep., 2014

Lynn, R. J.; Haljasmaa, I. V.; Shaffer, F.; Warzinski, R. P.; Levine, J. S. A Pitot tube system for obtaining water velocity profiles with millimeter resolution in devices with limited optical access. Flow Measurement and Instrumentation 2014, 40, 50–57.

MacFadyen, Amy, Eugene Wei, Christopher Warren, Charlie Henry, and Glen Watabayashi. 2014. Utilization of the Northern Gulf Operational Forecast System to Predict Trajectories of Surface Oil from a Persistent Source Offshore of the Mississippi River Delta. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 531-543.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.531

Macpherson, G.I; R.C. Capo, B. W. Stewart, T. T Phan, K. Schroeder and R.W. Hammack, "Temperature-dependent Li isotope ratios in Appalachian Plateau and Gulf Coast Sedimentary Basin saline water", Geofluids 10.111 (2014)

Mager EM, Esbaugh AJ, Stieglitz JD, Hoenig R, Bodinier C, Incardona JP, Scholz NL, Benetti DD, Grosell M. 2014. Acute Embryonic or Juvenile Exposure to Deepwater Horizon Crude Oil Impairs the Swimming Performance of Mahi-Mahi (Coryphaena hippurus). Environmental Science & Technology 48(12):7053-7061.

Majors, Lee, Susanne Miller, and Shannon Jensen. 2014. Oil Spill Preparedness for Polar Bears in Alaska. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 299530.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-299530.1

Maksym, T., Singh, H., Bassett, C., Lavery, A., Freitag, L., Sonnichsen, F., Wilkinson, J. 2014. *Oil spill detection and mapping Arctic sea ice using autonomous underwater vehicles*. Herndon, VA: Bureau of Safety and Environmental Enforcement.

MAR, Inc. 2015. Ocean Imaging, TRACS-Ohmsett User Guide. Sterling, VA: Bureau of Safety and Environmental Enforcement

Mark-Moser, M.; Disenhof, C.; Rose, K. Gulf of Mexico Geology and Petroleum System: Overview and Literature Review in Support of Risk and Resource Assessments; NETL-TRS-4-2015; EPAct Technical Report Series; U.S. Department of Energy, National Energy Technology Laboratory: Morgantown, WV, 2015; p 28.

McCanna, Jason, "Coiled Tubing Intervention System using an SSR with a Cost Effective Vessel, Project Number 10121-4505-01," RPSEA Ultra-Deepwater Technology Conference, Norris City Center Conference Center, Houston, Texas, 4 Sep., 2014

McCay, Deborah French, Danielle Reich, Jacqueline Michel, Dagmar Etkin, Lisa Symons, Doug Helton, and John Wagner. 2014. For Response Planning: Predicted Environmental Contamination Resulting from Oil Leakage from Sunken Vessels. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 300108.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-300108.1

McDonough, M. and J.H. Cowan, Jr. 2013. *Short-term movement, home range, and behavior of red snapper around petroleum platforms in the northern Gulf of Mexico, as determined by high resolution acoustic telemetry*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. October 2013. OCS Study 2013-0123. 71 pp.

McGrath, CDR Gabrielle and Christopher J. Hall. 2014. Standardizing Incident Command System Training Internationally in the Public and Private Sector. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 300322.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-300322.1

McKinney, K., DeVitis, D. 2015. ASTM Testing of Skimmers at Ohmsett. Herndon, VA: Bureau of Safety and Environmental Enforcement

McKinney, Kristi and DeVitis, Dave. 2015. *ASTM F2709-08 Testing of Skimmer Systems at Ohmsett Facility*. AMOP 2015 Conference Proceedings June 2015.

McKinnon, Renee V. and Agustus J. Bannan. 2014. Challenges of an NCP Response to the Tsunami of Northern California in 2011. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1019-1028.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1019

Mearns, Alan J.; Reish, Donald J.; Oshida, Philips.; Ginn, Thomas; Rempel-Hester, Mary Ann; Arthur, Courtney; Rutherford, Nicolle. 2014. Effects of Pollution on Marine Organisms. Source: Water Environment Research, 2014 Literature Review, pp. 1869-1954(86)

Mearns, Alan J., Gary Shigenaka, Buffy Meyer, and LTJG Alice Drury. 2014. Contamination and Recovery of Commercially-Reared Mussels Exposed to Diesel Fuel from a Sunken Fishing Vessel. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1686-1705.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1686

Merrick, Gary, Debra Scholz, Mike Sprague, Al Allen and Ann Hayward Walker. 2015. *In-Situ Burn Gaps Analysis (CG-D-01-15)*. U.S. Coast Guard Research & Development Center. June 2015

Merten, Amy A., Zachary Winters-Staszak, and Nancy E. Kinner. 2014. Incorporating Traditional Knowledge and Subsistence Mapping into the Arctic Environmental Response Management Application. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1512-1523.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1512

Michel, Jacqueline and Nicolle Rutherford. 2014. Determining the Need for Treatment of Oiled Marshes: Rates of Recovery and Treatment Options by Oil Type and Degree. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 294746.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-294746.1

Michel J and Rutherford N. 2014. Impacts, recovery rates, and treatment options for spilled oil in marshes. Marine Pollution Bulletin 82(1-2):19-25.

Michel, Jacqueline, Zachary Nixon, William Holton, Mark White, Scott Zengel, Frank Csulak, Nicolle Rutherford, and Carl Childs. 2014. Three Years of Shoreline Cleanup Assessment Technique (SCAT) for the *Deepwater Horizon* Oil Spill, Gulf of Mexico, USA. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1251-1266.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1251

Moran P, Bromaghin JF, Masuda M (2014) Use of Genetic Data to Infer Population-Specific Ecological and Phenotypic Traits from Mixed Aggregations. PLoS ONE 9(6): e98470. doi:10.1371/journal.pone.0098470

National Response Team and ICCOPR. 2014. *Plan for Incorporation of National Academy of Sciences Arctic Spill Response Assessmen*t. November 2014

Nayar, H. and J. Hall. 2015. *Field Applications for Advanced Robotics*. Offshore Technology Conference 2015. May 2015

Nelson B, Heintz R. 2014. Enhancing and Expanding Bioenergetics Research Despite Staff Attrition (Poster). Alaska Marine Science Symposium, Anchorage, AK, Jan 2014

Nelson, J. R.; Bauer, J. R.; Rose, K. Assessment of Geographic Setting on Oil Spill Impact Severity in the United States - Insights from Two Key Spill Events in Support of Risk Assessment for Science-Based Decision Making. Journal of Sustainable Energy Engineering 2014, 2, 152–165.

Nelson, J. R.; Grubesic, T. H.; Sim, L.; Rose, K. Geospatial approach for evaluating potential impacts and improving response readiness to hydrocarbon spills in the tourism sector. Submitted to Tourism Management, in review.

Nelson, J. R.; Grubesic, T. H.; Sim, L.; Rose, K.; Graham, J. Approach for Assessing Coastal Vulnerability to Oil Spills for Prevention and Readiness Using GIS and the Blowout and Spill Occurrence Model (BLOSOM). Ocean & Coastal Management 2015, 112, 1–11.

NETL. Adapting the National Energy Technology Laboratory's Offshore Integrated Assessment Modeling Approach for the Offshore Arctic; NETL-TRS-3-2015; EPAct Technical Report Series; U.S. Department of Energy, National Energy Technology Laboratory: Morgantown, WV, 2015; p 40.

NETL. Analyze Broad Risks and Potential Impacts Associated with Uncontrolled Hydrocarbon Release Events in the Offshore Gulf of Mexico; NETL-TRS-2-2015; EPAct Technical Report Series; U.S. Department of Energy, National Energy Technology Laboratory: Morgantown, WV, 2015; p 60.

NETL. NETL Boasts State-of-the-Art Capabilities for Cement Research. E&P Focus 2014, 1.

Niedoroda, A., S. Davis, M. Bowen, E. Nestler, J. Rowe, R. Balouskus, M. Schroeder, B. Gallaway, and R. Fechhelm. 2014. A Method for the Evaluation of the Relative Environmental Sensitivity and Marine Productivity of the Outer Continental Shelf. Prepared by URS Group, Inc., Normandeau Associates, Inc., RPS ASA, and LGL Ecological Research Associates, Inc. for the U.S. Department of the Interior, Bureau of Ocean Energy Management. Herndon, VA OCS Study BOEM 2014-616. 80 pp. + appendices.

Nixon, Zachary and Jacqueline Michel. 2015. Predictive Modeling of Subsurface Shoreline Oil Encounter Probability from the Exxon Valdez Oil Spill in Prince William Sound, Alaska. Environmental Science & Technology 49 (7), 4354−4361 February 26, 2015

Nixon, Zachary, William Holton, Mark White, and Chris Locke. 2014. Shoreline Oiling Data Management for the Deepwater Horizon oil spill, Gulf of Mexico, USA: Implications for Data Management Standards for Future Spills of Significance. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 300040.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-300040.1

NOAA. 2014. *NOAA Technical Memorandum NMFS-SEFSC-673 – Common Bottlenose Dolphins (Tursiops Truncatus) in Lake Pontchartrain, Lousiana: 2007 to Mid-2014.*

Nuka Research and Planning Group, LLC. 2014. Estimating an Oil Spill Response Gap Analysis for the U.S. Arctic. Herndon, VA: Bureau of Safety and Environmental Enforcement

Nuka Research and Planning Group, LLC, Coastal and Ocean Resources, and Archipelago Marine Research, Ltd. 2014. *ShoreZone mapping of the North Slope of Alaska: Final report.* US Dept. of the Interior, Bureau of Ocean Energy Management, BOEM Alaska OCS Regional Office, Anchorage. OCS Study BOEM 2014-- 657. 324 pp. November 12, 2014

Nuka Research and Planning Group, LLC, 2015. Permitting the Use of Oil Spill Simulants: Identifying Options and Building Consensus Final Report. Herndon, VA: Bureau of Safety and Environmental Enforcement

Packard, Richard, Mike Popovich, and John Stengel. 2014. Massachusetts First Responder Exercises: Preparing Local Communities for Oil Spill Response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 300125.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-300125.1

Panetta, P.D., McElhone, D., Carr, L., Winfield, K., Cartwright, G.G., & Friedrichs, C.T. 2014. *Acoustic Assessment of Subsea Chemical Dispersant Efficacy*. Herndon, VA: Bureau of Safety and Environmental Enforcement.

Panetta, P., McElhone, D., Carr, L., & Winfield, K. 2015. Acoustic Tool to Measure Oil Slick Thickness at Ohmsett. Herndon, VA: Bureau of Safety and Environmental Enforcement

Pangman, Peter, Michael Fehler, and Charles Meeder, "Final Report for Geophysical Modeling for Studying Acquisition and Processing Methods in the Deepwater Gulf of Mexico, RFP2007DW2001, Subcontract 07121-2001," 3 Jan., 2014

Parker, Heather A., Josie Clark, Brad H. Martin, Linda Pilkey-Jarvis, and Brian MacDonald. 2014. New Tools for the SCAT Program: An Innovative Approach to Assimilating Newer Responders into the Shoreline Cleanup Assessment Technique Program. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1298-1314.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1298

Parker, Heather A., Scott R. Knutson, Andy Nicoll, and Tim Wadsworth. 2014. International Offers of Assistance Guidelines – Developing an IMO Tool to "Internationalize" Oil Spill Readiness and Response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 328-339.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.328

Parker, Heather. 2015. *International Offers of Assistance - Guidelines for Enhancing Multi Agency Response from the International Community*. Interspill 2015 Conference Proceedings March 25, 2015

PCCI Engineering & Emergency Management, Inc. 2015. Emergency Response Exercise Best Practices. Herndon, VA: Bureau of Safety and Environmental Enforcement

PCCI, Inc. 2015. Development of Surrogate Ice Modules for Conducting Expanded Seasonal Testing in Simulated Arctic Environment at Ohmsett. Herndon, VA: Bureau of Safety and Environmental Enforcement

PCCI Marine and Environmental Engineering, Inc. 2014. *Technological assessment of Alaskan Arctic Oil Spill Response Temporary Oil Storage Options*. Herndon, VA: Bureau of Safety and Environmental Enforcement

PCCI Marine and Environmental Engineering, Inc. 2014. *Alaskan Arctic Oil Spill Response Temporary Oil Storage WCD Scenario Tool*. Herndon, VA: Bureau of Safety and Environmental Enforcement

Petron G, Karion A, Sweeney C, Miller BR, Montzka SA, Frost GJ, Trainer M, Tans P, Andrews A, Kofler J et al. . 2014. A new look at methane and nonmethane hydrocarbon emissions from oil and natural gas operations in the Colorado Denver-Julesburg Basin. Journal of Geophysical Research-Atmospheres 119(11):6836-6852.

Pihl C, Heffern K, Maselko J. 2014. Interannual Variability of Marine Debris on Select Gulf of Alaska Beaches (Poster). Alaska Marine Science Symposium, Anchorage, AK, Jan 2014

Potter, LT Kristen, MSTC Bridgette Brown and Rosiu, Cornell J. 2014. M/V JOHN B. CADDELL: Use of Solidifying Agent in ESF-10 Response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 299005. doi: http://dx.doi.org/10.7901/2169-3358-2014-1-299005.1

Potter, LT Kristen Potter, MSTC Bridgette Brown, and Cornell Rosiu. 2014. M/V JOHN B. CADDELL. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 299005.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-299005.1

Preble, Kristen and Bradford Benggio. 2014. Managing the Resource Consultation Process: A Case Study from the JIREH Grounding Response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 686-696.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.686

Prouty, Nancy G., Charles R. Fisher, Amanda W. Demopoulos, Ellen R. M. Druffel. 2014. Growth rates and ages of deep-sea corals impacted by the Deepwater Horizon oil spill Deep-Sea Research Part II: Topical Studies in Oceanography

Quattrini A, P. Etnoyer, C. Doughty, L. English, R. Falco, N. Remon, M. Rittinghouse, E. Cordes. 2015. *A phylogenetic approach to octocoral community structure in the deep Gulf of Mexico.* DOI:10.1016/j.dsr2.2013.05.027

Ragland JM, Liebert D, Wirth E. 2014. Using Procedural Blanks to Generate Analyte-Specific Limits of Detection for Persistent Organic Pollutants Based on GC-MS Analysis. Analytical Chemistry 86(15):7696-7704.

Reeves, T., J. Jacobson, D. McLeod, C. Embry, and B. Nickerson, "AUV-Based 3D Laser Inspection for Structural Integrity Management in Deepwater Fields," OTC 25381, Offshore Technology Conference, Reliant Center, Houston, TX, 6 May, 2014

Roberts, H.H. 2013. Improving the Predictive Capability of 3-D Seismic Surface Amplitude Data For Identifying Chemosynthetic Communities. US Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico Region, New Orleans, LA. OCS Study BOEM 2013-222. 190 pp. December 2013

Robertson A, Heintz R, Boswell K, Moran J, Vollenweider J, Barton M. 2014. Short Term Variation in Nearshore Fish Communities in Barrow, Alaska (Poster). Alaska Marine Science Symposium, Anchorage, AK, Jan 2014

Robertson, T.L., Campbell, L. K., Pearson, L., and Higman, B. 2013.. Oil spill occurrence rates for Alaska North Slope crude and refined oil spills. Report to Bureau of Ocean and Energy Management. Contract M11PS00021. October 2013

Rooker JR, Kitchens LL, Dance MA, Wells RJD, Falterman B, et al. 2013. Spatial, Temporal, and Habitat-Related Variation in Abundance of Pelagic Fishes in the Gulf of Mexico: Potential Implications of the Deepwater Horizon Oil Spill. Published October 10, 2013. PLoS ONE 8(10): e76080. doi:10.1371/journal.pone.0076080

Rooker JR, Kitchens LL, Dance MA, Wells RJD, Falterman B, et al. 2013. Spatial, Temporal, and Habitat-Related Variation in Abundance of Pelagic Fishes in the Gulf of Mexico: Potential Implications of the Deepwater Horizon Oil Spill. Published October 10, 2013

Rose, K.; Aminzadeh, F.; Ghanem, R. G.; Thimmisetty, C.; Jabbari, N.; Khodabakhshnejad, A.; Disenhof, C. Risks and Impact Assessment for Deepwater and Ultra-Deepwater Gulf of Mexico Resources. Offshore Technology Conference, Houston, TX, May 5–8, 2014; p 17. DOI:10.4043/25364-MS.

Rose, K.; Guthrie, G. Deepwater and Ultra-Deepwater Annual Report; NETL-TRS-UDW-2013; NETL Technical Report Series, U.S. Department of Energy, National Energy Technology Laboratory: Albany, OR, 2013; p 37.

Rosiu, Cornell J., S. Lehmann, D. Sherry, W. Brigg and P. Blanchard 2014. When Oil is the Lesser of Two Evils: Comparative Risk of the Shipwreck EMPIRE KNIGHT. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 299468. doi: http://dx.doi.org/10.7901/2169-3358-2014-1-299468.1

Royer, Brian, "Riser Concepts Recommendation Final Report," 11 Apr., 2014

Rozman, K. A.; Ziomek-Moroz, M.; Bullard, S.; Kruzic, J. J.; Hawk, J. A. Localized Corrosion and Fatigue Behavior of UltraDeep Drilling Alloys; NETL-TRS-1-2014; EPAct Technical Report Series; U.S. Department of Energy, National Energy Technology Laboratory: Morgantown, WV, 2014; p 28.

RPSEA. 2014. Maintenance, Repair, and Operations; Project 09121-3300-06", 09121.3300.06.Final, 12 Dec., 2014

Ryerson, T.B, K.C. Aikin, W.M. Angevine, E.L. Atlas, D.R. Blake, C.A. Brock, F.C. Fehsenfeld, R.-S. Gao, J.A. de Gouw, D.W. Fahey, J.S. Holloway, D.A. Lack, R.A. Lueb, S. Meinardi, A.M. Middlebrook, D.M. Murphy, J. A. Neuman, J.B. Nowak, D.D. Parrish, J. Peischl, A.E. Perring, I.B. Pollack, A.R. Ravishankara, J.M. Roberts, J.P. Schwarz, J.R. Spackman, H. Stark, C. Warneke, and L.A. Watts (2011): Atmospheric emissions from the *Deepwater Horizon* spill constrain air‐water partitioning, hydrocarbon fate, and leak rate, Geophysical Research Letters, 38, L07803, doi:10.1029/2011GL046726.

Ryerson, Thomas B., Richard Camilli, John D. Kessler, Elizabeth B. Kujawinski, Christopher M. Reddy, David L. Valentine, Elliot Atlas, Donald R. Blake, Joost de Gouw, Simone Meinardi, David D. Parrish, Jeff Peischla, Jeffrey S. Seewald, and Carsten Warneke (2012): Chemical data quantify *Deepwater Horizon* hydrocarbon flow rate and environmental distribution, Proceedings of the National Academy of Sciences, 109(50), p. 20246-20253, doi: 10.1073/pnas.1110564109.

Saad, Merna, Benjamin Silliman, Nathan Qian, Denise Lawn, Frederick Aulwes. 2014. *Will it Sink?: Predicting the Submergence of Diluted Bitumen*. NASA DEVELOP, NASA Langley Research Center, Hampton, Virginia.

Sack ,Andrea L. and Shikha Sharma, "A multi-isotope approach for understanding sources of water, carbon and sulfur in natural springs of the Central Appalachian Region, Environ Earth Sci (2014) 71:4715–4724.

Salimi, Amir, Mark Kalman, and Liang Yu, "Flexible Hybrid Reinforced Pipe Bend Stiffener Interface Design With Optimized Thermal Performance," OMAE 24267, 10121-4402-02, 33rd International Conference on Ocean, Offshore and Arctic Engineering (OMAE 2014), San Francisco, CA, 8 Jun., 2014

Salimit, Amir, "Phase 1 Final Report, Qualification of Flexible Fiber-Reinforced Pipe for 10000 ft WD," 10121.4402.02.10, RPSEA, 10 Dec., 2013

Sammarco, Paul W. 2013. Corals on oil and gas platforms near the Flower Garden Banks: population characteristics, recruitment, and genetic affinity. U.S. Dept. of the Interior,

Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2013-216. pp. 106. December 2013

Sammarco, Paul W. 2013. Deepwater coral distribution and abundance on active offshore oil and gas platforms and decommissioned Rigs-to-Reefs platforms. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2013-217. 45 pp. December 2013

Sammarco, Paul W. 2014. Determining the geographical distribution and genetic affinities of corals on offshore platforms, Northern Gulf of Mexico. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2014-011. 75 pp. March 2014

Sammarco, Paul W. 2014. New Invasive Marine Species Colonizing Energy Platforms in the Northern Gulf of Mexico: Verification, and Examination of Spread. US Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2015-005. 72 pp. January 2015

Sandia National Laboratories. 2015. *Literature Survey of Crude Oil Properties Relevant to Handling and Fire Safety in Transport*. March 2015.

Schmidt, Bill, Paul Meyer, and Steve Potter. 2014. Testing of Oil Recovery Skimmers in Ice at Ohmsett The National Oil Spill Response Research & Renewable Energy Test Facility. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 618-633.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.618

Schnapp, Kelly Lynn, Joseph Leonard, Michael Drieu, and Bryan Rogers. 2014. Incorporating Well Control Support Functions into a Broader Oil Spill Response Organization. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2098-2111.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.2098

Schwacke, Lori H. , Cynthia R. Smith, Forrest I. Townsend, Randall S. Wells, Leslie B. Hart, Brian C. Balmer, Tracy K. Collier, Sylvain De Guise, Michael M. Fry, Louis J. Guillette ,Jr., Stephen V. Lamb, Suzanne M. Lane, Wayne E. McFee, Ned J. Place, Mandy C. Tumlin, Gina M. Ylitalo, Eric S. Zolman, and Teresa K. Rowles (2014) Health of Common Bottlenose Dolphins (Tursiops truncatus) in Barataria Bay, Louisiana, Following the Deepwater Horizon Oil Spill Environ. Sci. Technol., 2014, 48 (1), pp 93–103, DOI: 10.1021/es403610f

Schwacke, Lori H. , Cynthia R. Smith, Forrest I. Townsend, Randall S. Wells, Leslie B. Hart, Brian C. Balmer, Tracy K. Collier, Sylvain De Guise, Michael M. Fry, Louis J. Guillette ,Jr., Stephen V. Lamb, Suzanne M. Lane, Wayne E. McFee, Ned J. Place, Mandy C. Tumlin, Gina M. Ylitalo, Eric S. Zolman, and Teresa K. Rowles (2014) Response to Comment on Health of Common Bottlenose Dolphins (Tursiops truncatus) in Barataria Bay, Louisiana Following theDeepwater Horizon Oil Spill. Environ. Sci. Technol., 2014, 48 (7), pp 4209–4211 DOI: 10.1021/es5009278

Schwacke, Lori H. , Cynthia R. Smith, Forrest I. Townsend, Randall S. Wells, Leslie B. Hart, Brian C. Balmer, Tracy K. Collier, Sylvain De Guise, Michael M. Fry, Louis J. Guillette Jr., Stephen V. Lamb, Suzanne M. Lane, Wayne E. McFee, Ned J. Place, Mandy C. Tumlin, Gina M. Ylitalo, Eric S. Zolman, Teresa K. Rowles (2013) Supporting Information for Health of Common Bottlenose Dolphins (Tursiops truncatus) in Barataria Bay, Louisiana, Following the Deepwater Horizon Oil Spill. Environ. Sci. Technol., 2014, 48 (1), pp 93–103.

Scott NM, Hess M, Bouskill NJ, Mason OU, Jansson JK and Gilbert JA (2014) The microbial nitrogen cycling potential is impacted by polyaromatic hydrocarbon pollution of marine sediments. *Front. Microbiol*. 5:108. doi: 10.3389/fmicb.2014.00108

Seaman, C., D.V. Brower, H. Tang, S. Le. *Development of a Post-Installed Deepwater Monitoring System*. Offshore Technology Conference 2015. May 2015

Seung Jun Kim, Dusan Spernjak, Samuel Holmes, Vimal Vinayan, and Arun Antony, "Vortex-Induced Motion of Floating Structures: CFD Sensitivity Considerations of Turbulence Model and Mesh Refinement," OMAE2015-42221, Proceedings of the 34th International Conference on Ocean, Offshore and Arctic Engineering, OMAE15, 31 May - 5 Jun., 2015, St. John's, Newfoundland, Canada

Sexson, M. G., J. M. Pearce, and M. R. Petersen. 2014. Spatiotemporal distribution and migratory patterns of Spectacled Eiders. BOEM 2014-665. Bureau of Ocean Energy Management, Alaska Outer Continental Shelf Region, Anchorage, Alaska. September 2014

Sewall F, Heintz R, Vollenwider J. 2014. Seasonal Trends in Growth and Stored Energy for Juvenile Pacific Herring in Prince William Sound (Poster). Alaska Marine Science Symposium, Anchorage, AK, Jan 2014

Shaffer, F.; Savas, Ö.; de Vera, G.; Lee, K. Determining the discharge rate from a submerged oil leak jet using ROV video. Flow Measurement and Instrumentation 2015, 43, 34–46.

Sharma, Shikha, Michon L. Mulder, Andrea Sack, Karl Schroeder, and Richard Hammack, "Isotope Approach to Assess Hydrologic Connections During Marcellus Shale Drilling", Groundwater Vol. 52, No. 3,May-June 2014 (pages 424–433)

Sharma, Shikha; Lindsey Bowman, Karl Schroeder, Richard Hammack, "Assessing changes in gas migration pathways at a hydraulic fracturing site: Example from Greene County, Pennsylvania, USA", Applied Geochemistry. 2014.

Shen, J., J. M. Pappas, and W. Letton, "More Improvements to Deepwater Subsea Measurement," OTC 25395, 2014 Offshore Technology Conference, 5-8 May, 2014, Houston, TX

Shigenaka, Gary. 2015. *Physical and Chemical Characteristics of In-Situ Burn Residue and other Environmental Oil Samples Collected During the Deepwater Horizon Spill Response*. Interspill 2015 Conference Proceedings March 25, 2015

Shigenaka, G. 2014. Twenty-Five Years After the Exxon Valdez Oil Spill: NOAA's Scientific Support, Moni-toring, and Research. Seattle: NOAA Office of Response and Restoration. 78 pp. [March 2014]

Shupe, Danielle, Gary Ott, and Kristen Preble. 2014. Evaluating Place of Refuge Risk in the Chesapeake Bay. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 814-824.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.814

Silliman, Benjamin Douglas. 2014. Guidelines to Prepare for Oil Sands Product Spills in Varied Aquatic Environments. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 426-433.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.426

Silva, M., P.J. Etnoyer, and I.R. MacDonald. 2015. Coral injuries observed at mesophotic reefs after the Deepwater Horizon oil discharge. Deep Sea Research Part II: Topical Studies in Oceanography. doi:10.1016/j.dsr2.2015.05.013

Sim, L.; Graham, J.; Rose, K.; Duran, R.; Nelson, J.; Umhoefer, J.; Vielma, J. Developing a Comprehensive Deepwater Blowout and Spill Model. Submitted to Environmental Modelling & Software, in review.

S.L. Ross Environmental Research Ltd. 2015. Review of ASTM Standards for Oil Spill Response. Herndon, VA: Bureau of Safety and Environmental Enforcement

S.L. Ross Environmental Research Ltd. 2014. *Subsea Chemical Dispersant Research*. Herndon, VA: Bureau of Safety and Environmental Enforcement.

S.L. Ross Environmental Research Ltd. 2015. Research to Support the Prediction of Effectiveness of Dispersant Use in the U.S. Beaufort and Chukchi Seas. Herndon, VA: Bureau of Safety and Environmental Enforcement

Sligh, Kevin. 2014. Oil Spill Preparedness & Response Compliance with the Endangered Species Act (ESA) and Reducing Action Agency Exposure to Future Litigation. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 300264. **doi:** http://dx.doi.org/10.7901/2169-3358-2014-1-300264.1

Smith, CAPT Shep. 2015. *Future Navigation: Building upon Navigation's history*. The Coast Guard Journal of Safety & Security at Sea – Proceedings of the Marine Safety & Security Council. Summer 2015.

Smith, Donald P. 2014. Inspection Technologies and Crisis Management: Field Automation lessons from the field. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 300246.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-300246.1

Socolofsky, S. A.; Adams, E. E.; Boufadel, M. C.; Aman, Z. M.; Johansen, Ø.; Konkel, W. J.; Lindo, D.; Mads, M. N.; North, E. W.; Paris-Limouzy, C. B.; Rasmussen, D.; Reed, M.; Rønningen, P.; Sim, L. H.; Uhrenholdt, T.; Anderson, K. G.; Cooper, C.; Nedwed, T. J. Intercomparison of Oil Spill Prediction Models for Accidental Blowout Scenarios with and without Subsea Chemical Dispersant Injection. Marine Pollution Bulletin 2015, 96, 110–126.

Somasundaran, Ponisseril, Partha Patra, Raymond S. Farinato, and Kyriakos Papadopoulos. 2014. Oil Spill Remediation: Colloid Chemistry-Based Principles and Solutions. ISBN: 978-1-118-20670-6

Sreenivasan A. 2014. Estmation of the Relationship Between Growth and Consumption Rates of Juvenile Pacific Cod (Gadus macrocephalus). Alaska Marine Science Symposium, Anchorage, AK, Jan 2014

St. John, Mark, "Phase 1 Final Technical Report and Human Factors Literature Review, 111215101-01," Document No. 11121.5101.01.01, RPSEA, 30 Apr., 2015

Stacy N, Innis C, Hernandez J (2013) Conservation Physiology Development and evaluation of three mortality prediction indices for cold-stunned Kemp's ridley sea turtles (Lepidochelys kempii) 2013 vol: 1 (1) pp: cot003-cot003 DOI:10.1093/conphys/cot003

Stalford, Harold L., "Intelligent Casing-Intelligent Formation Telemetry (ICIFT) System, FINAL REPORT," Document Number: 10121.4504.01.final, Contract Number: 10121-4504-01, RPSEA, 28 Jan., 28, 2015

Stalford, Harold, "FINAL PRESENTATION: Intelligent Casing-Intelligent Formation Telemetry System," 4 Jun., 2014

Steffek, Timothy. 2015. *Comparative Testing of Corexit EC9500A, Finasol OSR52, Accell Clean DWD, and ZI 400 at Ohmsett in a Simulated Arctic Environment*. Interspill 2015 Conference Proceedings March 24, 2015.

Stone, CDR John M. 2015. *21st Century Waterway Design: Providing Safe, efficient, and resilient waterways*. The Coast Guard Journal of Safety & Security at Sea – Proceedings of the Marine Safety & Security Council. Summer 2015.

Stout, Jordan and LCDR Jeff Rubini. 2014. National Contingency Plan Phase II Activities: A Problem Analysis & Decision Framework for Understanding & Evaluating Oil Pollution Threats from Sunken Ships Off California. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2134-2145.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.2134

Sundaravadivelu, D., M.T. Suidan, A.D. Venosa, P. Rosales (2014) Effect of salinity on the effectiveness of solidifiers for crude oil spill remediation. IOSC Proceedings, Savannah, GA, Vol. 2014, No. 1; 1457-1464.

Sundaravadivelu, D., M.T. Suidan, A.D. Venosa (2015) Parametric study to determine the effect of temperature on oil solidifier performance and the development of a new empirical correlation for predicting effectiveness. Mar. Pol. Bul., 95(1), 297-304.

Symons, Lisa, James Delgado, Deborah Marx, and Erika Martin Seibert. 2014. A Means to Streamline Historic and Cultural Resource Consultation and Compliance for Pollution Assessment and Recovery Activities on Shipwrecks. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2024-2036.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.2024

Symons, Lisa, Jacqueline Michel, James Delgado, Danielle Reich, Debbie French McCay, Dagmar Schmidt Etkin, and Doug Helton. 2014. The Remediation of Underwater Legacy Environmental Threats (RULET) Risk Assessment for Potentially Polluting Shipwrecks in U.S. Waters. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 783-793.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.783

Talbot, LTJG Kasey and Jeff Dauzat. 2014. Hurricane Isaac Post-Storm Response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2253-2259.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.2253

Tarpley, John, LTJG Alice Drury, and Doug Helton. 2014. Implementing Lessons Learned for NOAA's Emergency Response Division. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1420-1430.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1420

Tarpley, John, Jacqueline Michel, Scott Zengel, Nicolle Rutherford, Carl Childs, and Frank Csulak. 2014. Best Practices for Shoreline Cleanup and Assessment Technique (SCAT) from Recent Incidents. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1281-1297.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1281

Teague, W.J., H. W. Wijesekera, and E. Jarosz. 2014. Current-topography interaction and its influence on water quality and contaminant transport over shelf-edge banks. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2014-771. 280 pp. July 2014

Technology Systems, Inc. 2014. *CORN (Coordinated Oil-spill Response Network) Final Technical Report*. Herndon, VA: Bureau of Safety and Environmental Enforcement

Thomas J, Wafula D, Chauhan A, Green S, Gragg R, Jagoe C. 2014. A survey of deepwater horizon (DWH) oil-degrading bacteria from the Eastern oyster biome and its surrounding environment. Frontiers in microbiology 2014 vol: 5 pp: 149 DOI:

Thuring, Allen R. 2014. Oil Spill Response Under the NCP and the NRF/Stafford Act - Incompatible Regimes?. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1050-1058.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1050

Thuring, Allen R. 2014. The Oil Spill Response Fund – Four Decades of Success. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2146-2158. **doi:** http://dx.doi.org/10.7901/2169-3358-2014.1.2146

Tidwell L, Allan S, O'connell S, Hobbie K, Smith B, Anderson K Polycyclic Aromatic Hydrocarbon (PAH) and Oxygenated PAH (OPAH) Air–Water Exchange during the Deepwater Horizon Oil SpillEnviron. Sci. Technol., 2015, 49 (1), pp 141–149 DOI: 10.1021/es503827y (2015).

Trigatti, Larry, Ole-Kristian Bjerkemo, and Mark Everett. 2014. Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1485-1496.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1485

Tucci, CAPT Andrew. 2015. *Dial "C" for Cyber Attack: How marine system vulnerabilities can increase cyber risk.* The Coast Guard Journal of Safety & Security at Sea – Proceedings of the Marine Safety & Security Council. Summer 2015.

Tuttle, S.G., Farley, J. P, and Fleming, J.W. 2014. *Efficient Atomization and Combustion of Emulsified Crude Oil*. Herndon, VA: Bureau of Safety and Environmental Enforcement

Tuttle, Steven G., John P. Farley, and James W. Fleming. 2014. A Novel Low-Pressure Atomization Method for Burning Emulsified Crude Oil. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1806-1820.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1806

Ufford, A., McKeon, C., Owston, R., Plumlee, J., & Supak, K. 2014. *Dispersant Effectiveness Literature Synthesis*. Herndon, VA: Bureau of Safety and Environmental Enforcement

U.S. Arctic Research Commission (USARC). 2015. *Report on the Goals and Objectives for Arctic Research 2015-2016 for the US Arctic Research Program Plan*. May 2015.

U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory. 2014. Testing of Oil Skimmer Equipment Components for use in Arctic Environments. Herndon, VA: Bureau of Safety and Environmental Enforcement

U.S. Coast Guard Research and Development Center. 2014. Arctic Technology Evaluation 2014: August 8-30, 2014. Newsletter Updated July 23, 2014

U.S. Coast Guard Research and Development Center. 2014. Detection of Oil within the Water Column Final Report: Detection Prototype Tests. Herndon, VA: Bureau of Safety and Environmental Enforcement

U.S. Coast Guard Research and Development Center. 2014. Modernization of Special Monitoring of Applied Response Technologies (SMART) Technology and Methods. Herndon, VA: Bureau of Safety and Environmental Enforcement

U.S. Environmental Protection Agency (USEPA). 2014. Risk Assessment Forum White Paper: Probabilistic Risk Assessment Methods and Case Studies. EPA/100/R-09/001A. Washington, D.C.: Risk Assessment Forum, Office of the Science Advisor, USEPA.

U.S. Fire Administration. 2014. Coffee Break Bulletin: Bakken Crude in Transportation. (No. HM-2014-1) June 23, 4014

U.S. Fire Administration. 2014. Coffee Break Bulletin: Petroleum Crude Oil Transportation and Response Considerations. (No. HM-2014-2) October 27, 2014

U.S. Fire Administration. 2014. Coffee Break Bulletin: Petroleum Crude Oil: Preincident Planning. (No. HM-2014-3) November 3, 2014

U.S. Fire Administration. 2014. Coffee Break Bulletin: Petroleum Crude Oil: Principles of Successful Incident Management. (No. HM-2014-4) November 10, 2014

U.S. Fire Administration. 2014. Coffee Break Bulletin: Petroleum Crude Oil: Railroad Safety Procedures. (No. HM-2014-5) November 17, 2014

U.S. Fire Administration. 2014. Coffee Break Bulletin: Petroleum Crude Oil: Hazard Assessment and Risk Evaluation. (No. HM-2014-6) November 24, 2014

U.S. Fire Administration. 2014. Coffee Break Bulletin: Petroleum Crude Oil: Implementing Response Objectives. (No. HM-2014-7) December 1, 2014

URS Group Inc. 2015. Geo-Referencing Identification (GRID) Tag Final Report. Herndon, VA: Bureau of Safety and Environmental Enforcement

Van Dolah, F.M., M.G. Neely, L.E. McGeorge, B.C. Balmer, G.M. Ylitalo, et al. 2015. Seasonal Variation in the Skin Transcriptome of Common Bottlenose Dolphins (Tursiops truncatus) from the Northern Gulf of Mexico. PLoS ONE, 10(6): e0130934. doi:10.1371/journal.pone.0130934. June 25.

Venn-Watson, S., K.M. Colegrove, J. Litz, M. Kinsel, K. Terio, J. Saliki, et al. 2015. Adrenal Gland and Lung Lesions in Gulf of Mexico Common Bottlenose Dolphins (Tursiops truncatus) Found Dead following the Deepwater Horizon Oil Spill.. PLoS ONE, 10(5): e0126538. doi:10.1371/journal.pone.0126538. May 20.

Venn-Watson, S, L. Garrison, J. Litz, E. Fougeres, B. Mase, et al. 2015. *Demographic Clusters Identified within the Northern Gulf of Mexico Common Bottlenose Dolphin (Tursiops truncates) Unusual Mortality Event: January 2010 - June 2013*. PLoS ONE 10(2): e0117248. doi: 10.1371/journal.pone.0117248

Venosa, Albert D., Paul T. Anastas, Mace G. Barron, Robyn N. Conmy, Marc S. Greenberg, and Gregory J. Wilson. 2014. Science-Based Decision Making on the Use of Dispersants in the Deepwater Horizon Oil Spill (In Oil Spill Remediation: Colloid Chemistry-Based Principles and Solutions. ISBN: 978-1-118-20670-6. Wiley Publishing. April 2014)

Vidic-Perunovic, Jelena, "Final Concept Selection Report, Low Cost Flexible Production System for Remote Ultra Deepwater Gulf of Mexico (GOM) Field Development: 10121-4404-03," Document No.: 10121-4404-03.Final, 12 Nov., 2014

Vidic-Perunovic, Jelena, Final Global Performance Assessment Report of the circular floater concept, Low Cost Flexible Production System for Remote Ultra Deepwater Gulf of Mexico (GOM) Field Development: 10121-4404-03," Document No.: 10121-4404-18.Final, 19 Aug., 2014

Viet, R.R, H.F. Goyert, T.P. White, M.-C. Martin, L.L. Manne, and A. Gilbert. 2015. Pelagic Seabirds off the East Coast of the United States 2008-2013. US Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. OCS Study BOEM 2015-024. 186 pp.

Vinayan, Vimal, Arun Antony, John Halkyard, Seung-Jun Kim, Sam Holmes and Dusan Spernjak. 2015. Vortex-Induced Motion of Deep-Draft Semisubmersibles: A CFD-Based Parametric Study. Paper No. OMAE2015-42209, pp. V002T08A003; 11 pages doi:10.1115/OMAE2015-42209

Vipulanandan, C., and R. Krishnamoorti, "Report on Performance of New Slurries of Model-1 Wells - Smart Cementing Materials and Drilling Muds for Real Time Monitoring of Deepwater Wellbore Enhancement, RPSEA Ultra-Deepwater Program, Final Report – PHASE 2, Project No. 10121-4501-01," Dec., 2014

Vipulanandan, C., R. Krishnamoorti, A. Mohammed, V. Boncan, G. Narvaez, B. Head, and J. M. Pappas, "Iron Nanoparticle Modified Smart Cement for Real Time Monitoring of Ultra Deepwater Oil Well Cementing Applications," ROTC-25842-MS, Offshore Technology Conference, Houston, Texas, USA, 5–8 May, 2015

Vipulanandan, C. 2014."Development and Charcterization of Smart Cement for Real Time Monitoring in Deep Oil Well Applications," University of Minesota Warren Lecture Series, St. Paul, MN, 10 Oct., 2014

Vipulanandan, C. 2014."Smart Cement for Real Time Monitoring of Oil Well Cementing, " Ocean Energy Safety Institute R&D Roadmap Forum, College Station, TX, 7 Oct., 2014

Vlietstra, Lucy S., Karina L. Mrakovcich, Peter A. Tebeau, and Gregory J. Hall. 2014. Marine Oil Spill Simulation: A Scenario-Based Classroom Application of Meteorology and Oceanography to Environmental Protection. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 292696.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-292696.1

Vocke, William T. 2014. *Using Exercises as a Source of Oil Pollution Research Ideas.* International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1400-1407.**doi:** http://dx.doi.org/10.7901/2169-3358-2014.1.1400

Vocke, William T. 2014. *Building a Legacy of Research Coordination: A History of the ICCOPR from Exxon Valdez to Present Day*. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 93-101.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.93

Volk, M. 2015. "Phase I Preliminary Design Report-FINAL: Riser Lifecycle Monitoring System for Integrity Management, Contract 11121-5402-01," 11121.5402.01, 18 Feb., 2015

Wall, Andrew J. ; Rosemary C. Capo, Brian W. Stewart, Thai T. Phan, Jinesh C. Jain, J. Alexandra Hakalaa and George D. Guthrie "High throughput method for Sr extraction from variable matrix waters and 87Sr/86Sr isotope analysis by MC-ICP-MS", J. Anal. At. Spectrom 2013.

Warren, Christopher J., Amy MacFadyen, and Charlie Henry Jr. 2014. Mapping Oil for the Destroyed Taylor Energy Site in the Gulf of Mexico. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 299931.
doi: http://dx.doi.org/10.7901/2169-3358-2014-1-299931.1

Warzinski, R. P.; Lynn, R.; Haljasmaa, I.; Leifer, I.; Shaffer, F.; Anderson, B. J.; Levine, J. S. Dynamic morphology of gas hydrate on a methane bubble in water: Observations and implications for hydrate film models. Geophysical Research Letters 2014, 41, 6841–6847.

Watters, Jeff, "Analysis of Best Practices for Deepwater Cementing in Oil Based Mud (OBM) and Synthetic Based Mud(SBM), Phase 1 Report, RPSEA 12121-6503-01," 12121.6503.01.04, 10 Jun., 2015

Watters, Jeff, "Final Report to RPSEA, Deepwater Reverse-Circulation Primary Cementing, 10121-450201.FINAL," 21 Sep., 2014

Whelan, Ann, Josie Clark, Gary Andrew, Jacqueline Michel, and Bradford Benggio. 2014. Developing Cleanup Endpoints for Inland Oil Spills. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1267-1280.
doi: http://dx.doi.org/10.7901/2169-3358-2014.1.1267

Wilkin, Sarah. 2015. National Guidelines for Oiled Marine Mammal Response in the United States. Interspill 2015 Conference Proceedings March 26, 2015

Worcester Polytechnic Institute. 2014. *Burning Behavior of Oil in Ice Channels*. Herndon, VA: Bureau of Safety and Environmental Enforcement

Wreden, Crystal , Kyle Macfarlan, Richard Giroux, and Michael LoGiudice, "Reliability is key to developing deepwater RCPC," E&P Magazine, Mar., 2014.

Wreden, Crystal, "Analysis of Best Practices for Deepwater Cementing in Oil Based Mud (OBM) and Synthetic Based Mud (SBM), RPSEA 12121-6503-01," RPSEA Ultra-Deepwater Technology Conference, Norris City Center Conference Center, Houston, Texas, 3 Sep., 2014

Wreden, Crystal, "Analysis of Best Practices for Deepwater Cementing in Oil Based Mud (OBM) and Synthetic Based Mud (SBM), RPSEA 12121-6503-01," RPSEA Ultra-Deepwater Technology Conference, Norris City Center Conference Center, Houston, Texas, 3 Sep., 2014

Wreden, Crystal, "Deepwater Reverse-Circulation Primary Cementing, 10121-4502-01: Final Presentation," RPSEA UDW Technology Conference, , Norris Conference Center, Houston, TX, 3 Sep., 2014

Yan, C., "Solubility Study of Magnetite under Extreme High Pressure and High Temperature" OTC 25216, 2014 Offshore Technology Conference, 5-8 May, 2014, Houston, TX

Yan, C., et al., "Solubility Study of Magnetite under Extreme High Pressure and High Temperature" OTC 25216, 2014 Offshore Technology Conference, 5-8 May, 2014, Houston, TX

Yan, Chao, Jin Huang, Paula Guraieb, and Ross C. Tomson, "Evaluation of Ferrous Carbonate/Iron Oxides Scaling Risk under High Temperature in the Absence and Presence of Scale Inhibitors," SPE-173785, SPE International Symposium on Oilfield Chemistry, Marriott Waterway Conference Center, The Woodlands, TX, 13-15 Apr., 2015

Yan, Chao, Paula Guraieb, Jin Huang, and Ross C. Tomson, "Study of Siderite Solubility under Extreme High Temperature and Pressure at 1 M NaCl Solution," NACE-5623, NACE International Corrosion 2015 Conference & Expo, Kay Bailey Hutchison Convention Center, Dallas, TX, 15-19 Mar., 2015

Yemington, Charles R., "Final Summary Report – Year Two [Phase 2], Coiled Tubing Drilling and Intervention, System Using a Cost Effective Vessel," 10121-4505-01, Document Number: 10121.4505.02.02, 22 Dec., 2014

Young, Jaclyn. 2014. Assuring your agency's Area Contingency Plan is equipped with an effective Joint Information Center Model. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2127-2133. **doi:** http://dx.doi.org/10.7901/2169-3358-2014.1.2127

Yuan B, Warneke C, Shao M, de Gouw JA. 2014. Interpretation of volatile organic compound measurements by proton-transfer-reaction mass spectrometry over the deepwater horizon oil spill. International Journal of Mass Spectrometry 358:43-48.

Zaleski M, Heintz R, Garrison M. 2014. They Grow Up So Fast: Comparing Conditions of Young of the Year Gadids in Bering Sea and Gulf of Alaska (Poster). Alaska Marine Science Symposium, Anchorage, AK, Jan 2014

Zapp Sluis, M. and J.H. Cowan, Jr. 2013. *Platform recruited reef fish phase II: Do platforms provide habitat that increases the survival of reef fishes?* U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study. October 2013. BOEM 2013-0120 43 pp.

Zengel S, B.M. Bernik, N. Rutherford, Z. Nixon, and J. Michel. 2015. *Heavily Oiled Salt Marsh following the Deepwater Horizon Oil Spill, Ecological Comparisons of Shoreline Cleanup Treatments and Recovery*. PLoS ONE 10(7): e0132324. doi:10.1371/journal.pone.0132324

Zengel, Scott, Nicolle Rutherford, Brittany Bernik, Zachary Nixon, and Jacqueline Michel. 2014. Salt Marsh Remediation and the *Deepwater Horizon* Oil Spill, the Role of Planting in Vegetation and Macroinvertebrate Recovery. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1985-1999. **doi:** http://dx.doi.org/10.7901/2169-3358-2014.1.1985

Zhang, Jianfeng, "Subsea Produced Water Discharge Sensor Technical Requirements Final Report, 12121-6301-03," RPSEA 12121.6301.03.01, 19 Jun., 2015

Zhang, Jianfeng, "Technical Requirements and Gaps Analysis (Phase 1 Final) Presentation, Subsea Produced Water Sensor Development, 12121-6301-03," 10 Jun., 2015

Zhang, Liwei; Nicole Anderson, Robert Dilmore, Daniel J. Soeder, and Grant Bromhal,2014. "Leakage Detection of Marcellus Shale Natural Gas at an Upper Devonian Gas Monitoring Well: A 3‑D Numerical Modeling Approach", Environ. Sci. Technol. 2014, 48, 10795−10803

Zhao, Hongying, "Technology Status Assessment: Heavy Viscous Oil PVT, 08121-2201-02," RPSEA, 20 Nov., 2014

Zhao, L.; Boufadel, M. C.; Socolofsky, S. A.; Adams, E.; King, T.; Lee, K. 2014. Evolution of droplets in subsea oil and gas blowouts: Development and validation of the numerical model VDROP-J. Marine Pollution Bulletin 2014, 83, 58–69.

Zhao, L.; Torlapati, J.; Boufadel, M. C.; King, T.; Robinson, B.; Lee, K. 2014. VDROP: A numerical model for the simulation of droplet formation from oils of various viscosities. Chem. Eng. J. 2014, 253, 93–106.

Zhao, L., B. Wang, P.M. Armenante, R.N. Conmy, M.C. Boufadel (2015) Evaluation of turbulence structures in laboratory baffled flasks under different mixing energy: Implications for dispersant effectiveness testing. J. Environmental Engineering.

Ziccardi, Michael, Sarah Wilkin, and Teresa Rowles. 2014. Modification of NOAA's National Guidelines for Oiled Marine Mammal Response as a Consequence of the Macondo/Deepwater Horizon Oil Spill. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 986-997. **doi:** http://dx.doi.org/10.7901/2169-3358-2014.1.986

Ziomek-Moroz, M.; Hawk, J. A.; Collins, W. K.; Thodla, R.; Gui, F. The Consequence of Stress Intensity on Fatigue Crack Propagation in High-Strength Steels in Sour Environment. Electrochemical Society Transactions 2014, 61, 37–47.

Zuang, M. Abulikemu, P. Campo-Moreno, W.E. Platten, A.D. Venosa, R.N. Conmy (2015) A comparative study on the biodegradability of crude oil dispersed with JD-2000 at 5 and 25 ^{o}C. Chemosphere.

Independent Reports Sponsored by Interagency Committee Member Agencies:

Committee to Review the EDRC Project Final Report, Ocean Studies Board, National Research Council. 2013. A Review of Genwest's Final Report on Effective Daily Recovery Capacity (EDRC): A Letter Report (2013). The National Academies Press, Washington, DC. November 2013. 41 pages DOI: 10.17226/18579 DOI: 10.17226/18579Energy Information Administration. 2014. Annual Energy Outlook 2014 With Projections to 2040. DOE/EIA-0383(2014). April 2014

Energy Information Administration. 2015. Annual Energy Outlook 2015 With Projections to 2040. DOE/EIA-0383(2015). April 2015

National Academy of Sciences. 2014. Responding to Oil Spills in the Arctic Marine Environment. July 2014.

National Petroleum Council. 2015. Arctic Potential: Realizing the Promise of U.S. Arctic Oil and Gas Resources. July 2015.

Interagency Committee Publications not reported in the FY2012-2013 Biennial Report to Congress

The following are Interagency Committee member publications that were inadvertently left of the list of publications in the FY2012-2013 Biennial Report to Congress:

Bai, Z., Xiao, L., Kuo, Y., & Yang, L. 2013. Research on Vortex Induced Motion of a Deep Draft Semisubmersible With Four Rectangular Columns. International Society of Offshore and Polar Engineers. June 30, 2013

Chapman, Elizabeth C.; Capo, Rosemary C.; Stewart, Brian W.; Kirby, Carl S.; Hammack, Richard W.; Schroeder, Karl T.; and Edenborn, Harry M. 2012. "Geochemical and Strontium Isotope Characterization of Produced Waters from Marcellus Shale Natural Gas Extraction." Environmental Science & Technology 46, no. 6 (2012) : 3545-3553.

Chapman, Elizabeth C. , Rosemary C. Capo, Brian W. Stewart, Robert S. Hedin, Theodore J. Weaver, Harry M. Edenborn,. 2013. “Strontium isotope quantification of siderite, brine and acid mine drainage contributions to abandoned gas well discharges in the Appalachian Plateau”, Applied Geochemistry 31 (2013) 109–118.

Clarke, J.T., C.L. Christman, A.A. Brower, and M.C. Ferguson. 2013. Distribution and Relative Abundance of Marine Mammals in the Northeastern Chukchi and Western Beaufort Seas, 2012. Annual Report, OCS Study BOEM 2013-00117. National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way NE, F/AKC3, Seattle, WA 98115-6349.

Kaiser, M.J., B. Snyder, and A.G. Pulsipher. 2013. Offshore drilling industry and rig construction market in the Gulf of Mexico. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2013-0112. 375 p.

Konar, Brenda and Alexandra M. Ravelo. 2013. Epibenthic Community Variability on the Alaskan Beaufort Sea Continental Shelf Final Report. OCS Study BOEM 2013-01148. May 2013

Michel, J. (ed.). 2013. South Atlantic information resources: data search and literature synthesis. US Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2013-01157.

National Research Council of the National Academies. TRB Special Report 311: Effects of Diluted Bitumen on Crude Oil Transmission Pipelines. April 2013

Normandeau Associates, Inc. 2012. High-resolution Aerial Imaging Surveys of Marine Birds, Mammals, and Turtles on the US Atlantic Outer Continental Shelf—Utility Assessment, Methodology Recommendations, and Implementation Tools for the US Dept. of the Interior, Bureau of Ocean Energy Management. Contract # M10PC00099. 378 pp.

Quakenbush, L.T., R.J. Small, and J.J. Citta. 2013. Satellite tracking of bowhead whales: movements and analysis from 2006 to 2012. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Alaska Outer Continental Shelf Region, Anchorage, AK. OCS Study BOEM 2013-01110. August 2013. 60 pp + appendices.

Rouse, David R., Karen J. Nelson, and Jon C. Reiten. 2013. Montana - Impacts of Oil Exploration and Production to the Northeast Montana Wetland Management District. Montana Bureau of Mines and Geology Open-File Report 620. U.S. Fish & Wildlife Service, Region 6 Environmental Contaminants Program, Denver, CO. 264 pp.

S.L. Ross Environmental Research Limited and Mar Inc. 2013. Skimmer Tests in Drift Ice: Ice Month 2013 at Ohmsett. August 2013

Varmer, Ole. 2014. Underwater Cultural Heritage Law Study. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study BOEM 2014-005.

White, H.K., P.Y. Hsing, W. Cho, T.M. Shank, E.E. Cordes, A.M. Quattrini, R.K. Nelson, R. Camilli, A. Demopoulos, C.R. German, J.M. Brooks, H.H. Roberts, W. Shedd, C.M. Reddy, and C.R. Fisher. 2012. Impact of the Deepwater Horizon oil spill on a deep-water coral community in the Gulf of Mexico. Proceedings of the National Academy of Science. March 27.

White, H.K., P.Y. Hsing, W. Cho, T.M. Shank, E.E. Cordes, A.M. Quattrini, R.K. Nelson, R. Camilli, A. Demopoulos, C.R. German, J.M. Brooks, H.H. Roberts, W. Shedd, C.M. Reddy, and C.R. Fisher. 2012. Reply to Boehm and Carragher: Multiple lines of evidence link deep-water coral damage to Deepwater Horizon oil spill. Proceedings of the National Academy of Science, 190(40). October 2.

Zapp Sluis, M. and J.H. Cowan, Jr. 2013. Platform recruited reef fish phase II: Do platforms provide habitat that increases the survival of reef fishes? U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2013-0120 43 pp.

Zhang, X., J. Zhang, J. Krieger, M. Shulski, F. Liu, S. Stegall, W.Tao, J. You, W. Baule, and B. Potter. 2013. Beaufort and Chukchi Seas Mesoscale Meteorology Modeling Study, Final Report. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region, Anchorage, AL. OCS Study BOEM 2013-0119. 204 pp.

This page was intentionally left blank

FY2014-2017 Interagency Committee Member Projects[5]

Table of Contents

[5] The Interagency Committee monitors a variety of oil pollution research projects conducted by other non-Committee entities and, for purposes of brevity, only those research projects funded and managed by Interagency Committee members (includes those principally having access to the Oil Spill Liability Trust Fund) are listed in the appendices. The research projects are presented using the Interagency Committee's new Oil Pollution Research Categorization Framework. Projects are listed within their relevant Classes and SRAs.

This page was intentionally left blank

PREVENTION

Human Error Factors

Trident: A Human Factors Decision Aid Integrating Deepwater Drilling Tasks, Incidents, and Literature Review (11121-5101-01)
Contracting Agency: DOE
Estimated Completion: September 2016
The objective of this project is to design and develop Trident, a Human Factors database and decision aid to help industry practitioners understand and mitigate those aspects of deepwater drilling in which human and organizational performance limitations can result in the failure to meet safety, environmental, productivity, and other system goals. This is an industry accepted and participatory study to provide understanding of those aspects of deepwater drilling systems in which human error can lead to failure to meet system goals, which can guide operators, designers, vendors, service providers, and others in developing system improvements. The study includes the development and field testing of appropriate software to address the issue of predicting human error.

Human Centric Approach to Improve Pipeline Non-Destructive Evaluation (NDE) Performance and Reliability
Contracting Agency: PHMSA, Battelle Memorial Institute, Corporate Operations
Estimated Completion: 2018
The project will first identify major human factors impacting NDE measurements and then solve those high-impact gaps with human and technology interventions. Human factors will be identified using well-established Saba™ Peak Performance System (PPS) and its accompanying Human Performance Technology (HPT) Front-end Analysis (FEA). The project will then develop and validate intervention solutions that target those top human factors identified previously identified. Project reporting is publicly available at:
https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=644

PHMSA Transportation Rail Incident Preparedness and Response (TRIPR) Tools
Contracting Agency: PHMSA
Estimated Completion: on-going
The Transportation Rail Incident Preparedness and Response, Flammable Liquid Unit Trains resource materials were developed to provide critical information on best practices related to rail incidents involving hazard class 3 flammable liquids, such as crude oil and ethanol. A key component of this initiative is to learn from past experiences and to leverage the expertise of public safety agencies, rail carriers, and industry subject matter experts in order to prepare first responders to safely manage incidents involving flammable liquid unit trains. These training resources offer a flexible approach to training the first responders and emergency services personnel in pre-incident planning and response. Each module contains a PowerPoint presentation, Student Workbook, and Instructor Lesson Plan. Development and the tools is a collaboration between PHMSA, industry, and Interagency Committee members USCG, EPA, and FEMA/USFA.

Offshore Facilities and Systems

Effect of H_2S and CO_2 in HP/HT Wells on Tubulars and Cement
Contracting Agency: BSEE
Completed: 2015
This project aimed to improve our understating of the impacts of H_2S and/or CO_2 environment on oil and gas tubulars and cement. Specifically, the goals were to establish how commonly used tubulars and cement are affected by exposure to H_2S and/or CO_2 in HPHT wells, determine the capability of these materials to function properly in harsh downhole environments, and develop and evaluate new cement and specialty steel formulations which are suitable for HPHT sour gas environment to ensure long term integrity of the well.

Ice Scour and Gouging Effects with Respect to Pipeline and Wellhead Placement and Design
Contracting Agency: BSEE
Completed: 2015
The objective of this project was to identify the knowledge gaps in ice scour and gouging effects with respect to pipeline and wellhead placement and design in the Beaufort Sea. The review included, but was not be limited to collected field data, physical testing data and programs conducted to date, and numerical modeling techniques developed.

Physical Oceanographic and Meteorological Data for Beaufort and Chukchi Seas to Support Reliability-Based Design Criteria for Arctic Offshore Oil and Gas Structures
Contracting Agency: BSEE
Completed: 2015
The objective of this project was to produce information that facilitated strict implementation of the ISO J 9906 Standard: Petroleum and Natural Gas Industries - Arctic Offshore Structures. The information gathered under this contract consisted of meteorological and oceanographic information, for US waters in both the Chukchi and Beaufort seas, in a format consistent with the philosophy of the Normative.

High Resolution 3D Laser Imaging for Inspection, Maintenance, Repair, and Operations (09121-3300-06)
Contracting Agency: DOE.
Completed: December 2014
The primary objective of this project was to improve the accuracy and efficiency of the inspection, maintenance, and repair of ultra deepwater assets. 3D at Depth has successfully developed a subsea LiDAR system with performance comparable to its terrestrial counterpart. Through this RPSEA funded project, the team extended the technologies beyond the lab environment, developed a working prototype and now have two commercially available systems called the SL1 and SL2. The project has led to the development of a new industry segment called subsea LiDAR, which has redefined many subsea measurement processes and is rapidly being adopted.

Ultra-Reliable Deepwater Electrical Power Distribution System and Power Components (08121-2901)
Contracting Agency: DOE
Estimated Completion: 2014
The project goal is to design an electrical power transmission and distribution (T&D) system that will enable subsea oil and gas production for a deepwater field development scenario; it includes designing, building, and qualifying critical components in a system demonstration to advance their Technology Readiness Levels (TRLs). In Phase I, the Modular Stacked Direct Current (MSDC) system will be assessed against existing subsea T&D solutions, and critical building block components to enable the technology will be identified. In Phase II, four components will be designed, developed, and qualification tested using a demonstration system.

Hydrate Modeling & Flow Loop Experiments for Water Continuous and Dispersed Systems (10121-4202-01)
Contracting Agency: DOE
Estimated Completion: October 2015
The project objectives are to: (1) modify the current pressure drop modeling approach to account for a free water phase, (2) perform flow loop experiments to identify and quantify the key parameters affecting pressure drop, (3) incorporate the pressure drop model with the growth rate model in CSMHyK-fw, (4) validate the improved CSMHyK-fw model by predicting flow loop experiments, (5) model development for water+gas and water+gas+oil (continuous and partially dispersed) systems.

Autonomous Underwater Inspection Using a 3D Laser (10121-4903-02)
Contracting Agency: DOE
Completed: November 2014
This project integrated the capabilities of two prior projects to evaluate and characterize the viability of high resolution underwater 3D laser inspection from an autonomous underwater vehicle (AUV) in a local offshore trial. Current ultra-deepwater laser products are not operable from a moving platform and are very short range. This project successfully completed an open water field trial of the prototype.

Corrosion and Scale at Extreme Temperature and Pressure (10121-4204-01)
Contracting Agency: DOE
Estimated Completion: August 2015
A lack of data and models for corrosion, scale, and stress cracking at the extreme temperatures and pressures encountered in ultra-deepwater reservoirs increases the economic and safety risks of offshore production. The objective of this project is to develop the necessary data, models, and experimental tools to assess corrosion, stress cracking, and scale formation at extremes of temperature and pressure encountered in deepwater development. The key overall deliverable will be a detailed technical manual of recommended decision support guidelines based upon extended SAFT/Pitzer models to predict scale and corrosion formation potential in ultra-deep high-pressure -high -temperature wells.

More Improvements to Deepwater Subsea Measurement (10121-4304-01)
Contracting Agency: DOE
Estimated Completion: December 2015
The objective of the project is to reliably and economically identify and assess flow and well production or well control events and conditions for the purpose of preparing the appropriate response actions. The project puts emphasis on the development of techniques and methods that reduce the risk of uncontrolled fluid emissions from subsea equipment, such as blowout preventers, wellheads and Christmas trees, and risers and flowlines.

All Electric Subsea Autonomous High Integrity Pressure Protection System (HIPPS) Architecture (10121-4306-01)
Contracting Agency: DOE
Estimated Completion: May 2016
The project team will develop an all-electric high-integrity pressure protection system (HIPPS) to enable extraction from high-pressure fields and enable expansion of existing low-pressure subsea networks. Phase I of the development effort will research the state of the industry for HIPPS architecture, component technology, and functional requirements. Phase II will select the key component technology options and mature the system to TRL 2 using proof-of-concept hardware tests. Control hardware and power delivery and storage hardware may achieve technology readiness beyond level 2 with the use of full-scale prototypes in test.

Construction and Testing of Deepwater Permanent Subsea Pressure Compensated Chemical Reservoir (11121-5302-01)
Contracting Agency: DOE
Estimated Completion: September 2016
The project's objective is to develop a functional and qualified subsea chemical storage and injection system design with an effective 3,000+ barrel chemical storage volume. The size of the chemical storage dominates the operational constraints for this system. There are several viable approaches to replenishing the chemistry and installation of the facility. Proven technology with economic factors is expected to dominate the selection of these installation and maintenance approaches as the technology for this objective is matured.

Qualification of Flexible Fiber-Reinforced Pipe for 10,000-foot Water Depths (10121-4402-01)
Contracting Agency: DOE
Estimated Completion: December 2015
The objective of this work is to develop a novel hybrid flexible riser technology by a combination of design, analysis of performance, material and subcomponent testing, and prototype testing. The goal of this project is to develop a novel 7-inch ID hybrid (composite/metal) flexible deep-water pipe technology which meets the following oil and gas industry requirements; 10,000 foot (3,000m) water depth; 12,000 psi capability; 120^{o}C fluid temperature capability; 25 year field life; and sour gas capability.

Vortex Induced Motion Study for Deep Draft Column Stabilized Floaters (11121-5404-03)
Contracting Agency: DOE
Estimated Completion: December 2015
The objective of the study is to improve the overall mooring system safety and riser system integrity by testing design parameters for deep draft column stabilized floaters (DDCSFs) to determine which have the most impact on vortex induced motion (VIM), and which VIM mitigation strategies are preferred for DDCSFs. DDCSFs have excellent applicability to development of challenging reservoirs in deepwater and ultra-deepwater in the Gulf of Mexico. However, increased payload requirements and a general desire to reduce platform motions have resulted in larger platforms with deeper drafts, making them susceptible to VIM. Improved VIM performance has the potential to increase hydrocarbon reserves by making reservoirs more accessible to safe, reliable development.

Low Cost Flexible Production System for Remote Ultra-Deepwater Gulf of Mexico Field Development: Flexible Production Systems for UDW GOM: Concept Development and Comparison of Three Different Solutions (10121-4404-03)
Contracting Agency: DOE
Estimated Completion: January 2016
The objective of this project is to study the feasibility of a circular shaped floating platform unit as compared to two current floating production unit concepts, semi-sub and spars. The floater host will be located in 2,000-3,000 meters of water depth. Production will be gathered via four production risers from two separate drill centers. It is planned that gas will be exported with a gas riser/pipeline. The drill centers will sustain a total of 10 wells. Each well will be connected to wet trees controlled via umbilicals and power cables. Artificial lift supplied by either subsea pumps or downhole electric submersible pumps, is required. Processed oil will be directly offloaded from a single offloading station. It is anticipated that capacity for three additional risers for future improved oil recovery via water injection and/or future tie-ins will be required.

Integrity Management of Risers to Support Deepwater Drilling and Production Operations (11121-5402-01)
Contracting Agency: DOE
Estimated Completion: March 2016
The overall objective of this work is to develop a reliable, cost-effective real-time, riser integrity management system by closing technology gaps that include: availability of historical riser data for assessment of long-term integrity management of deepwater riser systems; on-board subsea equipment controls to detect anomalous behavioral modes and implement mitigation strategies; essential safety management system/software for riser system integrity data storage, riser

performance and user interface for on-ship and on-shore; and integrated deepwater drilling and production riser integrity management solutions encompassing hardware, software, processes, and people.

Methodology and Algorithm Development for the Evaluation of Ultra-deepwater or Arctic Floating Platform Performance under Hazardous Sea Conditions (12121-6402-01)
Contracting Agency: DOE
Estimated Completion: July 2016
The objective of the project is to improve the overall safety of ultra-deepwater or arctic floating platforms by implementing nonlinear effects in a state of the art software code that could be used by the industry. Better understanding of the effects of nonlinearity on floating platforms through research and development would inherently decrease the risks associated with implementing ultra-deepwater or arctic design projects. The objective will be met through the development of a methodology and associated algorithms for the evaluation of ultra-deepwater floating platform performance under hazardous sea conditions. Numerical tools will be developed and implemented for the computation of ultra-deepwater floating platform performance and safety for the extreme ocean conditions.

Hi-Res Environmental Data for Enhanced UDW Operations Safety (11121-5801-01)
Contracting Agency: DOE
Estimated Completion: September 2016
Ocean currents can pose significant challenges to safe oil and gas operations in the Gulf of Mexico (GoM). One primary objective of this research program is to better understand the physical mechanisms that cause periods of elevated current velocities. Specifically, the passage of Tropical Revolving Storms (TRS) over areas of relatively higher sea surface temperature (e.g., loop current (LC) or associated eddy (LCE)) may cause elevated currents in the boundary layers of the water column. Two in situ current measurement programs will focus on near bottom and near surface boundary layers and compare them to expert 3-D numerical models. The second primary objective of this program is to develop a technique to survey surface currents in real-time over a large horizontal range of at least 300 km per day.

Development of Advanced CFD Tools for the Enhanced Prediction of Explosion Pressure Development and Deflagration Risk on Drilling and Production Facilities (12121-6403-01)
Contracting Agency: DOE
Estimated Completion: September 2016
The objective of the project is to provide oil and gas companies operating in the GOM with the tools necessary to design “inherently safer” offshore facilities that can survive gas explosion incidents and prevent escalation. This project will enhance and validate the capabilities of the industry-standard explosion modeling CFD software, FLACS, to aid in reducing the HS&E-related incidents in the GOM. The project will improve and adapt the capabilities of FLACS to predict MCE early in the design phase of GOM UDW drilling and production facilities and provide the information necessary to design facilities to minimize the consequences of explosion incidents.

Subsea Produced Water Sensor Development (12121-6301-03)
Contracting Agency: DOE
Estimated Completion: September 2016
The overall objective of this work is to develop and design subsea water quality monitoring sensors to measure the quality of produced water separated at the Sea-floor. The sensors will also offer an improved failsafe system as well as for controls of Subsea production equipment. These sensors will be capable of determining if the level of contamination is below, at, or above the permitted level, and then be able to give signals to shut down operations or to divert all of the production fluids to a topside facility. The project intends to develop Subsea produced water (PW) sensors to Technology Readiness Level (TRL) 3.

Subsea DC Connectors for Environmentally Safe and Reliable Powering of UDW Subsea Processing (12121-6302-01)
Contracting Agency: DOE
Estimated Completion: September 2016
The objective of this project is to assess the risks and close the technology gaps of subsea DC connectors, a critical component to ensure the safe and reliable operation of subsea high voltage direct current (HVDC) transmission and distribution (T&D) systems, which is the emerging technology for environmentally safe and reliable powering of long step-out, ultra-deepwater (UDW) subsea oil and gas processing. The program will demonstrate the HVDC electrical functionality of the connector, and together with the field-proven mechanical design this will retire the key technical risks in order to reach Technology Readiness Level (TRL) 3.

Effects of Fiber Rope-Seabed Contact on Subsequent Rope Integrity (10121-4406-01)
Contracting Agency: DOE
Completed: October 2014
Objectives of this program included (1) developing a fundamental technical understanding of the effects of fiber-rope/seabed contact, whether accidental or planned, to ensure safe production when seabed contact occurs, (2) understanding the primary cyclic-wear process that reduces the strength of fiber ropes so that risks and unsafe conditions can be identified and avoided, and (3) assembling a testing plan and reach agreement between project industry participants and the US regulatory agencies for qualifying polyester mooring ropes for incidental seabed contact and seabed pre-installation. All testing conducted during this program has demonstrated that rope designs with multiple layers of filtering material (as well as one alternative filtering system evaluated) can completely protect mooring ropes from soil ingression. Based on these results, it is concluded that these types of ropes can be dropped to the seafloor without damage.

Ultra-deepwater Dry Tree System for Drilling and Production in the Gulf of Mexico, Phase 2 (10121-4405-02)
Contracting Agency: DOE
Completed: December 2014
The primary objective of this project was to mature two concepts of very large floating systems that are suitable for drilling and production in up to 10,000-foot GOM Ultra-Deepwater using conventional dry trees. This work performed validation and maturation of all safety/environmental critical aspects of the concepts so that each concept is ‘project-ready.’

Development of Carbon Nanotube Composite Cables for Ultra Deepwater Oil and Gas Fields (09121-3300-10)
Contracting Agency: DOE
Completed: May 2014
The purpose of this project was to develop a new technology for electrical power cables, using a composite of carbon nanotubes (CNT) and copper. The primary goal was to build a CNT-copper composite cable with twice the conductivity of an equivalent size pure copper cable. This composite cable should also be lighter and stronger than a comparable copper cable. Experimentally, the project developed an efficient method for dispersing the CNTs in solutions suitable for dip-coating. The solution-coating and wire drawing steps have been shown to produce highly-aligned, dense CNT coatings. The composite wires have resistivities that are close to Cu. The resistivities of the CNT coatings themselves are among the lowest reported to date by any research group world-wide.

Ultra-High Conductivity Umbilicals: Polymer Nanotube Umbilicals (PNUs) (10121-4302-01)
Contracting Agency: DOE
Estimated Completion: 2015
Estimated Completion: November 2015
The next step in this continuation project is to achieve a conductivity capability for subsea umbilicals (10-6 O•cm in a Polymer Nanotube Umbilical (PNU)) that is at least comparable to that of copper, but at a much lower weight. A polymer nanotube-based high conductivity wire for umbilicals, the cables that provide power to satellite wells, will increase the distance that satellite wells can be located away from surface facilities, leading to a reduction in energy requirements and a smaller operations carbon footprint. Ultimately, the reduced size and weight of the umbilicals will result in easier and potentially safer handling of cable during installation. It will also decrease the need to build and use hubs and platforms, since more efficient power transmission will allow for a subsea option as opposed to a platform option in some cases. The successful application of this technology should be able to be extended onshore, resulting in added efficiency and less stress on onshore power grids.

Ultra-Deepwater Riser Concepts for High Motion Vessels (10121-4401-02)
Contracting Agency: DOE.
Estimated Completion: December 2015
Research Objectives: (1) Develop a fundamental technical understanding of the differences between existing riser concepts to the response of high motion vessels, such as semi-submersibles and ship shape floating, production, storage and offloading (FPSO) units. Dynamic analysis will be used to capture riser response to both high and low frequency motions in extreme and fatigue seastates. (2) Develop a better understanding of the limitations of each riser concept and their causes. A risk assessment covering all phases of the riser's life will be key to obtaining this knowledge. (3) Assemble a meaningful testing plan, as agreed to between project industry participants and the U.S. regulatory agencies and carry out the testing within the agreed project schedule.

Gulf 3-D Operational Current Model Pilot Project – Phase I (08121-2801-02)
Contracting Agency: DOE
Completed: June 2014
The objective was to demonstrate a well-validated operational 3D modeling system that produces timely, accurate forecasts, nowcasts, and hindcasts of currents. Two major loop events in the past 1.5

years have been successfully predicted two months in advance. The Model has been running in real-time with minimal interruption since January 2013, producing 60- day forecasts once per week. Standard products (animations/plots) and value added products (RACs, trajectories) are processed and posted to the web automatically.

Effect of Climate Variability and Change in Hurricane Activity in the North Atlantic (10121-4802-01)

Contracting Agency: DOE

Estimated Completion: September 2015

The overall objective of this work is to help provide better planning guidelines to enable improved design of structures and operating procedures that will provide more efficient future oil and gas production and aid in the minimization of environmental and safety risks. The immediate goal of this project is to provide industry with credible projections of future hurricane activity in the Gulf of Mexico together with an assessment of direct impacts on safety, environmental risk and production.

Synthetic Hurricane Risk Model for Gulf of Mexico (10121-4801-01)

Contracting Agency: DOE

Estimated Completion: December 2015

The objective of this project is to develop of a synthetic track model and hurricane track database (both synthetic 100,000 years, and historical ~110 years). The research efforts from this project will produce a state of the art synthetic Gulf of Mexico hurricane model to evaluate hurricane risk to offshore and coastal locations for current and future climate scenarios. Improving the ability to accurately model and understand the hurricane hazards resulting from high wind and wave conditions will in turn result in safer designs for offshore structures, minimizing the risk of infrastructure and personnel loss.

Waterways Management

Project Title: Automatic Identification System (AIS) Transmit Capability
Contracting Agency: USCG/RDC/USACE
Estimated Completion/Completed: June 2015
This project explored the transmit capability of the AIS system to determine requirements and potential types of information that could be sent for both government and commercial users. Messages include specific warnings about hazards or other safety issues, such as weather. A test bed in Louisville evaluated process and procedures.
Another related project focused on the requirements specifically for the USACE for use in lock operations. The results of these efforts are being used by the Western Rivers project described below.

Project Title: Western Rivers e-AtoN Technology Demonstration
Contracting Agency: USCG/RDC/USACE
Estimated Completion/Completed: May 2017
This project is designed to demonstrate benefits and demands posed by e-Navigation (e-NAV) technology to inform maritime security, safety, and mobility requirements in the Western Rivers. It will inform USCG requirements to successfully operate an e-NAV system that includes the distribution of navigation, safety, and environmental information to users via the AIS. The test bed (both shoreside and potential users) has been expanded to address the employment of electronic Aids to Navigation (e-AtoN), use of electronic Maritime Safety Information (e-MSI) to distribute critical marine information, and the implementation of e-Navigation Management.

Project Title: Next Generation Arctic Navigational Safety Information System
Contracting Agency: USCG/RDC
Estimated Completion/Completed: January 2018
Reliable navigation information is not easily found in the Arctic. In addition, conditions can change quickly putting vessels and personnel into peril. This project is partnering with the Marine Exchange Alaska (MXAK) that already has a string of AIS systems along the coast. The objective of this project is to develop the Arctic Navigation Safety Information System (ANSIS) that builds on the messaging system identified in the previous projects to demonstrate expanded use of AIS transmit capability in Alaska. Basic messages were transmitted line-of-sight starting in 2015 with methods for longer distances being investigated.

Vessel Design

SSC SR-1461: Strength and Fatigue Testing of Composite Patches for Ship Plating Fracture Repair
Contracting Agency: USCG/Ship Structure Committee
Estimated Completion: 2014
This project will explore and experimentally validate the use of composite patches for preventing crack growth and extending the lifetime of aluminum and steel ship structures.

SSC SR-1469: Improving Decisions About Ship Structural Fatigue Performance and Construction Quality
Contracting Agency: USCG/Ship Structure Committee
Estimated Completion: 2015
Provide easy-to-use guidance, tools and training for use by ship surveyors, owners and government officials to make better, more-informed decisions about ship structural workmanship requirements, structural fatigue design performance and vessel service life.

SSC SR-1473: Survivability of Hull Girder in a Damaged Condition
Contracting Agency: MARAD/Ship Structure Committee
Completion: 2015
The objective of this project is to systematically study the effect of various types of structural damage on the hull girder ultimate strength using state of the art nonlinear finite element analysis techniques as well as to identify the most suitable modeling techniques. The results of this study will aid in rapid hull girder residual strength evaluations following an accident, and for improving the criteria for ship residual strength requirements.

Ultimate Strength of Ice Class Ship Structures in Intact and Damaged Conditions
Contracting Agency: USCG/Ship Structure Committee
Estimated Completion: 2015
The objective of this research project is to improve the ability to estimate the residual strength of ship structures operating in low temperatures and in ice-covered waters that have sustained damage. Damage sustained by ships in these conditions will necessarily impair to some degree the ultimate strength of the ship structure. The purpose of this study is to quantify, to the degree possible, the loss of strength of the structures as a result of in-service damages (e.g., local denting) and accidental damages (e.g., resulting from collision or grounding), taking into account the effect of low temperatures. The study includes a literature review on structural failures for ships operating in the Arctic Ocean and the effects of cold temperatures on ship materials and structures. A hypothetical ice-class tanker will be used as the basis for structural material modeling, ultimate panel strength analysis, and ultimate strength panel model tests.

Drilling

Effects of H_2S and CO_2 in High Pressure High Temperature (HPHT) Wells on Tubulars and Cement
Contracting Agency: BSEE
Estimated Completion: 2014
This project is aimed at improving our understating of the impacts of H_2S and CO_2 on oil and gas tubulars, cement, and commonly used materials in HPHT wells. It will determine the capability of these materials to function properly in harsh downhole environments while attempting to develop new cement formulations which are suitable for a HPHT sour gas environment and provide recommendations and guidelines to ensure long term integrity of the well.

Low Temperature Effects on Drilling Equipment
Contracting Agency: BSEE
Completed: 2015
The selection and effective qualification of new and existing materials, fluids and drilling methodologies commonly used in the Gulf of Mexico and the North Sea was reevaluated to take into consideration the 'cycles' in the temperature and extreme conditions in the arctic.

Evaluation of Automated Well Safety
Contracting Agency: BSEE
Estimated Completion: 2015
This study is to identify automated well safety technologies with the potential to increase safety during Outer Continental Shelf (OCS) drilling, well completion, well work over and production operations, as well as to assess early well kick detection approaches, equipment, techniques, and systems associated with drilling operations in the OCS.

Well Stimulation Effects on Annular Seal
Contracting Agency: BSEE
Estimated Completion: 2015
This proposed research will address the issue of OCS stimulation operations and cement/casing integrity. The proposed work fully covers the issue from fundamental research, to engineering, to field application. Strong emphasis is placed on regulation and control of well construction and stimulation processes as well as the impact of new or additional regulation on safety and environmental protection. Operational difficulties of new regulation will be identified along with methods to mitigate operational or enforcement concerns. In addition to current stimulation techniques and regulations, future industry trends and technology in these areas along with their corresponding effect on safety and regulation also will be considered. The objective of this proposal is to evaluate technological and safety aspects of well stimulation techniques in the OCS.

Real Time Data Monitoring
Contracting Agency: BSEE
Completed: February 2014
An independent assessment of the various types of real-time data monitoring systems available for offshore oil and gas operations was conducted. The assessment focused on drilling and production technologies and included a cost benefit analysis that would detail potential costs to industry, potential increases in safety performance, government resources needed for implementation, and necessary training for all parties involved. The assessment identified what automation systems are available or being developed, the potential they have to increase offshore drilling safety, and any negative impacts they have on operations.

Assessment of Blowout Preventer (BOP) Stack Sequencing, Monitoring and Kick Detection Technologies
Contracting Agency: BSEE
Completed: January 23, 2014
The key objectives of the project were to assess the potential for a new design of blind shear rams and BOP stack configurations to enable the reduction of the potential for unsupported pipe in the BOP bore and increase the possibility that pipe shear will be successful. Also, it evaluated new design methods for detecting failure and monitoring of BOP components and control

systems using the latest technology in order to prevent failure, explore the reliability of an independent complete acoustic package for functioning a short BOP deployed in deep water, and identify and assess equipment and technologies capable of and/or design to detect kicks.

Reliability of Annular Pressure Buildup (APB) Mitigation Technologies (12121-6502-01)
Contracting Agency: DOE
Estimated Completion: December 2015
This project will analyze APB mitigation technologies. Moreover, it will provide industry with a stochastic tool for analysis, comparison, and choice of possible APB mitigation techniques applicable to an operator's well and field situation. APB occurs in all wells with high bottom-hole temperature, multiple casing strings and annuli that cannot be vented --- which includes most deepwater Gulf of Mexico wells. APB can result in casing string and premature well failure, unless a well is properly designed, APB risks are fully assessed for all load cases, and any necessary APB mitigation methods are evaluated, fully analyzed for effectiveness, and properly implemented.

Intelligent BOP RAM Actuation Sensor System (11121-5503-01)
Contracting Agency: DOE
Estimated Completion: July 2016
The objective of this work is to design and develop an instrumented BOP ram prototype and laboratory testing. The technology development will be conducted in five stage gates within two phases. A system feasibility determination, gaps analysis, and a risk assessment will be conducted, followed by technology selection (TRL0).Instrumentation will be conceptualized and reviewed (TRL1), designed (TRL2), a prototype will be constructed and bench scale tested (TRL3-4), followed by review with BSEE and API, and development of a commercialization plan.

A 1,000 level Drill Pipe Deployed Fiber Optic 3C Receiver Array for Deep Boreholes (09121-3700-02)
Contracting Agency: DOE
Completed: February 2014
The objectives of this project were to design a drill pipe deployed 3C borehole seismic array that is capable of deploying 1,000 3C sensors, i.e., 3,000 channels, using novel broad band fiber optic geophones that can be deployed to at least 200ºC (392ºF) and 30,000 psig to a drilled depth of 30,000 feet. The deployment system based on small diameter drill pipe was designed and the prototypes were manufactured and tested for load bearing capabilities. This project demonstrated reception of useable signals up to 1500 Hz using next generation fiber optic sensors as compared to less than 100 Hz for conventional state-of-art receivers. In the sediments tested, this represents a resolution improvement from 100 feet vertical resolution to less than 2 feet. The project confirmed that the drill pipe based deployment system can be built to support a 30,000 foot long borehole seismic system.

Ultra Deepwater Resources to Reserves Development and Acceleration through Appraisal (08121-2701-03)
Contracting Agency: DOE
Completed: May 31, 2014

The objective of the project was to develop techniques to assess the connectivity characteristics of deepwater sediments based on analysis of reservoir analogs, reservoir databases, and a reservoir model for a mature reservoir. This project developed a new geological modeling framework based on multiple-point geostatistics and formulated a novel multiple point proxy function that represents the well test response in terms of the flow connectivity. The methods and techniques developed in this research were applied on the data for the Ewing block of the Lobster field. The addition of higher order terms to the proxy expression for a well test allows us to detect important permeability features such as transition between rock types by analyzing the well test profile.

Pressure Prediction and Hazard Avoidance through Improve Seismic Imaging (12121-6002-02)
Contracting Agency: DOE
Estimated Completion: September 2016
The primary objectives of the defined research are (1) to deliver a benchmark simulated seismic dataset that will be used by industry and academic research institutes to investigate improved approaches for prediction of deep over-pressured reservoirs, and (2) to reduce drilling risk – both safety and environmental – through improved pre-drill pressure prediction methodologies that are derived from iterative interpretations of the simulated dataset. The benchmark simulated seismic dataset will be acquired over a model that is representative of the challenges facing those who do pore pressure prediction using seismic data collected in the U.S. Gulf of Mexico. The model will be constructed to contain physically realistic pore pressure scenarios and in a manner that allows acquisition of realistic seismic data using numerical wave-field simulation over the model.

Intelligent Casing - Intelligent Formation Telemetry (ICIFT) System (10121-4504-01)
Contracting Agency: DOE
Completed: December 2014
The Intelligent Casing-Intelligent Formation Telemetry (ICIFT) system was developed in this project to enhance well control capabilities during cementing and completions operations by providing measurements from the external part of the production casing. The ICIFT system effectively places and isolates the casing without damaging the instrumentation. Efforts in this project included an extensive literature survey and background studies, review and evaluation of borehole telemetry systems, and design, development, and testing of the telemetry system's component prototypes.

Deepwater Reverse-Circulation Primary Cementing (10121-4502-01)
Contracting Agency: DOE
Completed: June 2014
The primary objective of this project was to assess the applicability of Reverse-Circulation Primary Cementing (RCPC) techniques to deepwater wells. With conventional primary cementing fluids are pumped down the casing and then up into the annulus; while with RCPC, the fluids are pumped down through the annulus and up into the casing shoe. Using RCPC greatly reduces the bottom-hole circulating pressure of the fluids compared to conventional cementing. One major challenge in deepwater cementing is the narrow formation fracture gradient, so the application of RCPC has clear beneficial potential. The scope of work included analysis of the RCPC cementing method, preparation of a development path for technology required to apply RCPC to deepwater wells, and creation of preliminary operational procedures with associated contingency plans. The project resulted in development of a finite-element software package which was used to develop a robust model capable of handling deepwater RCPC. The project also conducted laboratory intermixing studies to determine that rheology is a key parameter in fluid design and placement. Finally, key mechanical components required for deepwater RCPC were analyzed to determine state-of-the-art and future performance requirements.

Coil Tubing Drilling and Intervention System Using Cost Effective Vessel (10121-4505-01)
Contracting Agency: DOE
Completed: August 2014
The primary objective of this project was to advance the work previously done with industry funding by performing an offshore demonstration of a cost-effective Coil Tubing (CT) system for down-hole work in deepwater Gulf of Mexico satellite wells, without the need for a Mobile Offshore Drilling Unit (MODU). This project developed a design for a SSR and supporting equipment suitable for a cost effective vessel to do coiled tubing intervention in ultra-deepwater. The riser enables a full performance envelope of coiled tubing abilities. A successful field test on a deepwater satellite well will prove that a small vessel can operate coiled tubing through an SSR in deepwater, demonstrate improved safety and environmental protection, and incur a cost less than half that of a MODU.

Smart Cementing Materials and Drilling Muds for Real Time Monitoring of Deepwater Wellbore Enhancement (10121-4501-01)
Contracting Agency: DOE
Estimated Completion: August 2016

The objective in this project is to enhance the sensing properties of the drilling mud and cementing slurry, so that it can be used for real time monitoring during installation and the entire service life of the deepwater well by incorporating new technologies in the areas of materials and monitoring. Incorporation of new additives to the cementing slurry will make it piezoresistive (change in electrical resistivity with stress, strain, temperature and chemical reactions) from the time of mixing the drilling mud and cement slurry through the entire service life of the hardened cementing material. Advances in materials and grouting technologies will be combined with advancement in surfactant technology to produce drilling mud and cementing materials with enhanced sensing capabilities. With the sensing capabilities installed in the drilling mud and cementing slurry, it will also be possible to monitor the advancement of the drilling mud and cementing slurry front around the casing during the construction phase.

Development of Best Practices and Risk Mitigation Measures for Deepwater Cementing in Oil Based Mud (OBM) and Synthetic Based Mud (SBM) (12121-6503-01)
Contracting Agency: DOE
Estimated Completion: September 2016
The objectives of this project are to develop fundamental knowledge of mud-cement compatibility issues related specifically to deepwater cementing, to quantify risks associated with cementing in OBM/SBM and to develop best practices and derive recommendations in order to reduce the recognized risks. This study will analyze the relationship between temperature, pressure, cement bond, degree of mud removal and its effect on zonal isolation in complex well architecture. Fluids under laboratory investigation will include typical commercially available designs of cement slurries, SBM, OBM, and spacers with a focus on micro-particulate fluids and other new technologies. Environmental benefits of a successful project include a decrease in contamination, the formation of channels, and improved bonding of cement. Long-term wellbore integrity will be improved and environmental and safety issues such as leaks from the formation

and Sustained Casing Pressure (SCP) will be mitigated. The enhanced integrity of the cement will not only save operators from costly remedial work and additional rig time, but also increase productivity as well as reduce environmental and safety risks.

Onshore Drilling:

Coupled Flow- Geomechanical- Geophysical –Geochemical Analysis of Tight Gas Production (08122-45)
Lead Performer: DOE
Completed: March 2014
This study's objective was to provide new knowledge for application by the oil and gas industry, including how to design optimized production systems, the underlying relationship between changes in the pressure regime and the geomechanical status of a tight gas system, the long-term behavior of the induced and natural fracture systems and the effect on production, and the possible geophysical markers that can track the evolution of the flow properties and fracture characteristics of the reservoir. The key deliverable was monitoring during production, well stimulation designs, and improved pressure/production curves.

Improved Drilling and Fracturing Fluids for Shale Gas Reservoirs (09122-41)
Lead Performer: DOE
Completed: June 2014
The primary objective of the defined research was a reduction in the cost and environmental footprint of drilling and fracturing that will lead to a significant expansion of shale gas development. This project aims at developing materials and methods for substantially reducing drilling and completion costs and maximizing gas well productivities in shale gas reservoirs. The key deliverables were novel drilling and fracturing fluids for water-sensitive shales, fluorocarbon additives, and data.

Simulation of Shale Gas Reservoirs Incorporating Appropriate Pore Geometry, Capillarity, and Fluid Transport (09122-11)
Lead Performer: DOE
Completed: August 2014
The objective was to develop the algorithms necessary to implement the correct physical principles and pore geometries in a shale gas simulator by modifying current commercial simulators by substitution of new modules containing more appropriate approximations of pore geometries. The key deliverables were algorithms for commercial exploration and production simulators.

Field Demonstration of Eco-Friendly Creation of Propped Hydraulic Fractures (11123-23)
Lead Performer: DOE
Completed: October 2014
The overall objective of this research was to develop and demonstrate a biodegradable polymer for delivering proppant during hydraulic fracturing. The key deliverables were 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.

Zonal Isolation Improvements for Horizontal Wells Drilled in the Marcellus and Haynesville Shales (10122-19)
Lead Performer: DOE
Completed: October 2014
The objective of this project was to undertake a comprehensive study of the cementing process applied to horizontal wells drilled in the Marcellus Shale play along with the effects of zonal isolation problems on safety and environmental issues. Currently, a major challenge in the Marcellus Shale is maintaining proper zonal isolation from the time cement is placed, through completions. This study will focus on using zonal isolation improvements to lower the cost of drilling, improve operational safety, and reduce overall environmental impact.

Gas Well Pressure Drop Prediction under Foam Flow Conditions (09122-01)
Lead Performer: DOE
Completed: December 2014
This research addresses the issue of foam application for gas wells. The goal of this research was to develop better correlations for calculating pressure drop under foam flow conditions, in addition to developing recommendations for using foam and its operational constraints. The key deliverable was correlations to calculate the pressure drop in vertical gas wells.

Annular Isolation in Shale Gas Wells: Prevention and Remediation of Sustained Casing Pressure and other Isolation Breaches (11122-42)
Lead Performer: DOE
Estimated Completion: May 2015
The objectives of this project are to develop techniques to mitigate risk to groundwater resources associated with shale gas development, to remediate failed annular seal to stop communication in an existing well, to improve techniques that enhance lifelong wellbore annular isolation during the wellbore construction process, and to prevent potential annular seal failure which can cause sustained casing pressure (SCP) later in the well life. The application of this project will illustrate positive value and acceptable risk of the gas shut-off and prevention concepts. The success of the field trials will drive the technology transfer of this developed concept to shale gas driller cross the U. S. as well as other unconventional plays employing factory drilling methods for wells with high potential of SCP. In general, the issue of sustained SCP as it relates to horizontal shale wells will be researched.

Well integrity monitoring using Nanite™ (FE00014144)
Lead Performer: DOE
Estimated Completion: September 2016
The project goal is to demonstrate how real-time sensing of Nanite™ can improve long-term wellbore integrity and zonal isolation in shale gas and applicable oil and gas operations. Nanite is a cementitious material that contains a proprietary formulation of functionalized nanomaterial additive to transform conventional cement into a smart material responsive to pressure (or stress), temperature, and any intrinsic changes in composition. Nanite's electrical, radiometric, and acoustic properties; improved chemical and physical properties; and durability have the potential to ensure long-term wellbore integrity and zonal isolation.

nXis tool for interrogating well integrity in zones with multiple strings of casing (FE0024293)
Lead Performer: DOE
Estimated Completion: September 2017
The goal of this project is to develop a novel well-integrity inspection system capable of providing enhanced information about the flaw structure and topology of conventional and unconventional gas-filled wells. This will be achieved by developing a novel combined X-ray/neutron backscatter imaging device, suitably sized for operation in well bores.

Well integrity via MICP (FE0024296)
Lead Performer: DOE
Estimated Completion: September 2017
This project is aimed at develop improved methods at improving and testing the viability of Microbial-Induced Calcite Precipitation (MICP) process for sealing compromised wellbore cement in leaking natural gas and oil wells, thereby reducing the risk of unwanted upward gas migration. Integrated laboratory testing, simulation modeling, and field testing will be conducted to achieve this goal.

Utica Shale Energy and Environmental Laboratory
Lead Performer: DOE
Estimated Completion Date: September 2018
The goal of this project is to develop and maintain a field research facility in the heart of the Utica Shale play that will provide a platform for environmental and geotechnical studies before, during, and after unconventional oil and gas (UOG) development. The Ohio State University-led Team will: (1) identify and implement best practices that enhance long-term borehole integrity and assure the isolation of production zones from overlying sources of drinking water; (2) characterize the petrophysical, geological, geochemical, and microbiological conditions of reservoir rock and seals before, during, and after reservoir stimulation; (3) provide a site that will accommodate other projects and programs for improved characterization of reservoir conditions, fracture development and propagation, fluid emplacement, reservoir response, and stimulate rock volume; (4) conduct baseline and real-time monitoring of the environmental impact on land, air, water, and communities as well as demonstrating mitigation technologies; and (5) demonstrate as feasible the effectiveness of emerging environmental impact-mitigation technologies that have been developed with DOE support.

Subsurface Gas and Fluid Migration Assessment
Lead Performer: DOE
Estimated Completion: Ongoing
This project is aimed at improving understanding of the density and distribution of legacy wells located within the Appalachian Basin that could serve as conduits for gas or fluid migration into shallow systems. The outcome is expected to be an identification of an appropriate seal leakage model that represents potential gas or fluid leakage from shale gas reservoirs into shallow systems.

Effects of Well Activities on Shallow Gas Migration
Lead Performer: DOE
Estimated Completion: Ongoing
This project involves a field study to investigate the potential for gas well drilling in the Marcellus Shale to mobilize groundwater and stray methane gas in nearby water wells as the borehole penetrates shallow groundwater aquifers. This should produce data from baseline

groundwater analysis, water levels in observation wells, and hydraulic head monitoring at gas wells will be used to evaluate the potential for methane migration in shallow groundwater.
Effects of Gas Flow on Well Cementing (EPAct Complementary Program)

Lead Performer: DOE
Estimated Completion: Ongoing
The project goal is to evaluate potential for regional gas flow from shallow gas formations into the wellbore environment during drilling and/or completion, and the effects of shallow gas on hydration of wellbore cements (focus on Appalachian Basin). The key outcome will be data sets that quantify how the presence of shallow gas affects the integrity of wellbore cement during *in situ* hydration.

Pipeline Systems

Slug Loading and Response in Pipeline (SLARP) JIP
Contracting Agency: BSEE
Completed: 2014
This research was to investigate and conclude current state of industry practice and technology gaps with respect to evaluating slugging effects on pipeline, spools and riser, to investigate alternative methodologies analysis methods for defining slug and turbulence loading and assessing structural response in pipeline and spool and riser, to develop best practices guideline for modeling and analysis of slug and turbulence loading and response of pipeline, spool and risers.

SAFEBUCK Phase III & SAFEBUCK GEO Joint Industry Project (JIP)
Contracting Agency: BSEE
Estimated Completion: December 2014
This project sets out to increase knowledge, and thereby reduce conservatisms, associated with the design process and related limit states of deepwater pipeline design. Key areas of work include undertaking structural reliability analysis to confirm that the SAFEBUCK Design Guideline methodology ensures that the pipeline failure probabilities are consistent with industry targets; the collection of data on operating pipelines to generate lessons for future design by sharing the combined knowledge of lessons learned from recent projects; and the development of a new 'force-resultant plasticity model' to run inside standard software packages, capturing experience from modeling and testing lateral pipe-soil interaction.

Slug Loading & Response in Pipelines, Risers and Jumpers (SLARP) Joint Industry Project (JIP)
Contracting Agency: BSEE
Completed: December 2013
The goal of this JIP was to investigate and conclude the current state of industry practice and technology gaps with respect to evaluating slugging effects on pipeline, spools and riser; to investigate alternative methodologies analysis methods for defining slug and turbulence loading and assessing structural response in pipeline, spool, and riser; and to develop a best practices guideline for modeling and analysis of slug and turbulence loading and response of pipeline, spool, and risers.

Comprehensive Study to Understand Longitudinal Electrical resistance Weld (ERW) Seam Failures
Contracting Agency: PHMSA, Battelle Memorial Institute
Estimated Completion: 2015
The objective of the proposed project is to assist PHMSA in favorably closing NTSB Recommendation P-09-1 arising from the Carmichael Mississippi pipeline rupture involving an ERW seam, which directed that PHMSA conduct a comprehensive study of ERW pipe properties and the means to assure that they do not fail in service. The proposed work is anticipated to validate that periodic use of the current ERW seam integrity assessment methods (hydrostatic testing and in-line inspection using a crack-detection tool) are the best means to prevent ERW seam ruptures.

The work will address the characteristics of ERW seams that make them susceptible to failure, and it will identify the factors the pipeline operators must consider in order to assure that their ERW pipelines are safe. The scope was expanded in FY12 and FY13 to address broader seam weld challenges beyond just low frequency EWR pipelines and to address a review of the effectiveness of technology used to detect defects in seams. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=390.

Meandering Winding Magnetometer (MWM)-Array Characterization of Mechanical Damage and Corrosion
Contracting Agency: PHMSA, JENTEK Sensors Inc.
Completed: 2014
This project will advance the JENTEK MWM-Array technology to provide quantitative characterization of corrosion and mechanical damage. This includes characterization through coatings/insulation; followed by higher resolution imaging with coatings/insulation removed. For mechanical damage, quantitative characterization includes geometric variations and multidirectional residual stresses (near the surface and deeper within the pipeline).
This project will develop capability to detect cracks at damage sites. For corrosion, enhanced high resolution imaging of both external and internal corrosion will be developed for specific applications to support life management decisions. This team will build on demonstrated MWM-Array (and MR-MWM-Array) detection capabilities to deliver substantially enhanced characterization of damage and practical means for implementation. Project reporting is publicly available at:http://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=354.

Fuelfinder: Remote Leak Detector for Liquid Hydrocarbons
Contracting Agency: PHMSA, Physical Sciences Inc.
Completed: December 31, 2013
The project goal was to develop a commercially successful Remote Methane Leak Detector platform to a general purpose hydrocarbon leak detector – Fuelfinder™. Fuelfinder will adopt recent advances in room-temperature diode laser technology operating near 3 microns to enable remote sensing of gasoline, petrochemicals, biodiesel, and ethanol leaks from pipelines with man-portable, mobile, and airborne platforms in a low-cost, commercially-viable product offering. Project reporting is publicly available at:
https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=362.

Advanced Learning Algorithms for the Proactive Infrasonic Gas Pipeline Evaluation Network (PIGPEN) Pipeline Encroachment Warning System
Contracting Agency: PHMSA, Physical Sciences Inc.
Completed: June 30, 2014
Physical Sciences Inc., with American Innovations Ltd. and NYSEARCH, are addressing the technology gap of Early Warning Damage Prevention Monitoring Systems, specifically Advanced Development of Algorithms for Detecting Digging Threats and Avoiding Alarms. This research will implement and evaluate self-training algorithms in the Proactive Infrasonic Gas Pipeline Evaluation Network (PIGPEN) autonomous distributed seismic sensor system.

PIGPEN provides real-time warning of unauthorized right-of-way encroachment and excavation activity near a pipeline. Early warning enables a response to the potential intrusion in time to prevent pipeline damage, and thus preclude the additional cost and risk of repairs. The ideal PIGPEN alarm system would activate an intruder notification with 100% reliability and no alarms. The project will enhance reliability by enabling PIGPEN to learn the characteristics of its local environment and optimize its intruder detection algorithms based on learned experience. Field tests are expected to demonstrate better than 97% alarm reliability with few alarms. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=366.

A Quantitative Non-destructive Residual Stress Assessment Tool for Pipelines
Contracting Agency: PHMSA, Generation 2 Materials Technology LLC
Completed: 2014
Mechanical damage, including dents, bends, wrinkles, and other forms, is one of the leading causes of pipeline failures. Mechanically damaged regions act as fatigue crack initiation sites under cyclic loading (present for in-service pipelines). Crack initiation is the first stage of the appearance of fatigue cracking, which becomes much easier to initiate in the presence of damage because of the locally enhanced strain/stress field around the flaw. The damage and residual stresses lower the overall fatigue strength of the steel and its weldments. The size and shape of the flaw actually determines the level of stress necessary for crack initiation and propagation. This research will develop technology for detecting the limits of critical damage severity is essential to mitigating crack initiation and, therefore, mitigating fast crack propagation before failure. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=441.

Consolidated Project Full Scale Testing of Interactive Features for Improved Models
Contracting Agency: PHMSA, Electricore, Inc.
Estimated Completion: 2017
This project, which began in FY 2014, is addressing pipeline crack growth as influenced by complex operational circumstances. Full scale testing, is gathering data on mechanical damage interacting with secondary features – gouges (with cracks and micro-cracks), corrosion, and welds. The primary objectives of the project are to strengthen industry consensus standards and to generate data which will promote new knowledge. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=555

Improving Models to Consider Complex Loadings, Operational Considerations, and Interactive Threats
Contracting Agency: PHMSA, Kiefner Applus RTD
Estimated Completion: 2017
This project will be guidance in the form of decision processes and data needs for identifying and evaluating complex and/or interactive situations. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=557

Threat/Anomaly Mitigation Decision-Making Process
Contracting Agency: PHMSA, Kiefner Applus RTD
Estimated Completion: 2015
The objective of the project is to strengthen related pipeline industry consensus standards by providing enhanced guidance for conducting the technical aspects of a pipeline integrity management program. The work builds on the existing technology for defect assessment. Project reporting is publicly available at:
https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=558

Repair/Replacement Considerations for Pre-Regulation Pipe
Contracting Agency: PHMSA, Kiefner Applus RTD
Estimated Completion: Completed - 2015
This project created guidelines for implementing and executing a pre-regulation pipeline repair/replace program. The guidelines are tailored not only to natural gas transmission pipelines but to the special concerns associated with natural gas distribution pipelines and hazardous liquid pipelines as well. Project reporting is publicly available at:
https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=559

Definition of Geotechnical and Operational Load Effects on Pipeline Anomalies
Contracting Agency: PHMSA, BMT Fleet Technology Limited
Estimated Completion: 2016
The objective of this project is to use the previously validated pipe soil interaction model to develop an engineering tool to define the effects of operational and geotechnical loads on liquid and gas pipeline systems to support decision making regarding threat severity or repair scheduling. This tool would be incorporated in strain based design and assessment to facilitate the consideration of complex loading scenarios inducing significant flexural loads, including pipeline subsidence or lowering, and ground movements inducing lateral pipeline movements. Project reporting is publicly available at:
https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=561

Pipeline Damage Prevention Radar
Contracting Agency: PHMSA, Ball Aerospace & Technologies Corp.
Estimated Completion: 2016
This project will conduct a proof of concept demonstration of airborne Synthetic Aperture Radar (SAR) is proposed to reliably detect excavation damage threats in areas where the pipeline routes may be obscured by dense brush, forest canopy, low cloud cover, smoke, fog, haze, precipitation or low light conditions. SAR is widely used by the DoD for threat detection. Pipeline damage prevention offers a new application where SAR reduces false positives, lessens repeat flight passes and reduces weather related aircraft downtime resulting in operations cost savings. Project reporting is publicly available at:
https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=652

Combined Vibration, Ground Movement, and Pipe Current Detector
Contracting Agency: PHMSA, Operations Technology Development NFP
Estimated Completion: 2018
This project will use a suite of sensors to monitor pipelines and determine if there is unauthorized activity within the right of way. The sensors are discrete point types that can be installed in a small excavation. A vibration sensor and a current sense wire are attached directly to the pipe; a motion sensor is placed in the soil close by. The coincidence of events seen by these devices will help discriminate false positives. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=655

Framework for Verifying and Validating the Performance and Viability of Leak Detection Systems for Liquid and Natural Gas Pipelines
Contracting Agency: PHMSA, C-FER Technologies
Estimated Completion: 2017
This project will develop a Leak Detection Evaluation Framework for verifying and validating leak detection technologies. The framework will include standardized methods to assess the performance of technologies intended to detect small release events (i.e. leaks) and quantitative criteria to rank the performance of these systems over a range of release scenarios. The intent is to identify technologies that would be appropriate for field pilots but will not cover the processes required for the field pilot or operational implementation as these processes are well established in each operating company. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=657

Development of Comprehensive Pressure Test Design Guidelines
Contracting Agency: PHMSA, Kiefner Applus RTD
Estimated Completion: 2017
The project will develop comprehensive guidelines for the design of pressure tests that could be incorporated into industry standards or regulations. The proposed work will draw heavily on industry experience and scientific knowledge from prior research. The guidelines will assure as much as possible that pressure testing is carried out safely and effectively, that testing is performed to a consistent standard of quality, and that all stakeholders can have confidence in the safety of the tested pipeline. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=645

Use of Electromagnetic Sensors to Quantify Strength and Toughness in Steel Pipelines In and Out Of Service
Contracting Agency: PHMSA, Generation 2 Materials Technology LLC.
Estimated Completion: 2017
The project will produce a new nondestructive electromagnetic sensor for assessment of bulk strength and toughness of new and vintage steel pipelines operating in any environment. The strength and toughness of the steel pipelines determined from the electromagnetic system will be linked with other inspection and materials characterization testing to provide improved Integrity Management. At the end of the two-year program, the electromagnetic system will be appropriately commercialized and ready for inspectors to begin offering services to the industry. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=649

Approaches for Preventing Catastrophic Events
Contracting Agency: PHMSA, Gas Technology Institute
Estimated Completion: 2016
The project will present a thorough and critical review of approaches for preventing catastrophic events, both within and outside the natural gas industry, in order to be able to select the most appropriate approach(es) and model(s), develop them further, and ultimately issue guidelines for effective implementation in risk models and integrity management programs. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=638

Paper Study on Risk Tolerance
Contracting Agency: PHMSA, Kiefner Applus RTD
Estimated Completion: 2016
The project will conduct an initial literature search to understand what other regulatory bodies and industries have done to define risk criteria. This information will be supplemented with data gathered from a survey of pipeline industry members about their risk management decision-making process. Together, these activities will identify methods for defining risk criteria and highlighting best practices across the pipeline industry. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=639

Critical Review of Candidate Pipeline Risk Models
Contracting Agency: PHMSA, C-FER Technologies
Estimated Completion: 2016
The project will produce guidelines for developing the next generation of pipeline risk models based on the probabilistic quantitative risk analysis approach. The model development framework will be based on the following:
- A critical review of existing quantitative risk models both in the pipeline and other industries.
- An assessment of the desirable model attributes related to accuracy, verifiability, transparency, practicality and fit within the decision making processes used by both operators and regulators.

Project reporting is publicly available at:
https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=656

Patch and Full-Encirclement Repairs for Through-Wall Defects
Contracting Agency: PHMSA, University of Tulsa
Estimated Completion: 2016
CAAP Project: This project will investigate the effectiveness of patch-style bonded composite repairs of through-wall corrosion defects. Composite repairs of pipeline and pressure equipment are a growing segment of the corrosion mitigation industry and have seen large expansions since the introduction of the technique in the early 1990's. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=564

Wall Break-Through in Composite Repaired Defects
Contracting Agency: PHMSA, University of Tulsa
Estimated Completion: 2016
CAAP Project: This project will study the performance of composite repairs applied over realistic defects. Unique facilities for the investigation of erosion/corrosion at The University of Tulsa will be used to generate internal defects on pipe elbows. These defects will be repaired and then hydrostatically tested to determine failure pressure. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=565

Improved Coatings for Pipelines
Contracting Agency: PHMSA, Texas A&M University
Estimated Completion: 2015
CAAP Project: The research program focuses on using a novel epoxy nanocomposites spray coating technology to prevent corrosion of steel pipelines. A battery of tests will be conducted through collaboration with our industrial partners on test panels: adhesion, water permeability, electrical impedance, scratch resistance, ductility, and accelerated corrosion tests. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=568

Robust Anomaly Matching for ICIPs: Reducing Pipeline Assessment Uncertainty Through 4-Dimension Anomaly Detection and Characterization
Contracting Agency: PHMSA, Colorado School of Mines
Estimated Completion: 2016
CAAP Project: This work will focus on supporting the unique anomaly matching requirements of Integrated Internal Inspection and Cleaning Pigs (ICIPs). The goal is to develop a novel technique for automatic anomaly matching to optimize the accuracy and data processing capabilities of a developed algorithm. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=569

Laser Peening for Preventing Pipe Corrosion and Failure
Contracting Agency: PHMSA, Board of Regents of the University of Nebraska for the University of Nebraska-Lincoln
Estimated Completion: 2016
CAAP Project: The main objective of this project is to develop laser peening of steels used for pipelines to improve corrosion resistance. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=570

Corrosion Under Insulation: Innovative Solutions to Cold Climate Corrosion Challenges
Contracting Agency: PHMSA, University of Alaska Anchorage
Estimated Completion: 2017
CAAP Project: The project will investigate the corrosion properties of carbon manganese steel in bentonite clays and explore opportunities for mitigating Corrosion Under Insulation (CUI) using injectable bentonite inhibitors. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=637

Understanding and Mitigating the Threat of AC Induced Corrosion on Buried Pipelines
Contracting Agency: PHMSA, The University of Akron
Estimated Completion: 2018
CAAP Project: This project will explore new methods for assessing the threat of AC corrosion on buried pipelines. The results from this project will improve indirect inspection methods for assessing the impact of induced AC currents on pipeline corrosion rates and could be used for national and international standards. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=636

Bayesian Network Inference and Information Fusion for Accurate Pipe Strength and Toughness Estimation
Contracting Agency: PHMSA, Arizona State University
Estimated Completion: 2018
CAAP Project: This project will focus specifically on Development of Inspection Tools to Quantify Pipe Strength and Toughness. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=627

An Inorganic Composite Coating for Pipeline Rehabilitation and Corrosion Protection
Contracting Agency: PHMSA, Rutgers, The State University
Estimated Completion: 2017
CAAP Project: This project will address the need for an inorganic coating composite for corrosion protection and rehabilitation of pipeline in aggressive environments. We propose to use nano-modification and fiber reinforcement to improve the performance of coating composite as corrosion barrier and strengthening system for pipeline. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=635

Mitigating Pipeline Corrosion Using A Smart Thermal Spraying Coating System
Contracting Agency: PHMSA, North Dakota State University
Estimated Completion: 2018
CAAP Project: This project will achieve an ultimate and affordable corrosion mitigation solution for onshore pipelines through the advances of smart thermally sprayed coatings. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=634

Chemically Bonded Porcelain Enamel Coated Pipe for Corrosion Protection and Flow Efficiency
Contracting Agency: PHMSA, University of Missouri (The Curators - Rolla)
Estimated Completion: 2018
CAAP Project: This project will explore, develop, and demonstrate electrostatically-applied, chemically-bonded, dense and consistent enamel powder coating for improved corrosion resistance and durability, reduced surface roughness and pressure loss, and increased bond strength of underground steel pipes under combined external pressure, thermal effect, and internal pressure. Project reporting is publicly available at: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=631

PREPAREDNESS

Pre-Spill Baseline Studies

Atlantic Marine Assessment Program for Protected Species (AMAPPS)
Contracting Agency: BOEM, NOAA/NMFS, USFWS, USGS, DoD
Estimated Completion: 2014
BOEM is actively collecting new information about whales, turtles and birds through the on-going AMAPPS to fill data gaps in the distribution, abundance, migration, and habitat of endangered and non-endangered marine species. This multi-agency effort involving BOEM, NOAA, U.S. Geologic Service (USGS), USFWS, and the DoD expands upon previous studies under BOEM's Cetacean and Turtle Assessment Program (CETAP), which helped define critical habitat for protected species in the North Atlantic between North Carolina and Nova Scotia.

The AMAPPS effort includes seasonal vessel and aerial surveys to quantify abundance and distribution of protected species and to produce spatially explicit density distribution maps. The results will support environmental assessments and programs that monitor risk of extinction and recovery of the species detected during the surveys. The results will also provide important input to oil and gas leasing decisions as well as NRDA efforts in the event of an oil spill.

The AMAPPS spatial modeling efforts will be integrated into online or distributed products. In addition, the collected data will be incorporated into modeling efforts in an interactive manner to allow users to develop customized models for times and areas of interest. This effort will build off the Strategic Decision Support System developed jointly by NOAA and Duke University and funded by the USN's Strategic Environmental Research and Development Program (SERDP). Paper products expected to be produced by the project include at a minimum: annual updates to the Atlantic Oce*an and Gulf of Mexico Marine Mammal Stock Assessment Report*, annual reports of survey results, and a peer reviewed journal manuscript describing the model development and results.

Hanna Shoal Ecosystem Study
Contracting Agency: BOEM
Estimated Completion: 2016
This study constitutes a key component of Chukchi Sea environmental studies pertinent to Chukchi Sea oil and gas activity. The highest oil industry interest is in the area just to the south of Hanna Shoal. The BOEM analysts and decision makers will use the information in NEPA analysis and documentation for Lease Sales, EPs and DPPs decision-making in the Chukchi Sea.

Mackenzie River Delta Marine Arctic Ecosystem Study (MARES)
Contracting Agency: BOEM, USARC, USCG, USGS, NOAA, Office of Naval Research, et.al.
Estimated Completion: 2019
The BOEM and National Oceanographic Partnership Program (NOPP) partners awarded a contract for a broad Arctic study that will investigate the interrelationship among the physical, biological, chemical and social science components of the Beaufort Sea ecosystem from Barrow, Alaska, to the Mackenzie River delta in Canadian waters. The overarching goals of the study are to better understand the interrelationship of the physical, biological, chemical, and human systems, including traditional knowledge, of the Beaufort Sea and to advance scientific prediction capabilities for linkages between marine life, human uses, sea ice, atmospheric and oceanic processes and river discharge.

Technological Assessment of Alaskan Arctic Oil Spill Response Temporary Oil Storage Options (Project 1019)
Contracting Agency: BSEE/PCCI
Completed: November 30, 2014
This project conducted an assessment of Alaskan arctic oil spill response temporary storage options for available offshore vessels, onshore storage devices and pumping and transfer systems. This information was compiled into a user friendly Worst Case Discharge (WCD) Scenario tool. This tool was then used to evaluate temporary recovered oil storage capabilities for two Worst Case Discharge (WCD) scenarios. Given user inputs, the tool presented:

- volume of oil spilled by day
- running cumulative volume of spilled oil
- volume of oil removed by weathering
- volume of water uptake into an emulsion
- additional volume of free water collected by skimming
- percentage of free water removed by decanting
- percentage of total volume recovered mechanically, which was then used to determine adequacy of available temporary oil storage capacity.

Inventory of Gulf of Mexico ecosystem indicators using an ecological resilience framework
Contracting Agency: NOAA RESTORE Act Science Program, NatureServe
Estimated Completion: 2017
This research will evaluate ecosystem indicators collected by existing monitoring programs, assess their strengths and weaknesses, and make recommendations for a set of scientifically rigorous, practical, and cost-effective indicators for five key habitats (salt marsh, mangrove, seagrass, oyster beds/reefs, and coral reefs) across the Gulf of Mexico. This contract was awarded in August, 2015.

Ecosystem modeling efforts in the Gulf of Mexico: current status and future needs to address management and restoration activities
Contracting Agency: NOAA RESTORE Act Science Program, Texas A&M University Corpus Christi
Estimated Completion: 2017
The research team will work with resource managers and other researchers to test and align ecosystem models with management needs and restoration activities in the Gulf of Mexico. This contract was awarded in August, 2015.

Defining abnormal events of oceanographic, biological, and physical properties in the Gulf of Mexico to identify data gaps
Contracting Agency: NOAA RESTORE Act Science Program, The University of Southern Mississippi
Estimated Completion: 2017
This research will use archived satellite ocean observations, ocean circulation models, and existing fish and nekton sampling datasets to identify ecological active regions in the Gulf of Mexico and gaps in current oceanographic data collection. This contract was awarded in August, 2015.

Cooperative monitoring program for spawning aggregations in the Gulf of Mexico: an assessment of existing information, data gaps and research priorities
Contracting Agency: NOAA RESTORE Act Science Program, The University of Texas at Austin
Estimated Completion: 2017
The research team will work with a diverse group of experts from academia, federal and state government, and nongovernmental organizations to compile and evaluate existing information of fish spawning aggregations in the Gulf of Mexico to inform the conservation and management of the region's fisheries. This contract was awarded in August, 2015.

The central role of the Mississippi River and its delta in the oceanography and ecology of the Gulf of Mexico large marine ecosystem
Contracting Agency: NOAA RESTORE Act Science Program, Louisiana Universities Marine Consortium
Estimated Completion: 2017
This research will investigate the influence of the Mississippi River and its delta on the oceanography, ecology, and economy of the Gulf of Mexico and identify the additional data collection and modeling necessary for managers to better monitor and manage the Gulf's natural resources. This contract was awarded in August, 2015.

Improving Arctic baseline information
Contracting Agency: NOAA/ORR/ERD
Estimated Completion: On-going
Develop and implement plan for collaborative Arctic baseline studies and food security risk assessments, including determination of background PAH levels in the environment, marine mammal tissue archiving and analysis, and establishment of food consumption risk framework. This on-going effort will use opportunities to collaborate with Industry, the National Centers for Coastal Ocean Science, and the National Marine Fisheries Service for sampling and outreach.

Coastal Land Ocean Interactions in the Arctic (Arctic – COLORS)
Contracting Agency: NASA
Completed: September 2015
Arctic-COLORS is a Field Campaign Scoping Study funded by NASA's Ocean Biology and Biogeochemistry Program. The study's overarching objective is to better understand the impact of climate change on land-ocean processes in the Arctic Ocean and its effect on coastal ocean biology, biogeochemistry, and biodiversity. The study scoped a possible field campaign to establish baselines to assess the impacts of future changes on coastal ecosystems and biogeochemistry.

Response Management Systems

Special Monitoring of Applied Response Technologies (SMART) Protocol Enhancement (Project 1020)
Contracting Agency: BSEE/USCG RDC
Completed: October 27, 2014
The purpose of this project was to validate recent recommendations intended to improve the SMART Protocol's effectiveness, and recommend and pursue improvements to the SMART Protocol. The SMART program objectives and how the program has been used in recent spill response events were reviewed. This data was used to assess areas where the Protocol meets the program's goals, and identify areas where improvements could be made. This information was summarized in "Modernization of Special Monitoring of Applied Response Technologies (SMART) Technology and Methods - 2014" which documents the SMART program goals in spill response, discusses where the current SMART Protocol succeeds in meeting program goals, and where improvements can be made, and provides a review and assessment of potential value of new technologies that could be used to improve the SMART Protocol.

Software Development in Support of Preparedness Activities Regulated by BSEE (Project 1062)
Contracting Agency: BSEE with NOAA/NOS/ORR/ERD
Estimated Completion: February 12, 2017
This Intra-Agency Agreement establishes an agreement between the DOI BSEE, and the DOC, NOAA, Office of Response and Restoration, Emergency Response Division. (NOAA/NOS/ORR/ERD) through which NOAA will conduct software development activities to support preparedness activities regulated by BSEE. The goal of this interagency agreement is to support two activities:
1. Develop and implement a methodology for capturing existing Geographic Response Plan (GRP) and/or Area Contingency Plan resource protection data into a format that can be ingested into GIS systems, such as the Environmental Response Management Application (ERMA), and
2. Transition existing Response Operations Calculator into an open source web tool that can be more readily accessed by potential users and linked into potential future systems.

Effective Recovery System Potential (ERSP) Calculator Refinements
Contracting Agency: BSEE/Genwest Systems, Inc.
Estimated Completion: On-going
The ERSP Calculator was developed with the intent of reinforcing incentives for creating and acquiring more effective oil recovery systems. This project is an on-going effort to refine the current ERSP calculator for evaluating the potential of an advancing oil spill skimming systems to meet various regulatory planning requirements. The calculator is a tool that enables users to

explore how to configure a skimming system to best encounter, recover, store, and offload oil more efficiently. The project also is evaluating the possibility of expanding the calculator to evaluate in situ burning and dispersant systems.

Emergency Response Exercise Best Practices (Project 1055)
Contracting Agency: BSEE/PCCI
Completed: May 2015
PCCI, Inc. identified best practices, innovative approaches, and new concepts for designing, conducting, and evaluating oil spill exercises. All categories of exercises included in the Draft Updated January 2014 NPREP Guidelines were included in this study, with particular emphasis on notification exercises, announced and un-announced exercises, and equipment deployment exercises.
Task 1. Conduct literature searches and solicit input from oil spill professionals
PCCI reviewed published literature and reports on oil spill exercises, including NPREP exercises, to identify best practices as well as opportunities for improvements in exercise, design, execution, and evaluation.
Task 2. Identify and assess well-organized emergency response exercise programs
PCCI reviewed select government, industry emergency exercise programs to identify best practices with application to the design, conduct, and evaluation of NPREP exercises.
Task 3. Identify Innovative Exercise Design Features and Approaches
PCCI took a creative, new look at how exercises are designed.
Task 4. Identify innovative ways to conduct exercises
PCCI reviewed and identified innovative methods for conducting exercises that could more closely simulate the organizational, operational and technical problems, conflicts, social media, and other challenges that typically occur in large or complex oil spill events.
Task 5. Opportunities for improvement in Exercise Evaluation
PCCI explored ways to provide valuable training to the exercise players during the evaluation process.

Review of ASTM Standards for Oil Spill Response Equipment (Project 1024)
Contracting Agency: BSEE/SL Ross
Completed: February 16, 2015
This project reviewed currently existing applicable ASTM F20 "Committee on Hazardous Substances and Oil Spill Response standards" to determine those that may be applicable to assist in BSEE's regulatory mandate. Suggestions were made to the ASTM committee to modify standards where appropriate. In addition, new standards were initiated and spearheaded though the ASTM committee workgroups. These new standards will continue to move through the ASTM approval process.

Tagging of Oil Under Ice for Future Recovery (Project 1051)
Contracting Agency: BSEE/URS Group, Inc
Estimated Completion: September 2015
The goal of this project is to develop innovative, cost effective, and robust tagging devices and an automatic tracking system for use in tracking spilled oil under, or encapsulated within ice. This will be accomplished via the following key novel developments:

1. Implementing an innovative, multi-faceted pinging lamb wave communication system to use in an underwater acoustic identification (UWID) tag.

2. Develop a commercial off-the-shelf (COTS)-based GPS/satellite transponder with a lamb wave detector tag that is ruggedized for the Arctic environment and for a variety of deployment options including air drops.
3. Adaptive power management algorithms in conjunction with interfaced sensors to automatically stay dormant, when needed, to conserve power.
4. Employ an adaptive system level approach, along with an innovative packaging, material and coating design that will mitigate the adverse effects of snow buildup and ice formation on the wireless links.

Geo-Referencing Identification (GRID) Tag (Project 1050)
Contracting Agency: BSEE/URS Group, Inc
Estimated Completion: September 2015
The goal of this project is to develop a small, cost-effective and robust Geo-Referencing Identification (GRID) technology package to tag and automatically track equipment and assets in real time. This will be accomplished via the following key development issues:

1. Develop the device architecture for deployment such that low cost mesh radio-frequency identification (RFID) tags communicate in groups with just a few satellite/GPS modules;
2. Modify existing lower-cost commercial off-the-shelf active RFID tags to survive harsher conditions with the goal of subzero temperatures, seawater and prolonged deployment to provide more effective global tracking tags;
3. Adapt power management firmware and integrate additional sensors combined with intelligent algorithms with the goal to extend battery life by 25% compared to existing tags for all devices in the system;
4. Employ an adaptive system level approach, along with a novel GRID packaging design, to mitigate the adverse effects of snow buildup and ice formation on the wireless links; and
5. Integrate and confirm software to allow the system to stay dormant and conserve power; this could be accomplished via either user requests or automatically.

4203 Robot Capability Requirements and Alternatives for National Strike Force Response Support
Contracting Agency: RDC
Estimated Completion: 2017
The objectives/ scope of this project have evolved over the course of the project, which began in January of 2015. The National Strike Force (NSF) requested assistance in finding or developing a robot with a particular set of response capabilities. The current objective is to conduct market research to seek / test Commercial Off-the-Shelf technology and evaluate whether the needs articulated by the NSF can be met by existing technology. If no such technology exists, there is discussion about seeking alternative opportunities to develop capabilities. The project is expected to run through FY17.

2016-23 Shale Oil & Gas Preparedness and Response
Contracting Agency: RDC
Estimated Completion: 2017
The objective of this project is to develop an assessment characterizing the behavior of shale oil and the chemical composition of Shale Gas Extraction Wastewater (SGEWW), which could then serve as guidance to shape response policy and FOSC actions. The project is new as of FY16 and has been allocated funding through a partnership with the EPA's Great Lakes Restoration Initiative (GLRI).

Developing a Capabilities-Based Framework for Designing and Evaluating Oil Spill Response Exercises (Project 1048)
Contracting Agency: BSEE/George Washington University
Estimated Completion: March 2016
The objective of this project is to develop a framework that identifies capabilities critical to marine oil spill response readiness, and maps them to the design concepts and evaluation techniques for each capability within an exercise. GWU will research existing literature and couple that with their experience in other industries to develop a set of capabilities, exercise design concepts and evaluation techniques. GWU will observe four oil spill response exercises to collect data for analysis using Atlas.ti software. This information will be used to identify measureable elements within an exercise that demonstrates a capability. The final report will provide guidelines for using the framework to design and evaluate oil spill response exercises to ensure that each exercise is effective in testing and improving oil spill response readiness.

Leveraging Offshore Hydrocarbon Risk Assessment Models and Datasets to Support the Evaluation and Ranking of Worst Case Discharge Scenarios (Project 1046)
Contracting Agency: BSEE/National Energy Technology Laboratory (NETL)
Estimated Completion: September 2016
The objective of this effort is to develop a set of methodologies and algorithms, and a computer model for the comparison and ranking of different spill scenarios to determine which one has the greater potential for damage to the environment or result in other significant impacts, and should be classified as the worst case discharge scenario.
The model enhancement and testing for simulating various oil discharge scenarios are complete. The project team has completed all Gulf of Mexico simulations on the various NETL, Pacific Northwest National Laboratories (PNNL), and NOAA models to verify functionality. Simulations for Gulf of Alaska, Puget Sound, and Southern California are on-going. Efforts continue to apply additional datasets and user inputs to transition the software from a blowout model to a response planning tool.

Regulatory Application of Real-Time Monitoring
Contracting Agency: BSEE
Estimated Completion: 2016
This study is to explore how real-time monitoring technology can improve offshore drilling, workover, completion and production safety operations; and the implication that technology has BSEE's regulatory and oversight roles.

Responding to Oil Spills in Arctic Marine Environments
Contracting Agency: USARC, NOAA, USCG, BOEM, and BSEE
Completed: March 2014
The National Research Council Ocean Studies Board was tasked by five Interagency Committee agencies and three other organizations to assess the current state of science and engineering regarding oil spill response and environmental assessment in the Arctic region (with a specific focus on the Bering Strait and north), with emphasis on potential impacts in U.S. waters. As part of its report, the NRC-appointed committee assessed existing decision tools and approaches that utilize a variety of spill response technologies under the types of conditions and spill scenarios encountered at high latitudes. The report reviewed new and on-going research activities (in both the public and private sectors), identify opportunities and constraints for advancing oil spill research, describe promising new concepts and technologies for improving the response, including containment (surface and subsurface) approaches to reduce spill volume and/or spatial

extent, and recommend strategies to advance research and address information gaps. The committee also assessed the types of baselines needed in the near-term for monitoring the impacts of an oil spill and for developing plans for recovery and restoration following an oil spill in U.S. or international waters where a spill could potentially impact U.S. natural resources. http://dels.nas.edu/Study-In-Progress/Responding-Spills-Arctic/DELS-OSB-09-02

Advanced Oil Spill Response in Ice Training Course
Contracting Agency: CRREL/Alaska Clean Seas
Completed: January 2015
The advanced oil spill response in ice training course was held at the Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, NH. The course included both classroom and hands-on instruction to provide students with the opportunity to practice tactics for use in oil spill detection, containment, and recovery to include in situ burning with and without herders.

OCIO-managed DWH Institutional Repository
Contracting Agency: NOAA CIO
Estimated Completion: On-going
NOAA's Office of Chief Information Officer (OCIO) partnered with the National Technical Information Service (NTIS) to develop the Deepwater Horizon Institutional Repository (DWH-IR), which serves as a searchable, online index of thousands of publicly cleared DWH files located across NOAA data centers, Line Offices, libraries and websites. The DWH-IR is the result of NOAA's need to ensure the agency's DWH data and information is preserved, available and easily accessible through a single site; http://noaa.ntis.gov. The Institutional Repository Technology provides several benefits:

- Offers a cloud-based solution to host and disseminate data and information
- Promotes shared services across agencies and the federal landscape
- Reduces cost and effort associated with: hosting and maintaining multiple, redundant web sites, managing NOAA records, publishing Freedom of Information Act (FOIA) records, responding to eDiscovery requests
- Serves as a data and information management model for real-time use during future response and restoration efforts

Mobile Asset Tracking and Reporting during Incident if National Significance (IONS)
Contracting Agency: USCG/RDC
Estimated Completion: January, 2017
The objective of this project is to develop a flexible ad hoc interoperable communication/information system to enhance the USCG's ability to respond to Incidents of National Significance (IONS). Specifically, this effort will prototype a flexible interoperable communication/information system, processes, and procedures to enhance the USCG's ability to transfer information that will assist personnel responding to an IONS (e.g., oil spill). The system, processes, and procedures should make use of the equipment the responders are expected to bring to the incident such as smart phones, tablet computers, and laptops

At this time, mobile asset tracking systems have been developed for multiple mobile platforms. Called the Portable Handheld Next-Generation Incident Command System (PHINICS) it can be used on digital telephones, laptops, and tablets including Apple iOS devices. It will also be integrated with the Incident Action Plan (IAP) software recently procured by the USCG.

RESPONSE

Structural Damage Assessment and Salvage

Remediation of Underwater Legacy Environmental Threats (RULET)
Contracting Agency: NOAA/ORR/Emergency Response Division (ERD), NOAA Office of National Marine Sanctuaries
Estimated Completion: Publications are completed, support is on-going
During the reporting period, two wreck reports were updated, and four more are pending update based on changes in their status or survey information. Per a 2010 congressional appropriation, NOAA performed an assessment of the most significant potentially polluting wrecks in U.S. waters and provided a national report and 87 individual wreck risk assessments to the USCG. The report details the risk assessment process NOAA used to review the 20,000 wrecks in U.S. waters and provide a multidisciplinary assessment of the physical integrity, pollution potential for impacts to socio-economic and ecological resources. NOAA recommended in May 2013, that USCG consider in-water assessments and potential pollution recovery on 17 vessels. Currently, NOAA will continue to provide support to USCG districts and sectors incorporating this information into area contingency plans, as well as provide or facilitate surveys of opportunity where possible. As USCG units move forward with assessment and recovery activities, NOAA engagement continues with typical scientific support as well as support regarding the reevaluation of information in the individual RULET wreck risk assessments as surveys of opportunity occurs, new technical or historical information comes to light.

At Source Control and Containment

Capping Stack Technology Requirements
Contracting Agency: BSEE
Estimated Completion: 2015
This study aims to determine the state-of-the-art of Capping Stack technologies with the potential to increase safety during Outer Continental shelf drilling, well completion, well workover and production operations. The assessment will determine the differences between capping stacks currently in use by industry in the Gulf of Mexico, Alaska and overseas. This study will also conduct an assessment of the current capping stack standards, compile a list of usable Potential Incidents of Non Compliance (PINC) and provide criteria and guidelines for design, manufacture, maintenance, and inspection of Capping Stacks.

Oil Boom Biofouling Control by Mechanical Intervention and Material Technologies
Contracting Agency: USN's Environmental Sustainability Development to Integration (0817 NESDI) /NSWC Carderock
Estimated Completion: 2016
This project explores the use of a novel integrated coating to enhance boom performance with regard to the ease of cleaning beyond the rate fouling. The flexible, silicone-based coating (ClearSignal™) has been optimized for the long-term deployment of oceanographic instrument platforms such as offshore buoys and autonomous glider-like vessels used to collect data. The energy and effort to clean ClearSignal has been shown to be 1/10 or less of that needed to clean an untreated substrate, with the cleaned flexible material returning to its unfolded pristine condition.

Prototype sections of ClearSignal-coated boom will be fabricated and deployed with baseline boom material at three locations. These planned test sites are Port Canaveral Florida as managed by Florida Institute of Technology (FIT); Port Hueneme, California; and Indian Island, Washington. In some cases, booms will be subjected to cleaning as part of a test and evaluation protocol developed by Naval Surface Warfare Center Carderock (NSWCCD) and Severn Marine Technologies. In-water cleaning will be accomplished with powered tools such as rotary brushes and/or medium-high pressure water-jets. The rate of biofouling accumulation and time to clean will be compared to uncoated booms.

Concurrent with the in-water testing, refinements will be implemented as needed into the coating process and cleaning tools for the full commercial development of ClearSignal coated booms. Port Hueneme and Indian Island are active USN port facilities and FIT/Port Canaveral is a USN recognized corrosion and biofouling test-site. All combined, these sites should provide a good balance of practical field experience and research test rigor. It is anticipated that use of coated oil containments boom will result in a savings of 25 percent in material costs and a 70 percent reduction in maintenance costs.

Chemical and Physical Behavior Modeling

Development of Crude Oil Simulants to Mimic the Behavior of Oil Droplets in Seawater
Contracting Agency: BSEE/EPA
Estimated Completion: November 2017
The objective of this project is to develop a Crude Oil Simulant (COS) that advances the spill response and scientific community's understanding of the behavior and transport of oil plumes and floating slicks in aquatic environments. Materials currently used to simulate crude oil behavior in water are actually surrogates for slick, and not plume behavior (e.g., coffee beans, dog food, peat moss, oranges). This work represents a fundamental paradigm shift where the developed COS mimic's oil behavior within a plume, even at dilute concentrations. Phase One of this project demonstrated that (1) a COS can be fabricated using non-reactive fluorescent dye encapsulated within quasi-transparent core shells at the nanometer size range using synthesis techniques that are readily scalable from bench to industrial production, (2) the optically-active COS particles can be detected at dilute concentrations in artificial seawater due to their high fluorescent signature using commercial off-the-shelf (COTS) spill response fluorometers and (3) "Tuning" of the COS using innovative synthesis techniques allows flexibility in creating behaviors ranging from floating to sinking in the water column; The EPA is pursuing a patent for this technological approach and the period of performance has been extended to develop larger particles (micron-scale) in monodispersed and polydispersed batches to further the development and the Technology Readiness Level (TRL) of the oil simulant.

The goal is to do that without the risk of harming the environment and associated ecosystems. In order to do that, a means to conduct experiments with oil simulants that mimic the behavior of dispersed oil in the natural environment is needed. Experiments using materials that behave like oil but are environmentally benign would enable field testing without requiring rigorous permitting. This project will address these issues by: (1) Fabricating environmentally benign, optically active particles that simulate oil droplets in the water column using synthesis techniques that are readily scalable from bench to industrial production; (2) "Tuning" the oil simulant using innovative synthesis technique to allow flexibility in creating behaviors ranging from floating to sinking in the water column; (3) Detecting the oil simulant under dilute

concentrations due to the high fluorescent signature of the oil simulant; and (4) Verifying the oil simulant behavior using commercial off-the-shelf (COTS) response tools, such as fluorometers and particle size analyzers. The EPA is pursuing a patent for this technological approach and the period of performance has been extended to develop larger particles to further the development and the Technology Readiness Level (TRL) of the oil simulant.

Diluted bitumen oil biodegradation and toxicity
Contracting Agency: EPA ORD NRMRL
Estimated Completion: 2016
The production and shipping of emerging crude oils has increased substantially in the past 5 years. In turn this causes increased risk to ecosystems and communities for potential spills. One type of emerging crude, bitumen, poses unique problems for spill response and remediation options. This is due to its high viscosity, which requires dilution prior to transport. Dilution with condensate, diluent or synthetic oil produces 'diluted' and 'synthetic' bitumen (dilbit and synbit, respectively). Hence the chemical nature of the bitumen various widely, thus evaluating degradation rates, fate and transport models and toxicity is challenging. This project aimed at providing biodegradation rates for 2 types of diluted bitumen (Cold Lake and Western Access Blends) for freshwater microbial cultures collected from the Kalamazoo River and Gulf of Mexico seawater cultures at two temperatures. Metagenomic sequencing of the contrasting cultures will provide for information on the key oil degraders present in these waters.

Toxicity and oil concentrations were also evaluated. Both fresh and salt water species (fish and invertebrates) were used in the toxicity studies, with two types of bitumen oil. The toxicity tests used the standard effluent slow stir WAF (Water Accommodating Fraction) for fresh and salt water, with range finder tests conducted to bracket concentration ranges. Chemical analyses (TPH – total petroleum Hydrocarbons) for each test were evaluated. Acute toxicity for lethality and chronic toxicity for sublethal effects were evaluated. Results will inform transport modeling efforts by NRMRL in Ada, Oklahoma for the 2010 bitumen spill in the Kalamazoo River.

GNOME2/ADIOS 3
Contracting Agency: NOAA/ORR/ERD
Estimated Completion: 2016
The General NOAA Operational Model (GNOME) has been rewritten to account for new 3D functionality, ensuring better support of chemical spills and subsurface oil releases, and better interaction with external data sources and GIS systems. The new model will include oil property data and integrate weathering algorithms from the Automated Data Inquiry for Oil Spills (ADIOS3) model. Subsea release and oil-in-ice elements are in development for the final GNOME 2 release. The new model will primarily be available as a web application, but also able to run off-line in a scripting mode, or as a platform independent stand-alone application. New visualization capabilities will result in improved trajectory products for planning and the Unified Command.

GNOME2 is being designed as a piece within a larger risk assessment framework for future tool development in order to ensure cohesive development of future risk assessment tools. Following recommendations of the Ocean.us Data Management and Access Committee (DMAC), the GNOME2 can fully access datasets available via OPeNDAP. The code is being developed as a fully open-source application to allow review and contributions from others.

GNOME Online Oceanographic Data Server (GOODS)
Contracting Agency: NOAA/ORR/ERD
Estimated Completion: On-Going
Over the last few years, ERD has been developing an online tool to allow users of the transport model GNOME to easily utilize model output or observational data from external sources. The GNOME Online Oceanographic Data Server or "GOODS" website provides access to base maps, ocean currents, and winds from various models and data sources. GOODS allows users to select model data in their specific region of interest and download it in a format that can be read directly into GNOME. After being used successfully in-house for several years, in early 2012, GOODS was made publicly available at http://gnome.orr.noaa.gov/goods. Since then, ERD has received positive feedback from a diverse group of international GNOME users from within NOAA and other government agencies, the academic community and industry, with applications ranging from research to planning and emergency response.

ADIOS3
Contracting Agency: NOAA/ORR/ERD
Estimated Completion: On-going
ADIOS is an oil weathering response tool for emergency spill responders and contingency planners. The program integrates a library of oil properties with a short-term oil fate and cleanup model to estimate the amount of time that spilled oil will remain in the marine environment, and to develop cleanup strategies. ADIOS provides weathering information to NOAA's oil spill trajectory program, GNOME2. ADIOS3 builds on previous versions of ADIOS and includes new algorithms for biodegradation and sedimentation as well as technology upgrades to include a web interface.

Arctic Trajectory Analysis Planner (Arctic TAP)
Contracting Agency: NOAA/ORR/ERD supported by NFWF
Estimated Completion: October 2016
The Trajectory Analysis Planner (TAP) is superior to traditional oil spill trajectory models when the user doesn't know when or where a spill could occur and for providing extended response outlook beyond the certainty of weather forecasts in a specific incident. NOAA has developed the Trajectory Analysis Planner (TAP) incorporates historic weather and currents for developed TAP areas to explore a wide range of possibilities. Using funding from the National Fish and Wildlife Federation, NOAA ORR/ERD is developing a TAP geographic instance for the Alaskan Arctic. When complete, it will allow the user to set numerous options such as the location, amount, and type of oil that might be spilled and a level of concern. The user can then view maps that show probabilities of where oil could go, maps of how quickly oil can impact sensitive receptor sites, and maps of where oil could come from to impact a site.

The Roles of Gas Hydrates During the Release and Transport of Well Fluids into Deep Ocean
Contracting Agency: BSEE
Estimated Completion: 2014
The objective of this project is to use existing, novel equipment for obtaining fundamental, crosscutting chemical, physical, and hydrodynamic information on fluids that could be released and transported from deep, subsea hydrocarbon reservoirs and inadvertently released into a deepwater environment. Specifically, the research will use the resulting fundamental information in numerical, thermodynamic, and plume models to comprehensively describe potential roles and impacts of gas hydrates in such a scenario. The goal is to have a comprehensive understanding of the formation and stability of simple and complex hydrates

under deepwater conditions; the stability of hydrates and their interaction with hydrocarbon fluids at or near the point of release into deep water and at longer times as they are transported away from the point of release into the seawater column; and the impact of dispersants and anti-agglomerates on the fate and interaction of hydrates near the point of release and during transport in the seawater column.

Heavy Viscous Oil PVT (08121-2201-01)
Contracting Agency: DOE, Schlumberger
Completed: November 2014
The objectives of this work were to evaluate current practices in viscosity measurements, correlations, and models of heavy, viscous oil, to include experimental validation of the models; develop best practices of sample handing and laboratory measurement methods; study the impact of solvent and commingling of different fluids on viscosity change and asphaltenes instability, including examination of the existing models and mixing rules in handling the property change; and report on conditions in which multiple phases exist.

Oil Spill Detection and Surveillance

Detection of Oil within the Water Column
Contracting Agency: USCG RDC
Completed: July 30, 2014
The current spill technology is limited in its ability to accurately detect and mitigate subsurface oil within the water column down to 10,000 feet. The first objective of this project was to develop a technology that was capable of detecting and tracking oil along a water column down to a depth of 200 feet. The minimum requirements for the proposed technology were to operate in all environmental conditions and to locate and mark subsurface oil; this will aid decision-makers in formulating the most feasible approach to mitigate or remove the oil. In addition, the final product should have sufficient resolution for detecting small droplets of oil. The proposed technology should also have the ability to be efficiently used near shore and in rivers.

A Broad Agency Announcement (BAA) was issued in 2011 and three contracts were awarded in 2012 to perform analysis and designs for systems to detect oil. Two follow-on contracts for a sonar system and a system that uses a compact multi-angle scattering instrument were funded to develop prototypes. The prototypes were tested at Ohmsett in December 2013 with useful results. There were numerous lessons learned and Ohmsett was able to develop a novel oil release mechanism to create subsurface oil plumes that can be used for future projects.

Assessment of USCG Aviation Force's Capability for Airborne Oil Spill Remote Sensing and Reporting (Project 1060)
Contracting Agency: BSEE /USCG RDC (project 7609)
Estimated Completion: July 1, 2016
The objective of this project is to provide data that documents the capabilities of organic USCG airborne sensors to detect, map, and report oil spills. Specifically, this effort will:

- Conduct a comprehensive review of current USCG airborne sensor oil spill detecting, mapping, and reporting abilities.
- Review USCG aviation efforts involved with Deepwater Horizon Response spill surveillance.

- Evaluate current state of USCG airborne sensor data dissemination and near-term improvements, including the Minotaur Mission System and shift from INMARSAT voice to INMARSAT data.
- Perform in-flight evaluations on current USCG airborne sensor systems.
- Provide recommendations for future sensor requirements.
- Provide comprehensive data on available USCG capabilities and recommended use including assessment of oil thickness mapping.

During the week of May 18-24, 2015 the test team completed a soft test of all data acquisition equipment onboard the HC130J and executed the Field Test in Santa Barbara, CA. Approximately 210 GB of image, video, geolocation, environmental, and other data were collected from the primary data sources during the course of the exercise along with physical samples of the imaged oil.

CORN (Coordinated Oil-spill Response Network)
Contracting Agency: BSEE
Completed: December 5, 2013
The objective of this project was to develop a Coordinated Oil-spill Response Network (CORN) that will benefit response command centers by enabling them to provide clear mission profiles to vessels, share up-to-date oil spill/response information, collect field data for input into models used to reflect and predict conditions, and maintain and distribute a Common Operational Picture across all participants. It will provide real-time views of operational areas, and be electronically overlaid with routes, contamination/hazard areas, navigational aids, and other responders and vessels locations. Additionally, it will provide vessel operators with a computer-enhanced navigational system, Augmented Reality (AR). Augmented Reality enables vessel responders to see where transit routes, skim zones, other vessels, and other relevant objects are regardless of visibility.

Evaluation of Oil Fluorescence Characteristics to Improve Forensic Response Tools
Contracting Agency: BSEE & EPA
Estimated Completion: 2015
The objective of this project is to translate oil fluorescence Research & Development into operational tools for spill response, which will be highlighted by three specific goals. The first is to generate a comprehensive Excitation Emission Matrix Spectroscopy (EEMS) database, building upon existing data to provide fluorescence peak information as a function of oil type, weathering state, concentration and Dispersant-to-Oil Ratios (DORs). The second is to examine the database using advanced statistical methods and models to identify wavelengths best suited for oil monitoring during dispersant application and degradation. The third is to conduct wave tank experiments to determine submersible sensors capable of providing data comparable to scanning and/or fixed wavelength laboratory fluorometers for rapid deployment during response efforts.

Enhanced Oil Spill Detection Sensors in Low-light Environments (Project 1013)
Contracting Agency: BSEE & U.S. Army
Estimated Completion: **June** 2016
The goal of this collaborative effort is to enhance the methods currently in place to detect oil in a marine environment. The methods currently in place are not conducive to oil spill recovery operations during periods of low light and rely heavily on time-delayed aerial remote sensing technologies or visual observation. This project will leverage the knowledge and expertise of the

Army's Research, Development, and Engineering Command's Night Vision and Electronic Sensors Directorate (NVESD) personnel to assist BSEE in the identification and documentation of existing capability gaps; identification and assessment of technology gaps; test and evaluate potential new or alternative hardware; and, if necessary, support the design, development and demonstration of new technologies to meet identified needs.
Army NVESD will also perform preliminary design of aerial vehicle options (manned vs unmanned) for the demonstration in May 2017 International Oil Spill Conference (IOSC) with suitable sensors and data handling options for both. Sensor and data transmission capabilities tradeoffs will be based upon aircraft flight requirements and payloads. The task culminates with a preliminary design report and decision brief in March 2016 with decision to pursue potential follow on effort.

Oil Leak Detections with a Combined Fluorescence Polarization Instrument and a Wide Band MultiBeam Sonar (Project 1039)
Contracting Agency: BSEE / EIC Laboratories, Inc. and Norbit US, Ltd.
Estimated Completion: December 2015
This project will develop and test a prototype sensor that integrates two partial solutions (fluorescence and sonar) with a goal of operating at a suitable standoff distance and interrogating a wide area, while providing real-time data feed from the subsea environment. The project will be conducted in two phases.

Phase 1 objectives:

1. Enhance the long range detection capability of the fluorescence polarization sensor
2. Develop a mounting scheme for the two sensors so that the field of view of the sensors overlap
3. Develop a firmware/software that will integrate the data from the two sensors with accurate time tagging.

Phase 2 objectives:

1. Evaluate the performance of the combined sensors in open-water using oil simulants

Distributed Chemical Sensing for Sub-surface Oil Spill Sensing (Project 1040)
Contracting Agency: BSEE / University of Houston
Estimated Completion: December 2016
The objective of this project is to develop distributed chemical sensing by integrating plasmonic nanostructures, multi-modal spectroscopic sensing, and optical fiber technology, with the ultimate goal toward real-time leak quantification appropriate for subsea pipeline monitoring. This project will develop a small-scale mock-up instrument that will be tested in the laboratory and at Ohmsett.

Two important design parameters for nano porous gold disks (NPGD) were investigated: underlying gold layer thickness and etch depth into the NPG film. A systematic study of the influence of these parameters on Surface-enhanced Raman spectroscopy (SERS) activity of NPGDs has been conducted. The results have shown that the existence of a continuous gold under-layer significantly increases the performance of NPGDs.

HC-Sentinel: An AUV Glider for High Endurance Subsea Hydrocarbon Detection (Project 1041)
Contracting Agency: BSEE / Woods Hole Oceanographic Institution
Estimated Completion: September 2016
The objective of this project is to develop and test a next generation in-situ mass spectrometer payload that operates on an autonomous underwater vehicle (AUV) glider for real-time subsea hydrocarbon detection and classification. The system will be designed to operate for long-term subsea inspection, monitoring, and incident response. The project will be comprised of six main elements:

1. Construction of the HC-Sentinel hydrocarbon mass spectrometer.
2. Modification of a Slocum glider payload bay to accommodate the HC-Sentinel.
3. Calibration of the payload instrument system.
4. Development of goal-directed mission executive and rules-based expert system to adaptively survey areas of interest.
5. Sea trials in Buzzards Bay, Massachusetts.
6. Demonstration operations at a naturally occurring seafloor petroleum seep site.

Development of acoustic methods to measure oil droplet size and slick thickness on ROV and AUV platforms (Project 1065)
Contracting Agency: BSEE / Applied Research Associates (ARA), Inc.
Estimated Completion: September 2016
The objective of this project is to develop and test acoustic techniques and sensors mounted in free-swimming platforms [Remotely Operated Vehicles (ROVs) and/or Autonomous Underwater Vehicles (AUVs)] for field applications to measure: (a) slick thickness on the surface of the water, and/or (b) oil droplet size distribution at the well head for subsurface releases of crude oil and dispersants in the presence of natural gas.

Oil Spill Detection and Mapping under Arctic Sea Ice using Autonomous Underwater Vehicles (AUV)(Project 1000)
Contracting Agency: BSEE/Woods Hole Oceanographic Institution
Completed: **August 30,** 2014
The goal of this project was to evaluate and develop an AUV-based system for detection and mapping of oil in ice-infested waters from below the water and/or ice. Extensive laboratory ice-tank tests were be conducted to evaluate each candidate sensor package to develop a sensor suite capable of detecting and quantifying the thickness of oil, and suitable for deployment via an AUV. An AUV mission strategy to efficiently map the distribution of oil under complex sea ice terrain, and in the variety of ice conditions found in U.S. Arctic coastal waters, was also developed. The mapping capability of the system was tested at Lake Michigan and off the USCGC HEALEY in Alaska. Sensor package capabilities including communication of large volumes of data were tested off the Alaska North Slope.

Geo-Referencing Identification (GRID) Tag (Project 1050)
Contracting Agency: BSEE/AECOM, Inc (formerly URS)
Completed: September 24, 2015
The goal of this project is to develop a small, cost-effective and robust Geo-Referencing Identification (GRID) technology package to tag and automatically track equipment and assets in real time. This will be accomplished via the following key development issues:

1. Develop the device architecture for deployment such that low cost mesh radio-frequency identification (RFID) tags communicate in groups with just a few satellite/GPS modules;
2. Modify existing lower-cost commercial off-the-shelf active RFID tags to survive harsher conditions with the goal of subzero temperatures, seawater and prolonged deployment to provide more effective global tracking tags;
3. Adapt power management firmware and integrate additional sensors combined with intelligent algorithms with the goal to extend battery life by 25% compared to existing tags for all devices in the system;
4. Employ an adaptive system level approach, along with a novel GRID packaging design, to mitigate the adverse effects of snow buildup and ice formation on the wireless links; and
5. Integrate and confirm software to allow the system to stay dormant and conserve power; this could be accomplished via either user requests or automatically.

Tagging of Oil Under Ice for Future Recovery (Project 1051)
Contracting Agency: BSEE/AECOM, Inc (formerly URS)
Estimated Completion: December 31, 2016
The goal of this project is to develop innovative, cost effective, and robust tagging devices and an automatic tracking system for use in tracking spilled oil under, or encapsulated within ice. This will be accomplished via the following key novel developments:

i. Implementing an innovative, multi-faceted pinging lamb wave communication system to use in an underwater acoustic identification (UWID) tag.
ii. Develop a commercial off-the-shelf (COTS)-based GPS/satellite transponder with a lamb wave detector tag that is ruggedized for the Arctic environment and for a variety of deployment options including air drops.
iii. Adaptive power management algorithms in conjunction with interfaced sensors to automatically stay dormant, when needed, to conserve power.
iv. Employ an adaptive system level approach, along with an innovative packaging, material and coating design that will mitigate the adverse effects of snow buildup and ice formation on the wireless links.

Validation of Surface and Subsea Oil Detection Capabilities Using Remote Sensing Technologies in a Controlled Laboratory Setting
Contracting Agency: CRREL/International Association of Oil and Gas Producers (OGP) Joint Industry Programme (JIP)
Completed: July 2014
In support of a larger effort titled Oil Spill Detection and Mapping in Low Visibility and Ice, efforts undertaken at CRREL focused on implementing an OGP-JIP test program that was developed to identify and qualify sensors platforms capable of determining the presence of oil on, in, and under ice and capable of mapping the extent of the oil slick at each horizon. The test program performed at CRREL was the first time that an array of above surface and subsea sensors were deployed under controlled conditions. Simultaneous, multi-sensor data was collected from the point of initial sea ice growth through to complete melt.

Optical and Microstructure of Oil in Ice
Contracting Agency: CRREL/Prince William Sound Science Center
Completed: June 2015
In support of the larger effort titled Oil Spill Detection and Mapping in Low Visibility and Ice, efforts undertaken at CRREL focused on measuring the spectral albedo and transmittance of ice cover at distinct test sites during the validation of above surface and subsea oil detection capabilities in a controlled laboratory environment.

In- and On-Water Containment and Recovery

Detection of Oil in the Water Column
Contracting Agency: USCG RDC (4702)/BSEE (project 1021)
Estimated Completion: 2017
The current spill technology is limited in its ability to accurately detect and mitigate subsurface oil within the water column down to 10,000 feet. The first objective of this project is to develop a technology that is capable of detecting and tracking oil along a water column down to a depth of 200 feet. The minimum requirements for the proposed technology are to operate in all environmental conditions; and locate and mark subsurface oil to allow the decision-makers to formulate the most feasible approach to mitigate or remove the oil. In addition, the final product should have sufficient resolution for detecting small droplets of oil. The proposed technology should also have the ability to be efficiently used near shore and in rivers.

A Broad Agency Announcement (BAA) was issued in 2011 and three contracts were awarded in 2012 to perform analysis and designs for systems to detect oil. Two follow-on contracts for a sonar system and a system that uses a compact multi-angle scattering instrument were funded to develop prototypes. Testing is scheduled for December 2013.

Mitigation of Oil within the Water Column
Contracting Agency: USCG RDC/BSEE (Project 1033)
Estimated Completion: 2017
The Mitigation of Oil within the Water Column project builds on the efforts and lessons learned during RDC's work in the detection phase as well as those learned during the USCG's Deepwater Response. Once submerged oil in the near-shore or river environment has been encountered, the next step is to make the decision of whether an active approach is necessary to remove the oil or mitigate the subsurface plume's impacts on the environment, water intakes, and commercial facilities. Currently, there is no well-established technology, technique, or strategy to prevent the detected submerged oil from having further adverse impacts on the environment or manmade structures.

A Broad Agency Announcement (BAA) was issued in 2015 and two contracts were awarded in the same year to perform concept developments of the proposed systems to mitigate the impacts of oil. One system is based on reusable, environmentally benign absorbent foam and the other is based on microbubble flotation. Follow-on contracts to develop prototypes for the two systems are Government Options that may be exercised; they are dependent on the outcomes of the concept development phase. Should the Government Options be exercised, testing of the prototypes is anticipated for November 2016.

Arctic Technology Demonstrations
Contracting Agency: USCG RDC
Estimated Completion: On-going
The USCG RDC's continuing involvement with the USCG's Arctic Shield exercise, and now separately through specific demonstrations, has included testing of spill response equipment and operations. Efforts to date incorporated testing of five key process activities in Arctic oil spill response: searching above and below an ice flow, detecting spilled oil, producing data to be used to plot the safest course to the spilled oil, deploying response equipment to recover the spilled oil, and monitoring the recovery operation (above and below the ice) to ensure complete recovery. As part of the exercises, the RDC also evaluated five specific technologies and components: small unmanned aircraft system (sUAS), autonomous underwater vehicle (AUV), oil recovery skimmers, remotely operated vehicle (ROV), and communications support. The RDC released a video to document the 2012 and in 2013 Arctic Shield spill response logistics and operations. The focus of the 2016 demonstration is oil spill response off the North Slope of Alaska. The following Interagency Committee agencies have participated in one or more of the Arctic Shield exercises: NOAA, BSEE, and USN.

4701 Response to Oil in Ice
Contracting Agency: RDC/EPA
Estimated Completion: 2017
The USCG RDC is conducting an on-going series of demonstrations to develop and validate equipment and techniques for detecting, tracking, and recovering oil in ice-filled waters under all conditions. To date, the USCG has conducted three Oil-in-Ice Demonstrations in the Great Lakes in April 2011, January 2012, and February 2013. The Great Lakes demonstrations involved deploying autonomous underwater vehicles (AUVs), a remotely operated vehicle, tethered observation balloons, ice radar systems, and different skimmer systems. During the latest demonstration, USCG and BSEE collaborated to test BSEE's AUV equipment. The demonstrations also included testing of the incident command structure as well as collaboration with Canadian government and industry response groups. The project also provided a knowledge base and lessons learned that informed USCG operators as well as Arctic exercises during the summer of 2012 and 2013. The RDC is planning another Great Lakes demonstration for February 2016.

Oil Sands Products Spill Response
Contracting Agency: RDC (Project 4705)
Estimated Completion: 2017
The objective of this project is to identify best practices to assist the FOSC in responding to spills involving Oil Sands products. The RDC recently completed the first phase of this project, which included researching the existing literature on this topic to hone in on the particular research areas that the RDC could address. This also included background information on the ways that oil sands products are transported and refined. The RDC awarded a task order for analysis of a sediment sampling approach in FY15. Research on potential mitigation techniques should start in 2016. The project is scheduled out through FY17.

Development of Surrogate Ice Modules for Simulated Arctic Environment Testing at Ohmsett (Project 1023)
Contracting Agency: BSEE/PCCI
Completed: May 29, 2015
The purpose of this project was to explore the feasibility of using surrogate ice modules at the National Oil Spill Response Research & Renewable Energy Test Facility (Ohmsett) to test oil spill response equipment in various, repeatable, simulated arctic conditions. This project was initiated in order to devise a lower cost alternative to purchase of salt ice for this seasonal testing. The contracted portion of this project is complete. Internal work is ongoing to further develop the surrogate ice modules.

Testing of Skimmer Hoses and Hose Couplings Under Simulated Arctic Conditions (Project 1026)
Contracting Agency: BSEE/Cold Regions Research and Engineering Laboratory (CRREL)
Completed: October 31, 2014
This project's objective was to assess performance of standard skimmer hoses and hose couplings used during oil recovery operations when subjected to low temperatures found in the Arctic. Several separate, complimentary studies were conducted within this project. Pumping of oil/water/ice product at various concentrations at low temperatures was tested to highlight situations where the product flow through a hose might become an issue. Data on force required to couple/uncouple standard hose connections at varying temperatures with various gaskets was collected to provide guidance on gasket selection for use in low temperature conditions. Life cycle testing on gaskets and hose/hose couplings was also studied.

Mitigation of Oil in the Water Column (Project 1033)
Contracting Agency: BSEE/USCG RDC
Estimated Completion: April 4, 2016
The objective of this project is to develop techniques to mitigate oil in the water column. These techniques will be capable of being outfitted to any vessels of opportunity, operate in water depths of up to 200 feet, and be employable in a variety of conditions including offshore, near shore, and river environments. To date two alternative technologies have been selected for development. Design and laboratory testing is ongoing. This design phase may be followed by a prototype development phase for promising technologies.

Development of an Autonomous Oil Skimmer (Project 1037)
Contracting Agency: BSEE/Alion Science and Technology Corporation
Estimated Completion: April, 2016
The goal of this project is to develop a strap-on navigation, sensor, and computer control system that could be used to direct a variety of commercial off the shelf (COTS) skimmers and vessels to autonomously maneuver and skim the oil from a given area with automatic tracking and reporting of progress and performance. This autonomous oil skimmer (AOS) system consists of a commercial of the shelf (COTS) skimmer and vessel, a COTS autopilot system, a high precision navigation package, oil thickness sensors and a custom computer algorithm. This system will monitor the thickness of the oil being skimmed in real time and track oil thickness versus position as it is skimming. Based on the oil thickness gradients, the tracking algorithm will direct the vessel/skimmer to head in the direction of thickest oil concentration. As oil is recovered, statistics on oil thickness and oil recovery rate as a function of position will be tabulated for real time performance monitoring. During this effort Alion will develop a proof of concept prototype that will be field tested at the Ohmsett in 2016.

Development of a Universal Submersible Skimmer Delivery System (Project 1053)
Contracting Agency: BSEE/Alion Science and Technology Corporation
Estimated Completion: May, 2016
Alion will investigate a new approach to how oil skimmer technologies are deployed in ice-infested waters. They will leverage their experience with submersible ROV technology to develop a system to deploy and maneuver a skimmer underwater to the location of the oil, enhancing the ability to remove oil from otherwise inaccessible locations. During this effort they will develop a proof of concept prototype that will be field tested at the Ohmsett facility in 2016.

Development of DoubleHelix Oil/Water Separation Skimming Technology (Project 1054)
Contracting Agency: BSEE/Clean Ocean Technology Systems LLC (COTS)
Estimated Completion: March, 2016
COTS will investigate a new approach for addressing the recovery of oil in ice. They will develop and test a new skimming method that lifts and separates water and oil mixtures while minimizing the collection system's overall surface area. This system will be designed to respond to an assortment of oil/ice conditions, oil types and temperatures. The prototype system will be tested at the Ohmsett facility in 2016.

ASTM F2709-08 Testing of Skimmer Systems (Project 1064)
Contracting Agency: BSEE/MAR
Completed: June 30, 2015
BSEE recently conducted independent performance testing of various skimming systems owned by BSEE and the USCG with the goal of better understanding the relationship between manufactures' published nameplate recovery rates and rates obtained through testing with a prescribed standard. Skimmers were tested at the Ohmsett Facility to ASTM F2709-08 "Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems". Most skimmers were tested in Type I and Type II test oils as defined by ASTM F631 standard. Skimmers were tested in a boomed area within the Ohmsett tank in calm conditions with an initial slick thickness of 3 inches. Data collected included Oil Recovery Rate (ORR) and Oil Recovery Efficiency (ORE) for each skimming system as defined in ASTM F2709-08.

On Board Flotation System for the Removal of Surface Oil under Arctic Conditions (Project 1069)
Contracting Agency: BSEE/National Energy Technology Laboratory (NETL)
Estimated Completion: September, 2016
This project will focus on separation of water from emulsified oily water solution in simulated arctic conditions using flotation technology. Experiments will focus on efficiency of oil separation using different surfactants, temperatures, and ice conditions and will evaluate both batch and continuous operations. This technology has been previously developed for oil water separation at ambient temperature. This project seeks to verify the viability of this technology at environmental conditions that might be experienced in recovering oil in an arctic environment.

Literature Synthesis of Oil Properties and their Impact on Spill Response Options
Contracting Agency: BSEE
Completed: 2014
The range of oil products transported through, explored for, and produced in U.S. waters has increased dramatically over the last two decades. With these increases, the potential for spills of new materials, in new locations, or in severe climates brings into question the efficacy of traditional cleanup and spill response options. To support BSEE's mission towards promoting safety and protecting the marine environment, this project will synthesize the current state of knowledge on the relationship between the range of oil properties and spill response options to establish a baseline and aid in developing a roadmap for future research and technical development. The findings concerning the state of knowledge and key knowledge gaps will be summarized in a report and a searchable database of articles and/or abstracts and links will be provided.

Rapidly Deployable Thermal Hydrate Preventer for Subsea Oil Spill Mitigation
Contracting Agency: BSEE
Completed: October 31, 2013
The objective of the research was to assess the feasibility of a Thermal Hydrate Preventer (THP) system that will provide spill response teams with a tool that can be used to quickly mitigate subsea oil spills while preventing the formation of hydrates that can cause buoyancy problems and clog flow lines. The project established a set of deep sea conditions and requirements that can be used as a basis from which an analytical and chemical feasibility study can be conducted to assess the feasibility of a THP system with regard to conditions that will likely exist at the damaged well head; consider the hydrodynamics, thermodynamics, and chemistry of hydrates as they relate to the THP system to prevent formation of hydrates during the process of interfacing and initially capturing oil flowing from a damaged well on the sea floor and maintain a hydrate-free environment once the THP is successfully engaged with the damaged well; developed a set of scaling rules that can be used to scope and size the THP system; developed a preliminary THP system design; designed a THP demonstration test plan that can be performed immediately following the completion of this project; and established a commercial implementation plan, which defined pathways and possible commercialization partners, as well as potential funding opportunities to support the commercialization and implementation of the THP tools outside of the funding provided under this project.

Dispersants

Validation of the Two Models Developed to Predict the Window of Opportunity for Dispersant Use in the Gulf of Mexico
Contracting Agency: BSEE
Completed: 2014
In a previous BSEE-funded research project entitled "Identification of Window of Opportunity for Chemical Dispersants on Gulf of Mexico Crude Oils," two correlation models were developed to predict the window of opportunity (or time-window) for successful chemical dispersant use in the Gulf of Mexico (GOM). The models consist of correlation relationships established using best-fit correlation between readily available fresh oil properties and the window of opportunity for successful chemical dispersant use estimated using data from GOM

crude oils and spill volumes of 1,000 and 10,000 barrels. The study demonstrated that combination of Sulfur, Saturate, and Wax contents of the fresh oils correlated best with the time-window for dispersant use.

This project aims to validate and improve the two correlation models using a well known oil spill model OILMAP by adding crude oils from outside the GOM for which physical and chemical properties are available, introducing 10 new crude oils from the GOM for which physical and chemical properties will be measured in this study, considering existing data from large tank tests and field trials/spills, and using data from new small tank tests. The project also aims to evaluate the sensitivity of the models to water temperature, wind speed, and the oil viscosity with the aim to include effects of these parameters into the models.

Operational Chemical Dispersant Research at Ohmsett
Contracting Agency: BSEE
Completed: April 2014
The overall objective of the proposed research was to advance the state of the art and knowledge in chemical dispersant use in marine spill applications. Three separate projects were conducted primarily at the Ohmsett test facility in Leonardo, New Jersey. Project (1): Validation of Time Window for Dispersant Use Model. A two-week testing program was conducted at Ohmsett to validate the models that have been developed for predicting the time window for successful use of dispersants. Project (2): Comparison of Small Scale Dispersant Testing Methods to Ohmsett Results: The Effects of Dispersant Type and Oil Properties. A one-week dispersant effectiveness testing program at Ohmsett and a series of laboratory-scale dispersant effectiveness tests in Ottawa, ON, Canada were conducted to compare results of the two methods using different oil types and dispersants. Project (3): Effectiveness of Typical Aircraft Spray Dosages on Outer Continental Shelf Crude Oils. A one-week testing program at Ohmsett was conducted to study the effectiveness of dispersant applied at typical aircraft application dosages (5 gallon/acre) on light to medium Outer Continental Shelf oils including the MS 252 crude oil spilled during the BP Horizon incident under near-at sea conditions.

Subsea Chemical Dispersant Research
Contracting Agency: BSEE
Completed: 2014
The objective of the proposed research is to advance the state of the art and knowledge in chemical dispersant use when injected into an uncontrolled subsea oil release. The research will be conducted in the laboratory and at Ohmsett. The initial testing program in the laboratory and a small wave tank will investigate the role of natural gas in the gas-dispersant-oil system and evaluate measurement methods to quantify the oil drop and gas bubble plumes resulting from a treated or untreated subsea release. This testing will determine if it is feasible to use air in subsequent under water injection tests without biasing test results. The tests will also investigate dispersant effectiveness (DE) as a function of basic parameters such as oil type, dispersant to oil ratio, and dispersant injection location.

Acoustic Assessment of Subsea Chemical Dispersant Efficacy
Contracting Agency: BSEE
Completed: September 30, 2014
The goal of this project is to develop acoustic techniques to measure the droplet size distribution for subsea release of crude oil and dispersants in the presence of natural gas. It will build off of the results of BSEE's previous proof-of-concept study for using ultrasound to assess dispersant

efficacy by measuring oil droplet sizes. This project will add the variable of natural gas to advance the measurement technology to separate the responses from oil droplets and natural gas bubbles in a subsea plume.

The project includes laboratory measurements of dispersed oil and gas to measure the acoustic resonance and scattering response from gas bubbles released from the bottom of a tank of water. Using a non-flammable gas with similar acoustic resonance properties as natural gas, various sized oil drops ranging from below 100 microns to several millimeters in diameter will be measured. The oil will also be mixed with COREXIT 9500 to determine if the dispersant alters the bubble size. Droplet sizing algorithms will be developed to best determine the oil droplet size in the presence of gas and dispersants using acoustic scattering and resonance measurements. To optimize the methods for real world conditions, tests will be conducted in the Ohmsett wave tank and the SINTEF tower tank on both surface and subsurface applications of dispersants to further develop measurement methods and algorithms.

Dispersant Effectiveness, In-Situ Droplet Size Distribution, and Numerical Modeling to Assess Subsurface Dispersant Injection as a Deepwater Blowout Oil Spill Response Option
Contracting Agency: BSEE & EPA
Completed: 2015
The project will address three issues. The first is to evaluate the performance of dispersants for subsurface injection into sub-sea blowouts. The second is to track, model, and predict the movement and spread of the deepwater plume and oil surfacing from deepwater blowouts. The third is to evaluate the influence of dispersant applications in reducing the concentration of volatile organic compounds emanating from the water surface on one specific crude oil. This will be accomplished by a number of tasks; refine existing technologies, and methodologies for the assessment and monitoring of subsurface dispersant application by measuring dispersed oil concentration, fluorescence, and in-situ oil droplet size distribution; evaluate dispersion effectiveness (DE) as a function of oil type, oil release flow rate, and dispersant-to-oil ratio (DOR) for deepwater blowout spill response; model the particle size distribution of dispersed oil under high flow velocities in deepwater blowouts; integrate the new formulation on droplet size distribution with deepwater blowout models to study the effects of the new formulation on oil fate/transport models; study the effects of dispersant on the droplet size distribution; develop a formula to predict droplet size distribution and integrate it with a transport/behavior model component for oil released from deepwater blowouts.

Dispersant Effectiveness Literature Synthesis
Contracting Agency: BSEE
Completed: 2014
To address the need for a comprehensive review and record of completed and on-going research in dispersant effectiveness, this project will review, summarize, and report on the literature available regarding dispersant effectiveness. This effort will develop reference documents and a searchable database of historical research on dispersant effectiveness. Also, the project will analyze the gaps in the existing knowledge bank and suggest possible future topics for dispersant effectiveness research studies.

Response Risk Communication Tools for Dispersants and Oil Spills
Contracting Agency: NOAA/CRRC, SEA Consulting Group
Completed: February 2014
This project developed preparedness recommendations and response tools to address public and stakeholder information needs and risk perceptions about dispersants and oil spills. The approach is original and integrative: building on the mental models approach for risk communications, this project conducts original survey research, analyzes social media data, leverages other current survey research and decision analysis, and integrates relevant social and natural science research findings to design effective and useful communications strategies for dispersant use at oil spills for use in future preparedness and response planning. The SEA/University of Washington team consisted of investigators with extensive public, private, and academic research experience with oil spills and risk communication. Qualitative research engages community participants from recent workshops and incorporates Twitter data collected during *Deepwater Horizon* by the investigators to inform the design of the national survey. The survey research and social media analyses exploited new technology and analytical capabilities in both domains, and built on data from prior oil spill workshops as well as *Deepwater Horizon*. Quality was assured through a workshop structured to produce peer-reviewed assessments of and guidance from the project's research results, put into the context of other relevant recent research. Products from this project can be applied immediately by NOAA, other federal, state and local, as well as industry, end users to promote effective response communications about dispersants and oil spills. Project deliverables are expected to provide direct input to a strategic risk communications plan for oil spills and response options, including dispersants, that to mitigate the consequences of spills which threaten coastal communities.

DTox: a Worldwide Quantitative Database of the Toxicological Effects of Dispersants and Chemically Dispersed Oil and CAFÉ incorporation
Contracting Agency: NOAA/CRRC/Research Planning Institute
Completed: April 2014/July 2015
The ability to rapidly assess the toxicity of chemically dispersed oils is a goal shared by government, industry, consultants, and academic groups involved in oil spill response. One common need of the oil spill community is the unrestricted and rapid access to available toxicity data on dispersants and chemically dispersed oils. However, there are no centralized data repositories gathering decades of existing toxicity data. The end-result of the proposed project, the Dispersant and Chemically Dispersed Oil Toxicity Database (DTox), addresses that shared need of the oil spill community, and will contribute to a better understanding of the biological effects of dispersants and dispersed oil, a major goal of the CRRC. This database also addresses one of the three main R&D needs on the biological effects of dispersants highlighted in a recent dispersant initiative workshop. The main objectives of this project were to identify, evaluate, compile, and integrate all available toxicity data on dispersants and chemically dispersed oil, and to generate an interactive tool that can assist the oil spill response community in their management decisions regarding the use of dispersants. The ultimate goal of this effort was the synthesis of information in a meaningful way to improve scientific decision-making as well as to provide rapid access to centralized toxicity data.

Data compilation efforts built upon on-going or existing efforts, such as using the information already available in various reference databases that have already identified research on the effects of dispersants and dispersed oil. Data consider for inclusion in DTox underwent a rigorous evaluation following a strict set of rules aimed at selecting the best available and suitable data for inclusion. Data entered into the database went through QA/QC procedures

including periodic reviews of the database to ensure accurate data entry. A stand-alone executable file of DTox contains interactive features including standard navigation buttons, a navigation page including search attributes (e.g., oil type) with single or multi-factorial keyword search capabilities (e.g., Arctic, Corexit, fish), and search results displayed in various table, graphic, or report formats. Critical steps in assessing the effectiveness and usefulness of the proposed database deals with its transferability to drills, workshops, or real oil spill situations, as well as its ability to provide information that can help inform tradeoff decisions based on the current state of knowledge. In order to address this particular concern, end-users worked closely with the PI and co-PI, and were given the opportunity to review the database and provide suggestions for improvement prior to its public release. Furthermore, as part of the objectives of this project, two small areas of current oil exploration interest and with very different characteristics were used as pilot sites to assess the usefulness of the database. These tests also helped identify data gaps and sources of uncertainty, and will provide information on specific research needs. The practical application of DTox is the organization of copious amounts of toxicity data into a practical, versatile, and logical system that is easy to use by oil spill practitioners, that can be used as a scientific support tool, and that can facilitate communication of risks with the public and the scientific community concerned about the use of dispersants. The continued strength and growth of this proposed database will ultimately depend upon the active support and involvement of the oil spill community who stand to derive greatest benefit from this shared effort.

The DTox database was incorporated as one of three primary toxicity data sources in NOAA's Chemical Aquatic Fate and Effects (CAFÉ) tool released in July of 2015, along with EPA's ECOTOX and the European Centre for Ecotoxicology and Toxicology of Chemicals datasets. See http://response.restoration.noaa.gov/CAFE

Understanding chronic impacts of chemical dispersant and chemically-dispersed oil on behavior, molting success, and hormone status and of blue crab larvae: inputs for recruitment and population models.

Contracting Agency: NOAA/CRRC, University of Maryland Center for Environmental Science (UMCES)

Estimated Completion: 2014

The use of chemical dispersants as a response option following an oil spill has always been controversial, and numerous reports and reviews have highlighted the many data gaps and uncertainties regarding their use (e.g. NRC, 2005). Their goal is to reduce the impacts of oil and provide a net environmental benefit. However, the unprecedented spatial and temporal extent of their use during the BP *Deepwater Horizon* (DWH) incident led to intense media and public outcry, particularly regarding their novel subsurface use directly at the wellhead. A meeting organized by the CRRC in May 2010 concluded that their use was indeed beneficial overall, but it also highlighted data gaps and uncertainties especially regarding the length of time of their use and the need for continued re-evaluations. There are still many unknowns regarding the environmental fate and effects of dispersant and chemically dispersed oil, particularly to nonstandard laboratory species and at chronic and sub-lethal levels. The blue crab, a keystone species of the Gulf of Mexico and Atlantic coast, is crucial to both the ecology and economy of both regions. Very little is known regarding the impacts of oil, dispersant and chemically dispersed oil on any stage of the blue crab life cycle. The timing of the DWH incident coincided with crab spawning, whereby pelagic crab early life stages were exposed to oil and/or chemically-dispersed oil offshore in the photic zone surface waters. Blue crab recruitment, and thence fishery abundance, depends upon larval survival in the coastal zone, which in turn hinges

on larval perception, feeding, molting, and swimming abilities. Even at sub-lethal levels (as determined by LC50 methods), oil, dispersant or chemically-dispersed oil may impair these behaviors, resulting in larvae that do not survive until the megalopa/crab transition. These behavioral effects would be therefore functionally lethal, because of the ensuing growth, feeding, recruitment, and ultimate population level consequences.

The proposal described herein seeks to understand the impacts of dispersant, oil and dispersed oil on blue crab larvae at various stages of development. Although we will carry out some preliminary experiments to define acute (for comparison to other species in the literature) and sublethal doses our goal is to focus on the sub-lethal effects that will ultimately result in recruitment failures. These include novel approaches to ascertain physiological (molting success and endocrine disruption) and behavioral perturbations. UMCES has a unique collection of crab hatchery technology and scientific expertise to address the question of how oil, dispersant and dispersed oil affects blue crab larvae using a multiple toolbox of molecular, biochemical, physiological and behavioral endpoints. Findings and methodology of the study proposed by UMCES investigators will have value as tools to assist managers and scientists in rapid risk assessment/decision making for dispersant use during spills. The project will also develop methods adaptable for simple *in situ* and laboratory assessments of the effects of oil, dispersant and dispersed oil on blue crab larval behavior. Interactions with end users at all phases of the project will ensure that protocols and metrics are adapted to be useful in modeling or forecasting the chronic effects of "subacute" levels of chemical dispersant use on larval crab behavior and crab recruitment.

Experimental Wave Tank Studies of Oil Spill Response Using Dispersants
Contracting Agency: EPA/NRMRL
Estimated Completion: 2015
This project, which is being conducted with the Department of Fisheries and Oceans Canada (DFO), addresses the performance evaluation of dispersants applied to oil spills on the water surface and subsurface injection in subsea blowouts during oil spill response. Dispersant effectiveness (DE) will be evaluated by conducting experimental studies using a modified flow-through wave tank that is capable of generating advective current flow. The EPA/DFO wave tank will be modified to incorporate a pressurized underwater oil and gas release system. DE will be evaluated by measuring dispersed oil concentrations, ultraviolet fluorescence, and droplet-size distributions. Analysis of dispersed oil droplet size distributions will be performed using submersible Laser In-Situ Scattering and Transmissometry (LISST-100X) instruments and a digital holographic imagery camera (DHIC) particle counter. Wave tank studies will be conducted to evaluate DE as a function of oil type, dispersant type, dispersant-to-oil ratio (DOR), and oil and gas flow rates. The influences of other operational conditions, such as high oil temperature, the presence of suspended particulate materials on oil dispersion efficiency will also be tested. The experimental results, particularly those obtained for in-situ droplet size distribution data, will have significant application in the oil spill trajectory and ocean circulation models required by responders to predict the fate and transport of subsurface plume and surface oil slicks.

A second aspect of this project is development of numerical models of dispersant use. One of the most important parameters required for oil spill models to provide better prediction of oil transport is oil droplet size distribution. Literature reviews indicate that this is still poorly understood, particularly for the case of a deep water blowout where dispersants are applied. This project addresses this issue by conducting research to: (1) model the particle size distribution of

physically dispersed oil in deep water blowouts; (2) study the effects of dispersants on droplet size distribution; (3) evaluate effects of high oil temperature, low water temperature, and the co-presence of natural gas on dispersed droplet size distribution; (4) determine the minimum droplet size needed for re-coalescence of oil droplets; and (5) develop a new numerical formula for droplet size distribution and integrate it into a deep water blowout model.

Biodegradability of Dispersants and Dispersed Oil at Two Temperatures
Contracting Agency: EPA/NRMRL
Estimated Completion: 2015
The BP *Deepwater Horizon* blowout raised questions not only about the biodegradability of oil in deep waters and surface waters of the Gulf of Mexico but also raised concerns about the rate of biodegradation of the dispersants per se and the dispersed oil. The objective of this study is to determine the rate of biodegradation of several crude and refined oils, beginning with S. Louisiana crude oil (SLC) spilled in the Gulf of Mexico (GOM) in the BP *Deepwater Horizon* blowout with and without the presence of two dispersants currently on the National Contingency Plan Product Schedule (NCPPS). Since the temperatures of the GOM at depth and at the surface are substantially different, a further objective was to determine biodegradation rates at 5 °C, corresponding to average temperature at depths > 1000 m, and at 25 °C, corresponding to average temperature in the top 5 m. The experiment with Corexit 9500 on SLC has been completed and published. Experiments with two other oils were also completed, and experiments with JD2000 on the three oils were also completed in 2013. Two manuscripts comparing results from the 2 dispersants and 3 oils at the 2 temperatures will be prepared during FY2014. Additional experiments on Corexit 9500 on SLC were also conducted with substantially lower concentrations of crude oil. A manuscript by Zhuang et al describing results from this project was available in 2015.

Mesocosm testing of dispersants, shoreline cleaning agents, and bioremediation agents
Contracting Agency: NOAA/NCCOS and NOAA/ORR
Estimated Completion: March 2016 (dispersant), 2016 (shoreline cleaners), and TBD (bioremediation)
This series of studies to take place at the NOAA National Centers for Coastal Ocean Science will look at chemical oil treatment options and interaction with estuarine mesocosms, including dispersants, shoreline cleaners, and tentatively bioremediation agents. The dispersant study will determine oil and dispersant exposure thresholds for survival and sublethal responses in seven key estuarine species, representing different habitats (water column and benthos), feeding types, and trophic levels. The proposed test species include: sheepshead minnow, grass shrimp, mysids (small, shrimp-like crustaceans), an amphipod (a small, shrimp-like crustacean without a carapace), a snail, the hard shell clam, and a polychaete worm. NCCOS will also examine the influence of oil and dispersants on the growth of clinical and environmental strains of the pathogenic bacteria, *Vibrio vulnificus*. Additionally, we will assess the impacts these chemicals have on salt marsh vegetation (e.g., growth and survival) and benthic sediment communities, and compare these data with field data from the Deepwater Horizon oil spill to better define recovery horizons for benthic communities.

Developing an Innovative Dispersant Spray Drift Model (Project 1070)
Contracting Agency: BSEE/AMOG Consulting, Inc.
Estimated Completion: September 30, 2016
The objective of this project is to develop a Computational Fluid Dynamics (CFD) model of the forces acting on dispersant as it is sprayed from four commonly used aircraft models. The CFD

model results will feed into a software tool that will identify operability windows and establish exclusion zoned based on the maximum extent of dispersant spray. Specifically this effort will:

(1) Develop a thorough operational understanding of aerial dispersant spraying campaigns and develop operability limits criteria.
(2) Develop and validate CFD numerical models on a set of 4 aircraft representing a cross section of platforms used for spraying dispersants.
(3) Evaluate the CFD models and integrate into existing dispersion modeling tools as applicable.
(4) Integrate the results of Tasks 1-3 to produce a software tool to support aerial dispersant spraying operations using meteorological conditions to identify operability windows and exclusion zones.

Comparative Testing of Corexit EC9500A, Finasol OSR 52, Accell Clean DWD, and ZI 400 at Ohmsett in a Simulated Arctic Environment
Contracting Agency: BSEE
Completed: 2015
The BSEE recently conducted independent dispersant effectiveness testing. Four dispersants were selected from the EPA's National Contingency Plan (NCP) Product Schedule and were tested on an Alaskan crude oil under simulated arctic conditions at Ohmsett. They include Corexit® EC9500A, Finasol® OSR 52, Accell® Clean DWD, and ZI 400. To capture operational effectiveness issues, the dispersants were applied to a surface slick using Ohmsett's spray bar, which simulated a system similar to a boat spraying system. Data collected included dispersant effectiveness (DE) based on the volume of the surface slick which remained after the test as compared to the volume dispersed into the water column and droplet size distribution. In addition to providing performance data of the products in pseudo-field conditions, operational performance was captured as a general discussion about the ease of use, limitations, and concerns about the products in the arctic environment.

Research to Support the Prediction of Effectiveness of Dispersant Use in the U.S. Beaufort and Chukchi Seas
Contracting Agency: BSEE
Completed: 2015
The objective of the study has been to provide information to support dispersant use decision-making with respect to oil spill chemical dispersant effectiveness under the environmental conditions likely to be encountered in the U.S. Beaufort and Chukchi Seas. The goals of the research were to identify the prevailing environmental conditions in the U.S. Beaufort and Chukchi Seas that would affect dispersant performance; identify existing dispersant effectiveness tests that have been completed on Alaskan oils under conditions similar to those that exist in these two regions and identify gaps in the knowledge of dispersant effectiveness; and conduct dispersant effectiveness tests at medium scale to address the knowledge gaps.

Biodegradation Following Dispersant Usage in a Cold, Stratified, Deep Sea Setting
Contracting Agency: BSEE/Pacific Northwest National Laboratory
Estimated Completion: August 31, 2016
This project will include a series of controlled laboratory experiments simulating environments of the US Outer Continental Shelf characterized by high pressure, low temperature, and low mixing to first characterize the performance of dispersants and second, to characterize subsequent biodegradation. The experiments will characterize the physical state of the oil after

treatment with a dispersant, the influence of droplet size on biodegradation, novel noninvasive approaches to characterizing emulsions and oil degradation in pressure chambers, and the combined effects of low temperature, high pressure, and low mixing on oil biodegradation

Effectiveness of Dispersants in Frazil or Slush Ice
Contracting Agency: BSEE
Estimated Completion: March 31, 2016
The objectives of this study will be to advance the understanding of the effectiveness of chemical dispersants when applied to oil in ice-infested waters, specifically in slush or frazil ice conditions. This study will conduct weathering studies and dispersant effectiveness tests at meso-scale to establish the rate of change of oil properties when spilled in frazil ice and determine the potential for the use of chemical dispersants in this scenario.

In situ Burning

Effort: In Situ Oil Burner Tests
Contracting Agency: CRREL/SL Ross Environmental Research Ltd.
Completed: February 2015
In support of a larger effort titled In Situ Burning of Oil in Ice – Herders Fate and Effects Window-of-Opportunity, research undertaken at the Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, NH focused on determining environmental windows-of-opportunity for two commercially available herders. The goal of this effort was to define the duration of time required for the herders to effectively herd slicks of different oils and emulsions, with different degrees of evaporation, to an ignitable thickness.
http://www.arcticresponsetechnology.org/research-projects/chemical-herders-fate-effects-and-window-of-opportunity

Development of a Low-Emission Spray Combustor for Emulsified Crude Oil (Project 1061)
Contracting Agency: BSEE/Naval Research Laboratory
Estimated Completion: October 31, 2016
The objective of this project is to transition the Technology Readiness Level (TRL) of a low-emission, low pressure atomization and combustion process for emulsified crude oil from TRL 3 to TRL 5 by developing and refining the performance of a quarter and half-scale flow blurring atomizer spray burner. This project builds off of the proof-of-concept project complete as OSRR #1012.
Traditional offshore *in situ* burning of crude oil is performed by gathering the surface oil into large pools where they are ignited to form large fires. This process generally produces large plumes of soot and leaves a slick of residual hydrocarbons remaining on the ocean surface. This project will develop an operable, low-pressure oil flare system that can be incorporated into an effective oil spill remediation strategy. The system will incorporate a flow-blurring atomizer (FBA) and associated flow system capable of burning at a minimum liquid flow rate of 225 barrels per day, a combustor shroud, and a plasma torch. Design of the full-scale system is expected to commence in November 2015.

Efficient Atomization and Combustion of Emulsified Crude Oil
Contracting Agency: BSEE
Estimated Completion: July 2014
The objective of this project was to assess the potential effectiveness of low pressure atomizing burners as a means to augment in situ burning of emulsified crude oil while minimizing pump infrastructure requirements. During this project the droplet formation and combustion behavior of flow-blurring atomizers (FBA) and effervescent atomizers (EA) were evaluated to assess their suitability and determine infrastructure requirements for disposing of emulsified oil resulting from oil spills. Atomizers with flexible geometries were designed and constructed so that the geometry may be varied to minimize atomizing air flow rate and pressure while minimizing the atomized droplet diameter, as measured by phase Doppler interferometry (PDI). The combustion behavior of the atomized oil in both straight and swirled jets was examined, again measuring the droplet diameters at different locations within the jet to determine the rate of droplet evaporation and combustion, as well as determining the operational limits including turn down, ignition, and lean blow out. The same behaviors was measured with emulsions of crude oil and sea water to determine how the atomization and combustion behavior changed with increasing fractions of sea water and determined the practical combustion limits of emulsified oil. This project was successfully completed and the lessons learned were incorporated into a new project *Development of a Low-Emission Spray Combustor for Emulsified Crude Oil* to advance the Technology Readiness Level (TRL) from a 3 to a 5 by developing and refining a quarter- and half-scale flow blurring atomizer spray burner.

Development of a Planning Standard for In-Situ Burning Operations (Project 1057)
Contracting Agency: BSEE/ SL Ross Environmental Research Ltd.
Estimated Completion: November 30, 2015
The objective of this project is to develop a planning standard for in-situ burning of crude oil on the surface of the water. This standard will encompass all factors involved in offshore burns including operating conditions, mobilization and transit times, variations in the condition of the surface slick, burn rates, and the feasible boom swath widths and tow rates. A second component of this project will be the development of a computer-based planning tool for calculating burn potential for an in-situ burning system.

A Novel Experimental Approach to Enhance Burning of Oil-Water Emulsions by Immersed Objects (Project 1049)
Contracting Agency: BSEE/Worcester Polytechnic Institute
Estimated Completion: November 30, 2015
The objective of this study is to develop a technology to use conductive metal rods to enhance the burning rate of a liquid pool of emulsified oil. Worcester Polytechnic Institute (WPI) will develop experiments in order to evaluate and optimize various parameters of importance in developing this technology, including the length, diameter, and spacing of the rods. A simplified computational fluid dynamics (CFD) analysis will be performed in parallel with the experiments to help guide the experiments and to develop an understanding of how simplifications may be successful in developing empirical relationships that will ultimately be used for designing burners deployed in the field. This study has three phases:

Phase I (small scale tests) - An experimental setup will be developed with optimum size, number and placements of rods immersed in a 10 cm pool of oil-water emulsions of octane, octane/xylene, and Alaska North Slope (ANS) crude oil at various water content. A burn consumption rate of greater than 20 mm/min will be targeted. A CFD analysis will be conducted

in parallel to explore controlling parameters. The results will be used to develop an empirical model to predict the burning rate and efficiency for given immersed object geometry and fuel parameters.

Phase II (intermediate scale tests) - In this phase the configuration developed in Phase I will be analyzed to determine if it can deliver comparable burning rates and efficiencies in a 50 cm pool of water-oil emulsions. Adjustments will be applied to the experimental configuration based on the test results. Additional parameters associated with scaling radiative and convective heat fluxes, because of increase in size, will be incorporated in the empirical model developed during Phase 1.

Phase III (large scale tests) - A prototype burner design for field deployment will be implemented during Phase III. Four large scale tests will be performed using ANS crude oil. Three sets of tests will be performed with water content at 25%, 40%, and 60%. The outcome of these large scale tests could inform the design of a simple, efficient prototype burner design that could be implemented in the field.

Burning Behavior of Oil in Ice Channels (Project 1007)
Contracting Agency: BSEE/Worcester Polytechnic Institute
Completed: December 31, 2013
The objective of this project was to assess in-situ burn efficiency of oil spills in icy conditions and set new experimental and modeling framework to explore oil spill burning on ice. This allowed quantification of combustion efficiency as well as point of extinction for liquid fuel spills in icy conditions. The objectives were accomplished in two phases. Phase one focused on identifying controlling mechanisms governing the spread and burning rate of a combustible liquid in an ice channel. Specifically, it focused on the influence of combustible liquid flash point, viscosity, channel width and channel height on the spread and burning rate of the liquid. The results were interpreted using a theoretical model developed as a part of this study. Phase two included lab-scale oil-spread and burning studies to analyze predictive models developed during phase one and evaluated additional parameters due to the increase in scale. This project was successfully completed and led to the development of a new project Burning of Crude Oil in Ice Cavities – II. The new study analyzes the impact of temperature, emulsification and weathering on ignition behavior, smoke point, lateral cavity formation, wicking agents and flame spread at bench-, intermediate-, and large-scale.

Burning of Crude Oil in Ice Cavities – II (Project 1036)
Contracting Agency: BSEE/Worcester Polytechnic Institute
Estimated Completion: September 20, 2016
The objective of the study is to experimentally investigate flammability of crude oil slicks in cold conditions. Specifically, the controlling parameters of ignition, flame spread, burning rate, and radiative fraction of heat release for oil spills in Arctic environmental conditions will be obtained. The approach taken is similar to an earlier study by WPI and sponsored by BSEE as Project 1007. A predictive model validated using intermediate and large-scale tests will also be developed. The results will improve the strategies and the net environmental benefit of, and by it the success of, oil clean-up after an accidental spill.

Improved In-Situ Burning for Offshore Use (BSEE Project 1035, RDC Project 4704)
Contracting Agency: BSEE/RDC
Estimated Completion: May 2017
This project, co-funded by the USCG RDC and BSEE, began in February of 2014 and will continue through FY2017. The overall objective is to identify best practices for ISB use. The long term objective of this project is to ensure that a safe and efficient in-situ burn (ISB) process is developed for offshore spills. The immediate objective is to ensure that all lessons learned have been incorporated into guidance for future burns, confirm the state of any new developments, and conduct initial test burns in the burn tank at the Joint Maritime Test Facility (JMTF) at Little Sand Island in Mobile Bay, Alabama.

The first task of the project was to conduct an assessment of efforts undertaken since the Deepwater Horizon oil spill response and was completed in February, 2015. The assessment included a review of new technologies that have been developed and areas where further technology development is needed; new operational procedures and/or job aids that have been developed; and the after-action evaluation concerning the use of ISB during the Deepwater Horizon response.

The second task is to conduct test burns at the JMTD burn tank. In the past, the RDC has tested several types of fire boom and several types of igniters. Three burns were conducted November 13-19, 2015 at the JMTF. These burns were the first since 2003 to take place at this location, after a significant equipment and facility overhaul. This time, the RDC burned diesel fuel and the purpose of this burn is to develop burn test procedures so the burn pan is ready for full operational use. An additional optional task may be added to implement recommendations from the first two tasks.

Preliminary Technical Guidance and Literature Review to Assist in Evaluation of Wellhead Burning as a Blowout Response (Project 1063)
Contracting Agency: Naval Research Laboratory (NRL)
Estimated Completion: November 15, 2015
The long-term objective of this effort is to ensure safe and efficient oil spill response and recovery methods (as well as wellhead control measures) are developed and in place for potential offshore oil spills from man-made gravel islands in the federal waters off of Alaska. The immediate objective is to ensure that a thorough understanding of all historical, technical and scientific issues is gained in order to consider the case for using wellhead burning as a response tool to mitigate the effects of a well blowout from a gravel island. (Note: This work is not in-situ burning of oil contained within fire-booms; rather, it is the ignition of an uncontrolled release of oil and gas from an uncontained well directly at the wellhead after pressure control systems have failed.)

Offshore Oil Burn System via Floating Immersed Objects (Project 1068)
Contractor: Worcester Polytechnic Institute (WPI)
Estimated Completion: September 2017
The objective of this proof-of-concept study is to develop and refine a design of a simple and robust system to directly burn off oil slicks in booms at high efficiencies and with low emissions. The approach uses noncombustible and conductive immersed object to enhance the heat transfer from flames back to the fuel to achieve higher vaporization rates.

The project will be carried out in three Phases:

Phase I: Small-scale (10 and 25 cm diameter burn pans): Determine how basic material and geometric parameters affect the heat transfer and mass loss rates. Effects of thickness, surface area and void volume of the metal mesh/wool blanket as well as the diameter, pitch, and material of the springs will be measured. Further investigation of the controlling parameters of heat and mass transfer including the height and number of springs will be analyzed.

Phase II: Intermediate-scale (70 cm diameter burn pan): Analysis and modeling of the 25 cm pan tests will be used to design the test parameters in Phase II. The data from Phase II will then be used as a guide for designing and conducting the large-scale tests.

Phase III: Large-scale (140 cm diameter outdoor burn pan): Experimental tests in a 140 cm pan will be used to evaluate the designed prototype burner for field use. The large-scale test will be a collaborative study with the USCG's Research and Development Center (R&D). The designed prototype will be tested in the USCG's test tank in Mobile, Alabama.

Quantitative Measurement of In-Situ Burn Efficiency and Rate
Contractor: Applied Research Associates
Estimated Completion: September 23, 2016
The objective of this proof-of-concept study is to develop and refine methods to directly measure the volume of oil burned and the burn rate in real time during *in-situ* burns (ISB) by integrating the direct thickness measurements using acoustic methods and surface area measurements derived from visible and infrared images.

The project will consist of the following overall tasks:

Task 1. Acoustic thickness measurement of burning oil: This task will include determining the speed of sound gradient as a function of temperature through the oil slick through direct measurements and modeling of the temperature gradient of burning oil. The effects of surface modulations caused by waves from various sea states or turbulence produced during burning operations will be determined. Thickness will be measured as a function of time.

Task 2: Image Analysis: Image processing algorithms to improve the accuracy of surface area measurements will be investigated to enable rapid, automated measurements including the effect of waves on the surface area measurements. Surface area of the burning oil will be measured as a function of time.

Task 3: System Integration: Thickness and surface area measurements will be integrated to calculate the burn efficiency and rate in real time.

Task 4: *In-Situ* Burning at Worcester Polytechnic Institute: The methods developed in the preceding tasks will be tested on larger-scale burns (1 meter diameter burn pans).

Task 5: *In-Situ* Burning at the United States Army's Cold Regions Research and Engineering Laboratory (CRREL): Tests to further develop the methods to measure ISB efficiency and rate of oil in ice will be performed in an outdoor facility.

Task 6 (Optional): *In-Situ* Burning in the Arctic: This optional task will be to determine the effects of real-world conditions on the methods developed to measure ISB efficiency and rate.

Comparison of Physical and Chemical Characteristics of In-Situ Burn Residue and other Environmental Oil Samples Collected during the Deepwater Horizon Spill Response (Project 1010)
Contracting Agency: BSEE & NOAA
Completed: September 3, 2014
The objective of this project was to use the physical and chemical analysis of the BP *Deepwater Horizon* in-situ burning samples as a focal point for comparisons to the analyses of other oil and residue samples of relevance to the spill response. In particular, the pre- and post-burn sample results were compared to samples from three sources. The first set of samples came from the Macondo well source oil, the same source oil burned under controlled conditions at the NOAA/LSU chemistry support lab in Baton Rouge, Louisiana. The second set of samples came from tarballs trawled from the depths by deepwater shrimp nets in late 2010 and early 2011 north of the blowout location. The third set of samples came from *Deepwater Horizon* oil collected at sea, in marshes, and from beaches.

The results provided insights into the changes that occur to oil when it is burned and how the physical and chemical characteristics compare to other forms of oil encountered during a spill (e.g., emulsified surface oil, beach- and marsh-stranded oil, etc.). Analysis of burn residues and comparison to deepwater tarballs helped obtain an understanding of the longer-term fate of burned oil and identify potential impacts to pelagic and benthic environments and human activities like mid-water and bottom trawling. In addition to the physics and chemistry of the different oil types, the work examined candidate biomarkers used to "fingerprint" oil and residues to source materials and recommend those that appear to have the greatest utility for identifying the origins of burned and/or weathered oil.

Multifunctional Herding-Sorbent Agents for Use in Icy Waters (Project 1071)
Contracting Agency: BSEE/PNNL
Estimated Completion: September 17, 2016
This project will evaluate the potential of three novel approaches to herd oil for in-situ burning or recovery operations, and the potential biodegradation of residues remaining. Specifically, this study will:

(1) Evaluate candidate treatments to enhance sawdust absorption of oil and decrease absorption of water, resulting in development of a candidate sawdust herding material.
(2) Evaluate the properties of the selected material developed in icy water
(3) Evaluate the ability of the agents to herd oil to a suitable thickness for burning, and conduct small burns to confirm that the agents will burn. The study will potentially conduct large scale burning tests pending the success of smaller scale tests.
(4) Evaluate the biodegradation of oil absorbed onto the sawdust agents, and the potential for pre-treating the sawdust with biodegradation agents.

Bioremediation

Biodegradability and Toxicity of Biodiesel Blends
Contracting Agency: EPA/NRMRL
Estimated Completion: 2014
While there are great benefits to using biodiesel as a fuel, its environmental fate and effects need to be evaluated and the risks associated with their use understood. There is a dearth of information on the states and conditions biodiesel and its blends have in the environment, their

fate, and their effects on aquatic organisms. The current understanding of the fate and effects of biodiesel and its various blends is inadequate to evaluate environmental risks from its use. Unlike petroleum diesel, biodiesel fuels are made from many sources, including soy oil, rapeseed/canola oil, reclaimed restaurant grease, fish oil, and rendered animal fats, each having different chemical compositions. This wide variability of biodiesel formulations may result in very different toxicological and environmental fates depending on the feedstock.

The objective of this work is to determine the biodegradability and biodegradation kinetics of different biodiesel blends (B0, B20, B40, B60, B80, and B100, corresponding to 100% petroleum diesel and 20-100% soybean oil fatty acid methyl esters). The second objective is to quantify the toxicity of the water accommodated fraction of the biodiesel blends as measured by the Microtox assay, which uses the bioluminescent bacterium *Vibrio fischeri* as the test species. Aerobic biodegradation kinetics experiments on the six soybean-oil based blends were successfully completed (soybean oil is predominantly characterized by 1 double bond in its fatty acid structure). The fatty acid methyl esters (FAMEs) of the biodiesel were found to undergo abiotic disappearance in the killed controls and the blanks, by hydrolysis of the FAMEs into free fatty acids (FFA) followed by polymerization in the presence of a putative catalyst. Work has also been completed on the aerobic biodegradation kinetics of flaxseed oil (characterized by predominantly 3 double bonds in the fatty acid structure). Work is continuing on the anaerobic biodegradation of flaxseed and soybean oil biodiesel and their blends. This research is scheduled to end in FY 2014. Four journal articles were produced from this project, and at least one more is scheduled for completion and publication by the end of FY 2014.

Alternative Chemical Countermeasures

Development of a Laboratory Protocol Testing the Effectiveness of Commercial Solidifiers in Cleaning Up Oil Spills on Water
Contracting Agency: EPA/NRMRL
Estimated Completion: 2016
The objectives of this laboratory study are: (1) to develop a protocol for testing the effectiveness of solidifying an oil slick on water using commercial solidifiers; (2) to evaluate the recovery of oil from solidified product; (3) to determine the mechanism of solidification; and (4) to quantify the effects of environmental conditions (temperature, salinity, mixing energy, degree of oil weathering, etc.) on the solidification process. These objectives will lead to a better scientific understanding of the solidification process so that interpretation of results of testing is facilitated. Good progress has been made in the laboratory, and results have been published in Sundaravadivelu et al., 2014 and 2015 and can be found in the publication list of this report. A round robin experiment was initiated in 2015 and results will be available in 2016. Final protocol delivery to EPA OSWER Office of Emergency Management (OEM) will be made before FY17.

Development of a Surface Washing Agent Protocol
Contracting Agency: EPA/NRMRL
Estimated Completion: 2016
The goal of this work is to develop a standardized and reproducible testing protocol to evaluate the shoreline cleaning efficiency of surface washing agents (SWAs). Oil removal efficiencies for SWA treatments are being compared to the washing efficiency of salt water without SWA. Since a good SWA should not disperse oil into water, the dispersability of each SWA is being evaluated separately using the baffled flask test (BFT). To date, the protocol experiments have

already been completed for a medium crude oil (Prudhoe Bay Crude or PBC), a light crude oil (S. Louisiana Crude or SLC), and a heavy refined oil, IFO180. The Headquarters program office, the Office of Emergency Management (OEM) asked if the protocol could be extended to larger media (like granite tiles) for more realistic application and testing of products, however reproducibility issues existed with using granite tiles. Experimental testing reverted back to the use of sand media and a round robin test was conducted in 2015. Final delivery of protocol and completion of this project will be in 2016.

Temporary Oil Spill Storage and Recovery in Alaskan Arctic Using Petrogel Technology (Project 1034)
Contracting Agency: BSEE/The Pennsylvania State University
Estimated Completion: March 31, 2016
Petrogel is a superabsorbent polymer that exhibits promising absorption capacity (40 times its weight in preliminary testing) as well as the potential for being effectively refined as a regular crude oil. The objective of this project is to advance the polymer "Petrogel" with a focus on the practical development and evaluation of Petrogel materials for use with Alaskan North Slope (ANS) crude oil in low temperature conditions. Its absorbency characteristics as well as methods for recovery of this absorbent will be tested at the Ohmsett facility in 2015 and 2016.

Enhanced Oil Recovery from Oil-Seawater Mixtures Through the Coupling of Magnetic Nanoparticles and Electrically Conducting Ultrafiltration Membranes (Project 1052)
Contracting Agency: BSEE/University of California, Riverside
Estimated Completion: October, 2015
The objective of this project is to develop a continuous oil/seawater separation process that can be deployed in arctic conditions aboard oil skimming vessels and can recover a majority of skimmed oil while producing an oil-free water stream that can be safely discharged. This separation technique relies on the coupling of electrically conducting ultrafiltration membranes with ferromagnetic nanoparticle-stabilized oil droplets allowing for efficient collection and separation of spilled oil without the need for storing vast volumes of contaminated water. The process involves the following steps:

1. The recovered oil/water mixture is mixed with ferromagnetic nanoparticles (MNs).
2. This mixture is sent through an ultrafiltration membrane to separate the oil from the water.
3. The separated oil is stripped of the MNs which can be reused.
4. The oil-free water could theoretically then be discharged.

This project will result in a bench scale oil/water separation treatment train, a preliminary techno-economic analysis for a full-scale oil/seawater separation process, and a preliminary engineering design package for a pilot-scale oil/seawater separation process

Oily Waste and Oil Disposal

Demonstration of a Polypropylene Packed Material for the Treatment of Solids in Shipboard Bilgewater (WP-201224)
Contracting Agency: USN/NSWCCD
Estimated Completion: 2016
The current USN Fleet has more than 170 oil/water separators (OWS) as primary treatment systems and 30-35 of these ships have membrane-based ultrafiltration systems for secondary treatment with more planned for backfit. The presence of solids or particulate matter in USN shipboard oily waste processing streams is known to negatively impact the operation and

performance of oil pollution abatement equipment. Solids removal is a critical step in the treatment of ships' oily waste streams, e.g., bilgewater. Wastewater solids build up rapidly on currently available filters, resulting in frequent backflushing. Solids that are not properly managed contribute to increased maintenance requirements, system downtime, and associated costs that may otherwise have been avoided. Inspections of OWS' plate stack assemblies have shown that over time, unprocessed particulate matter accumulates in the system, reducing performance and requiring more frequent maintenance. Solids can also cling to oil droplets suspended in water, making the droplet neutrally or negatively buoyant and resulting in oil passing through the OWS and accumulating on the membrane faces. Clogging of the openings to the ceramic membrane lumens (axial channels through which the wastewater flows) has been a continuing problem. Solids blocking the lumen entrances can (1) severely reduce the membrane flow rate resulting in much lower bilgewater processing rates, (2) increase membrane regeneration frequency, and (3) require manual removal and cleaning of the membranes. These maintenance issues are directly attributable to the inability of current treatment system filters to reliably remove solids from the waste stream. The objective of this project is to demonstrate the ability of the Bacti-Twist Filter Media (BTFM) technology to retain solids from shipboard generated oily waste with measurement of key effluent quality parameters. The BTFM filter is a black spiral-shaped plastic media made of polypropylene material, which is hydrophobic, giving it the ability to attract the complex hydrophobic mixture of oil, fine solids, and surfactants present in bilgewater. The project will conduct laboratory and shipboard evaluations to validate the performance of the BTFM filter. In addition to performance, the evaluations will determine the system's reliability, operation, maintenance, and integration requirements.

The laboratory validation testing has been completed and data analysis is currently in progress. Preliminary data results indicate that the BTFM technology is successful in removing the problematic solids that lead to clogging of the ceramic membrane lumens. The BTFM technology will be recommended for shipboard validation testing. The BTFM filter will provide Armed Forces ships with a filter media system that would allow the ships to process their oily waste without being hindered by solids. Maintenance for an OWS with the BTFM will be lower than one without the technology. The filter will reduce the frequency of solids clogging membranes and membrane face plugging events. The filter should also help decrease the manpower requirement and costs associated with operating and maintaining the OPA treatment systems. The life of the primary and secondary treatment stages will be longer with the BTFM filter.

INJURY ASSESSMENT AND RESTORATION

Environmental Impacts and Ecosystem Recovery

Deepwater Horizon Natural Resource Damage Studies
Contracting Agency: NOAA, NRDA, DWH Trustees
Estimated Completion: April 2016
Nearly 200 studies assessed the impacts of the BP Deepwater Horizon spill and response to natural resources and human uses in the Gulf of Mexico. These studies are listed at http://www.gulfspillrestoration.noaa.gov/oil-spill/gulf-spill-data/ and data is continuing to be posted on DWH Data Integration Visualization Exploration and Reporting (DIVER) at https://dwhdiver.orr.noaa.gov/.

Improving injury assessment techniques for marine oil spills in the Arctic: Field testing high priority ephemeral data collection guidelines
Contracting Agency: NOAA/ORR/ARD
Estimated Completion: 2014
This research contributes to a broad effort by NOAA's Office of Response and Restoration, Assessment and Restoration Division to plan for Natural Resource Damage Assessment (NRDA) in the Arctic by helping to improve exposure and injury assessment techniques. In the event of an oil spill in the Arctic, a high priority for NRDA, during the first few days and weeks after the spill, would be shore-based ephemeral data collection to assess pre-impact conditions and exposure and injury to resources in, or associated with the nearshore areas. Along much of the high arctic coast, nearshore areas include sheltered lagoons and the shorelines of the barrier islands that delimit lagoons. These habitats are highly productive and at risk of being impacted by a marine oil spill. The Assessment and Restoration Division has been developing high priority ephemeral data collection guidelines, a subset of which were field tested at nearshore sites on the North Slope in July, 2013. Sampling protocols for environmental media and organisms that were tested included: water, ice, sediment, benthic invertebrate, fish and fish bile. In the event of a spill, these samples would be analyzed for polycyclic aromatic hydrocarbon (PAH) or PAH metabolites to evaluate exposure to oil chemicals, as well as for assessment of injury endpoints in exposed resources. In addition to protocol testing, this work evaluated methods and levels of effort required for sampling and contributed to identifying appropriate, reasonable and defensible exposure and injury endpoints for NRDA in the Arctic. High Arctic ephemeral data collection protocols were updated with new information garnered from field testing and will be going through additional peer review and refinement. Having reviewed and validated ephemeral data collection protocols for baseline sampling and NRDA helps assure that high priority data of sufficient quality and quantity for NRDA is collected during the early phase of an oil spill.

Bowhead Whale Baleen efficiency testing in water, with oil, and with dispersed oil
Contracting Agency: NOAA/ORR/ERD, NOAA/ NMFS/OPR, North Slope Borough, BSEE/OHMSETT, WHOI (NOAA/NMFS grantee)
Estimated Completion: 2016
This cooperative research project evaluates the effects of oil, dispersed oil, and dispersant on the physical performance characteristics of bowhead and humpback whale baleen. The experiments utilize baleen provided by the North Slope Borough Wildlife Department and National Marine Fisheries Service (NMFS)/Woods Hole Oceanographic Institute (WHOI), facility time and crude oil provided by BSEE, and dispersant provided by OSRL. The study will provide basic new information to cetacean biologists and resource managers, assess the impacts of oil and dispersed oil on feeding behavior, and provide inputs for modeling the bioenergetics of baleen whales.

Enbridge Oil Spill Natural Resource Damage Assessment
Contracting Agencies: NOAA, USFWS and other trustees
Estimated Completion: On-going
NOAA and the USFWS are coordinating with co-trustees and Enbridge, to collect information as part of the NRDA for an oil spill in the Kalamazoo River. The purpose of the NRDA is to determine the appropriate type and amount of restoration needed to compensate the public for injuries to or lost use of their natural resources from the oil spill and associated response activities. The spill occurred on July 25, 2010 when a 30-inch diameter pipeline ruptured and released diluted bitumen, a heavy form of crude oil, into a tributary creek of the Kalamazoo River in Marshall, MI. This type of oil is also referred to as "tar sands oil." Enbridge, the owner and operator of the pipeline, estimated that approximately 843,000 gallons spilled. Oil traveled approximately 40 miles downstream in the Kalamazoo River. Containment and absorbent booms were placed and the oil did not pass Morrow Lake, located about 10 miles east of Kalamazoo, MI. http://www.darrp.noaa.gov/greatlakes/enbridge/index.html

Evaluation of Gulf of Mexico oceanographic observation networks impact assessment on ecosystem management and recommendation
Contracting Agency: NOAA RESTORE Act Science Program, University of Miami
Estimated Completion: 2017
This research team will work with resource managers to expand observing system evaluation techniques typically focused on observations of ocean circulation to include biogeochemistry and ecosystem observations in order to provide recommendations on the full suite and location of observations needed for monitoring and managing the Gulf of Mexico. This contract was awarded in August, 2015.

Environmental Restoration Methods and Technologies

Beaver Butte Creek Gasoline Spill Restoration Plan Implementation and Habitat Improvement
Contracting Agency: NOAA, USFWS, and Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO)
Estimated Completion: On-going
A tanker truck and trailer, loaded with approximately 10,300 gallons of unleaded gasoline, jackknifed and became separated. The tanks on both the tanker truck and trailer ruptured and approximately 5,388 gallons of unleaded gasoline were spilled. A majority of the gasoline flowed overland and was released directly into Beaver Butte Creek just above the confluence with Beaver Creek on the reservation of the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO). The spill resulted in direct impacts to Chinook salmon, steelhead, and other natural resources. Riparian vegetation was also impacted.

NOAA, USFWS, and CTWSRO, as Trustees, worked together to develop a Restoration Plan and Environmental Assessment, which was finalized in 2009. Using funds from the settlement with the company responsible for the spill, the Trustees have chosen a range of restoration projects to improve conditions for steelhead trout and Chinook salmon throughout the Beaver Creek watershed. The restoration plan focuses on steelhead in particular because they are an endangered species, already on the brink of extinction.

Implementation of the Restoration Plan began in 2011 with construction of the Lower Quartz Creek Riparian Fencing Project. In 2012 two in-stream restoration projects were constructed on the main stem of Beaver Creek and two more fencing projects were built in the Quartz Creek watershed. Project implementation and monitoring is on-going and will continue for the next several years.

Human Safety and Health

Development of a Real-time Monitoring Protocol for Assessing Volatile Organic Compounds (VOC) Impacts on Response and Cleanup Workers' Safety during Dispersant Operations (Project 1006)
Contracting Agency: BSEE/Louisiana State University
Completed: December 4, 2014
The objective of the proposed research was to develop real-time and passive monitoring protocols to effectively determine the impact of dispersant use and VOC release, in both surface and subsurface applications, on oil spill response worker safety. A series of bench-scale laboratory studies was performed to determine mass balance of airborne benzene, toluene, ethyl benzene, and xylenes (BTEX) components within a baffled-flask microcosm following addition of the dispersant COREXIT 9500 to a South Louisiana crude oil. This was followed by a series of macro-scale laboratory studies to determine mass balance of BTEX components within an 85 liter flow-through tank system for analysis and modeling of VOC concentrations in the air and water boundary layers surrounding an oil slick prior to and following dispersant application. A series of high-pressure static vessel laboratory studies wasperformed to determine mass balance of BTEX components within a one liter stainless steel pressure vessel to simulate VOC dissolution in oil plumes at various depths and pressures following subsurface dispersant application. Finally, a series of test-tank studies was conducted at Ohmsett to determine real-time analysis of VOCs in water and air phase after South Louisiana crude oil is chemically dispersed into the water column. After analysis of all of the data, in cooperation with NOAA and USCG, recommendations and countermeasures to optimize dispersant use for VOC control and worker safety were developed.

Sociological and Economic Impacts

Indicators and assessment framework for ecological health and ecosystem services
Contracting Agency: NOAA RESTORE Act Science Program, Texas A&M University Corpus Christi
Estimated Completion: 2017
This research will develop and test a set of ecological and ecosystem service indicators, including their link to human wellbeing, and an approach for using them based on specific management needs in the Gulf of Mexico. This contract was awarded in August, 2015.