DELUGE OF OIL HIGHLIGHTS RESEARCH AND TECHNOLOGY NEEDS FOR EFFECTIVE CLEANUP OF OIL SPILLS

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

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JANE WISE *Research Assistant*
ALEX MATTHEWS *Research Assistant*

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DELUGE OF OIL HIGHLIGHTS RESEARCH AND TECHNOLOGY NEEDS FOR EFFECTIVE CLEANUP OF OIL SPILLS

WEDNESDAY, JUNE 9, 2010

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
Washington, DC.

The Subcommittee met, pursuant to call, at 10:04 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Brian Baird [Chairman of the Subcommittee] presiding.

BART GORDON, TENNESSEE
CHAIRMAN

RALPH M. HALL, TEXAS
RANKING MEMBER

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Subcommittee on Energy and Environment
Hearing on

Deluge of Oil Highlights Research and Technology Needs for Effective Cleanup of Oil Spills

Wednesday, June 9, 2010
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

Witness List

Panel I

Mr. Douglas Helton
Incident Operations Coordinator, Office of Response and Restoration
National Ocean Service
National Oceanic and Atmospheric Administration (NOAA)

Captain Anthony Lloyd
Chief, Office of Incident Management and Preparedness
United States Coast Guard

Ms. Sharon Buffington
Chief, Engineering and Research Branch
Offshore Energy and Minerals Management
Minerals Management Service

Dr. Albert Venosa
Director, Land Remediation and Pollution Control Division
National Risk Management Research Laboratory, Office of Research and Development
Environmental Protection Agency

Panel II

Dr. Jeffrey Short
Pacific Science Director, Oceana

Dr. Samantha Joye
Professor of Marine Sciences, University of Georgia

Dr. Richard Haut
Senior Research Scientist, Houston Advanced Research Center

Dr. Nancy Kinner
University of New Hampshire
Co-Director, Coastal Response Research Center (CRRC)

Mr. Kevin Costner
Partner, Ocean Therapy Solutions, WestPac Resources

HEARING CHARTER

COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
U.S. HOUSE OF REPRESENTATIVES

Deluge of Oil Highlights Research and Technology Needs for Oil Recovery and Effective Cleanup of Oil Spills

WEDNESDAY, JUNE 9, 2010
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On Wednesday, June 9, 2010 the House Committee on Science and Technology, Subcommittee on Energy and Environment will hold a hearing entitled "***Deluge of Oil Highlights Research and Technology Needs for Oil Recovery and Effective Cleanup of Oil Spills***." The purpose of this hearing is to explore the research, development, and technology needs for the recovery of oil and effective cleanup of oil spills. The Committee will examine Federal agency roles in oil spill response research, the activities and programs Federal agencies have pursued since the passage of the Oil Pollution Act of 1990, the current gaps in spill response research and technology development, and what is needed to improve the coordinated Federal response going forward.

In addition, the Committee seeks to understand how oil interacts with the natural environment, the extent to which oil can be bioremediated through natural processes, the ecosystem effect(s) of chemically dispersed oil and of natural biodegradation, and the effectiveness of currently deployed technologies such as booms, skimmers, and *in situ* burns. The Committee also seeks to identify the barriers to the development and use of transformational technologies for oil spill cleanup.

Witnesses

Panel I

- **Mr. Douglas R. Helton**, Incident Operations Coordinator, Office of Response and Restoration, National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce.
- **Captain Anthony Lloyd**, Chief, Office of Incident Management and Preparedness, United States Coast Guard.
- **Ms. Sharon Buffington**, Chief, Engineering and Research Branch, Offshore Energy and Minerals Management, Minerals Management Service (MMS), U.S. Department of the Interior.
- **Dr. Albert Venosa**, Director, Land Remediation and Pollution Control Division, National Risk Management Research Laboratory, Office of Research and Development (ORD), U.S. Environmental Protection Agency (EPA).

Panel II

- **Dr. Jeffrey Short**, Pacific Science Director for Oceana. Dr. Short was the lead government chemist for the natural resource damage assessment and restoration of the Exxon Valdez oil spill and led numerous studies on the distribution, persistence, and effects of the oil.
- **Dr. Samantha Joye**, Professor of Marine Sciences, University of Georgia. Dr. Joye studies the biogeochemical cycling of nutrients and organic materials in coastal environments, ecosystem and geochemical modeling, and microbial ecology. She has been aboard the Walton Smith research vessel in the Gulf of Mexico as a member of a multidisciplinary science team, whose objectives are to conduct a comprehensive study of the deepwater plumes, including the plume's distribution, microbial activity, and geochemical constituents.

- **Dr. Richard Haut**, Senior Research Scientist, Houston Advanced Research Center. HARC is a non-profit based in the Woodlands, Texas that is dedicated to improving human and ecosystem well-being through the application of sustainability science and principles of sustainable development. Dr. Haut serves as the team lead for the Environmentally Friendly Drilling program.
- **Dr. Nancy Kinner**, Professor of Civil and Environmental Engineering, University of New Hampshire and Co-Director of the Coastal Response Research Center (CRRC). CRRC is a partnership between NOAA's Office of Response and Restoration (ORR) and the University of New Hampshire. Dr. Kinner is a Response Technology Engineer who works to transform research results into practice and conducts research on bioremediation of contaminated subsurface environments.
- **Mr. Kevin Costner**, Partner, Ocean Therapy Solutions (OTS). Mr. Costner's firm developed a device that separates oil from water that is currently being tested by BP in the Gulf of Mexico.

Background

Oil spills are reported every day in the United States. Few spills are environmental disasters of national or global significance; most of the three million gallons of oil[1] that is spilled into U.S. waters each year goes unnoticed by the public. Regardless of the level of public awareness in each case, natural resources such as fish, corals, marine mammals, sea turtles, birds, beaches, coastal habitats, and water quality are often negatively affected, as are the businesses and industries which depend on the immediate and long-term health of these resources.

The United States has incorporated lessons learned from past spills into Federal law[2] and relevant response readiness practices. We now have response tools and trained personnel at ports and aboard vessels across the nation. Oil recovery and clean up techniques, including *in situ* burns, chemical dispersants, skimmers, and floating oil-capturing barriers called "booms" have changed little since the Exxon Valdez oil spill of 1989.

Learning from the Past

The Exxon Valdez oil spill occurred in Prince William Sound, Alaska on March 24, 1989, when the *Exxon Valdez* oil tanker hit Bligh Reef and spilled at least 11 million gallons of crude oil, which eventually covered 1,300 miles of coastline[3] and 11,000 square miles of ocean.[4] The Exxon Valdez oil spill is considered to be one of the most devastating human-caused environmental disasters in U.S. history.[5]

The Exxon Valdez spill became a learning opportunity for spill responders and scientists from industry, government, academia, and the private sector. For example, although over 10,000 people contributed to the recovery effort, standard response technologies were largely ineffective due to weather conditions and properties of the spilled oil and the local environment. Response equipment was in short supply and inaccessible, and the remote location of the spill (accessible only by helicopter, plane and boat) strained government and industry response efforts. In addition to these constraints, the predominant scientific advice and public pressure at the time was to clean up one-hundred percent of the oil, which in some cases had adverse consequences. For example, shoreline cleanup methods such as the application of high-pressure hot water displaced and destroyed microbial populations; many of these organisms are the basis of the coastal marine food chain, and others (certain bacteria and fungi) are capable of facilitating the biodegradation of oil.

Despite the magnitude of the cleanup response, oil from the Exxon Valdez spill has left a lasting impact on Prince William Sound. Less than 10% of the oil was recovered from this spill, and a NOAA study determined that as of early 2007, more

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[1] Oil and refined petroleum product

[2] The Federal Government's oil spill response framework is found in the National Contingency Plan (40 CFR Part 300). Congress first established the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) in 1968, after U.S. policymakers observed the response to a 37-million-gallon oil tanker spill (*Torrey Canyon*) off the coast of England. Subsequent laws have amended the NCP, including the Clean Water Act in 1972; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) in 1980; and the Oil Pollution Act (OPA) in 1990.

[3] Questions and Answers. Exxon Valdez Oil Spill Trustee Council. *http://www.evostc.state.ak.us* Accessed 05 June 2010.

[4] The Exxon Valdez Spill is All Around Us. March 2009. Wired Science. *http://www.wired.com/wiredscience/2009/03/valdezlegacy/* Accessed 05 June 2010.

[5] Oil Spill Facts. Exxon Valdez Oil Spill Trustee Council. *http://www.evostc.state.ak.us* Accessed 07 June 2010.

than 26,000 gallons of oil remained in the sandy soil of the contaminated shoreline, declining at a rate of less than 4% per year.[6] In addition to the long term ecological consequences of the Exxon Valdez oil spill, some important commercial fisheries have yet to recover in the region.[7]

Legislative Response

The Oil Pollution Act (OPA) was signed into law, P.L. 101–380 (8–18–1990), in August 1990, largely in response to rising public concern following the Exxon Valdez oil spill. The intent of OPA was to improve the nation's ability to prevent and respond to oil spills by establishing provisions that expand the Federal Government's ability, and provide the funding and resources necessary, to respond to oil spills. In addition, OPA created the national Oil Spill Liability Trust Fund, which is available to provide up to one billion dollars per spill incident.

OPA also mandated new requirements for contingency planning both by government and industry. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP)[8] was expanded under OPA in a three-tiered approach: the Federal Government is required to direct all public and private response efforts for certain types of spill events; Area Committees—composed of Federal, state, and local government officials—must develop detailed, location-specific Area Contingency Plans; and owners or operators of vessels and certain facilities that pose a serious threat to the environment must prepare their own Facility Response Plans. Lastly, OPA increased penalties for regulatory noncompliance, broadened the response and enforcement authorities of the Federal Government, and preserved State authority to establish law governing oil spill prevention and response.

Key Provisions of the Oil Pollution Act for Oil Spill Response and Cleanup

- **Section 4202** Strengthens planning and prevention activities by: (1) providing for the establishment of spill contingency plans for all areas of the United States; (2) mandating the development of response plans for individual tank vessels and certain facilities for responding to a worst case discharge or a substantial threat of such a discharge; and (3) providing requirements for spill removal equipment and periodic inspections.
  - The planning and prevention activities conducted under this provision enables and guides the on-site response to the BP Deepwater Horizon oil spill in the Gulf of Mexico.
- **Section 2761** Establishes an Interagency Coordinating Committee on Oil Pollution Research (hereafter, "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. Fourteen Federal partners are named as members of the Interagency Committee, and a representative of the Coast Guard serves as Chairman.

This program provides for research, development, and demonstration of new or improved technologies which are effective in preventing or mitigating oil discharges and which protect the environment, including oil pollution technology evaluation, oil pollution effects research, marine simulation research, demonstration projects, simulated environmental testing, and regional research programs. In carrying out the regional research programs, the members of the Interagency Committee may enter into contracts and cooperative agreements and make grants to universities, research institutions, and other relevant entities in order to address regional research and technology needs.

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[6] Short JW, Irvine GV, Mann DH, Maselko JM, Pella JJ, Lindeberg MR, Payne JR, Driskell WB, and Rice SD. 2007. Slightly weathered Exxon Valdez oil persists in Gulf of Alaska beach sediments after 16 years. Environmental Science and Technology. 41: 1245–1250.

[7] Brown ED, Norcross BL, and Short JW. 1996a. An introduction to studies on the effects of the Exxon Valdez oil spill on early life history stages of Pacific herring, *Clupea pallasi*, in Prince William Sound, Alaska. Canadian Journal of Fisheries and Aquatic Science 53: 2337–2342.

[8] The NCP provisions specific to oil spill response are codified in 40 C.F.R. Part 300, Subpart D. As the primary response authority in coastal waters, the U.S. Coast Guard On-Scene Coordinator (OSC) has the ultimate authority to ensure that an oil spill is effectively removed and actions are taken to prevent further discharge from the source. The OSC is broadly empowered to direct and coordinate all response and recovery activities of Federal, state, local and private entities (including the responsible party), and will draw on resources available through the appropriate Area Contingency Plans and Regional Response Teams.

- The Interagency Committee produced the first Oil Pollution Research and Technology Plan in 1992 and, after consulting with the National Academy of Sciences, submitted a second plan in 1997. The plans identified and prioritized twenty research and development program areas. These areas focused on spill prevention; spill response planning, training, and management; spill countermeasures and cleanup; fate and transport; and effects, monitoring, and restoration. The plans also assigned research and development focus areas to ten member agencies. The plan was last updated in 1997.
- Despite the Interagency Committee's detailed research plan, only modest technological advances have been made in oil spill cleanup technology since 1990. For example, the Interagency Committee reported that, as late as 1997, "most of the technology and information gaps of 1990 remain," due to a failure to appropriate sufficient funds for oil pollution technology programs.[9]
- Of the fourteen members of the Interagency Committee, NOAA, EPA, MMS, and the Coast Guard have conducted the majority of oil pollution research. Funding levels have been far lower than the $28 million per year originally authorized for the program.

BP Deepwater Horizon Oil Spill

On April 20, 2010, an explosion and fire occurred on the BP[10] Deepwater Horizon drilling rig in the Gulf of Mexico. This resulted in the death of eleven workers, a massive oil release, and a national response effort in the Gulf of Mexico region by the Federal and state governments as well as BP.

Estimates of the flow reveal that this spill is projected to be much larger than that which occurred in the Exxon Valdez spill. The flow rate from the damaged well head is the subject of much scientific debate. The Flow Rate Group led by the U.S. Geological Survey (USGS) recently estimated that oil is flowing out of the damaged well head at a rate of 12,000 to 19,000 barrels per day.[11] To put these flow rate estimates into perspective, USGS's low estimate is equivalent to an oil spill the size of Exxon Valdez every 21 days and the high estimate is equivalent to an Exxon Valdez spill occurring every 13 days in the Gulf of Mexico. June 9, 2010 will be day 51 of the BP Deepwater Horizon oil spill.

The response to the BP Deepwater Horizon oil spill is the largest operation of its kind in U.S. history. Vast quantities of boom and chemical dispersant have been mobilized and deployed, and more *in situ* burns have been conducted than ever before for a single incident. A disaster of this magnitude forces decision makers to evaluate the tradeoffs and the net long-term environmental benefits of each response strategy. Despite the scale of the BP Deepwater Horizon response, efforts to mitigate the tremendous flow of oil have had limited effect. Thus far, the spill has damaged natural resources in the area and impacted the regional economy.

Economy and Environment

Oil spills can harm living organisms that inhabit ocean and coastal areas and may result in significant costs to businesses and the public. Coastal areas can be especially vulnerable because of oil stranding in wetlands and other coastal ecosystems. Oil coating, absorption, or ingestion can result in direct mortality and sublethal effects that reduce the fitness of regional organisms. When natural resources are affected by oil spills, services that benefit the public may be damaged.

To date, crude oil has been washing into marshes and estuaries and onto beaches and affecting wildlife in states including Louisiana, Mississippi, Alabama, and Florida. Underwater plumes of oil have been confirmed by independent and Federal scientists. Wildlife has been killed and efforts are underway to save oil-coated birds and sea turtles. The most immediate economic impact of the oil spill has been on the Gulf fishing industry. Gulf fisheries, including seafood processing and related

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[9] Interagency Coordinating Committee on Oil Pollution Research (1997) Oil Pollution Research and Technology Plan.

[10] Formerly British Petroleum

[11] U.S. Geological Survey. May 27 2010. Updated June 3, 2010. Flow Rate Group Provides Preliminary Best Estimate of Oil Flowing from BP Oil Well. News Release. *http://www.doi.gov/news/pressreleases/Flow-Rate-Group-Provides-Preliminarv-Best-Estimate-Of-Oil-Flowing-from-BP-Oil-Well.cfm#* Accessed 06 June 2010.

wholesale and retail businesses, support over 200,000 jobs with related economic activity of $5.5 billion annually.[12]

[12] Hagerty CL and Ramseur JL. 27 May 2010. Deepwater Horizon Oil Spill: Selected Issues for Congress. Congressional Research Service. *http://crs.gov/ReportPDF/R41262.pdf* Accessed 07 June 2010.

Chairman BAIRD. This hearing will now come to order. Good morning, and welcome to today's hearing.

Today is the 51st day of a national tragedy that is still unfolding in the Gulf of Mexico. The BP Deepwater Horizon oil well blowout and the catastrophic explosion took the lives of 11 men and resulted in an ongoing, massive oil spill. It devastated commercial fisheries and it is threatening coastal wetlands throughout the region.

According to estimates by the U.S. Geological Survey, the BP Deepwater Horizon spill is now two to four times the size of the 1989 Exxon Valdez spill. It is now the largest oil spill ever to originate in U.S. waters, and it is growing every day.

A little over a year ago, I had the privilege of chairing a hearing entitled, "A New Direction for Federal Oil Spill Research and Development." That hearing was spurred by the Cosco Busan spill in San Francisco Bay in 2007 and Ms. Woolsey's subsequent legislation. I want to thank Ms. Woolsey for her leadership on that legislation and for her continued dedication to this important issue.

Like most Americans, I am deeply frustrated by this. We have a massive, ongoing response effort with tens of thousands of people working in the Gulf to clean up this oil. Response workers are deploying boom, conducting in situ burns, skimming oil from the surface of the water, dispensing chemical dispersants, and picking up tar balls from beaches. Responders are working to protect the Gulf, its wetlands, beaches, fisheries, coral reefs and industries, and they are working to protect their way of life.

Unfortunately, the response tools need improving. We are using essentially the same tools in the Gulf as we were using in 1989 in Prince William Sound, Alaska. Those tools did not work particularly well even then.

In Alaskan coastal zones that were fouled by the Exxon Valdez spill, scientists discovered oil that has scarcely changed 16 years later. Beaches still ooze oil and scientists expect that oil to remain, perhaps even for centuries. It takes years to recover and clean up from oil spills.

Exxon Valdez served as a catalyst for the passage of the Oil Pollution Act of 1990, also called OPA 90. This legislation expanded the federal government and industry's capacity for oil spill prevention, preparedness and response. The goal of Title VII of OPA 90 was to coordinate Federal research to encourage the development of new technologies to address oil spills. Despite the Interagency's detailed research plan, there have been modest technological advances in oil spill cleanup since those laws were enacted.

Today, we will hear from our expert panel of witnesses on how we can fill these gaps and move forward with an effective response to spills, and particularly preventing spills as well. We have two excellent panels of witnesses who will discuss what is needed for an effective and coordinated Federal oil spill response as well as the research and technology needed for cleanup. I want to thank all of you for being here today. Because we have two panels, I will encourage my colleagues to be brief in their remarks opening and then in the questioning. We will hear in a moment from Mr. Hall, and then the Chairman of the Full Committee, Mr. Gordon, wants to offer comment.

[The prepared statement of Chairman Baird follows:]

PREPARED STATEMENT OF CHAIRMAN BRIAN BAIRD

Good morning and welcome to today's hearing.

Today is the 51st day of a national tragedy that is still unfolding in the Gulf of Mexico. The BP Deepwater Horizon oil well blowout and catastrophic explosion took the lives of eleven men and resulted in an ongoing, massive oil spill. It devastated commercial fisheries and it is threatening coastal wetlands throughout the region.

According to estimates by the U.S. Geological Survey, the BP Deepwater Horizon spill is now 2 to 4 times the size of the 1989 Exxon Valdez spill. This is the largest oil spill ever to originate in U.S. waters. And it is growing in size every day.

A little over a year ago, I chaired a hearing entitled, "A new direction for Federal oil spill research and development". The hearing was spurred by the Cosco Busan spill in San Francisco Bay in 2007 and Ms. Woolsey's subsequent legislation. I want to thank Ms. Woolsey for her leadership on that legislation and for her continual dedication to this important issue.

I, like most Americans, am frustrated. We have a massive ongoing response effort with tens of thousands of people working in the Gulf to clean up this oil. Response workers are deploying boom, conducting *in situ* burns, skimming oil from the surface of the water, dispensing chemical dispersants, and picking up tar balls from beaches. Responders are working to protect the Gulf, its wetlands, beaches, fisheries, and industries. They are working to protect our way of life.

Unfortunately, our response tools need improving. We are using essentially the same tools in the Gulf as we were using in 1989 in Prince William Sound, Alaska. These tools did not work well then.

In Alaskan coastal zones that were fouled by the Exxon Valdez spill, scientists discovered oil that has scarcely changed 16 years later. Beaches still ooze oil and scientists expect the oil to remain—perhaps even for centuries. It takes years to recover and cleanup from oil spills.

According to the Committee on the Marine Transportation of Heavy Oils, most oil spills experience a 10 to 15 percent rate of recovery. More research and development is necessary to reach acceptable levels of mitigation.

Oil spills occur every day in America. We need a better understanding of how oil spills affect the environment and we need better tools to clean them up. There is a big need here for targeted scientific research, development and technology.

Exxon Valdez served as a catalyst for the passage of the Oil Pollution Act of 1990 (OPA 90). This legislation expanded the Federal Government and industry's capacity for oil spill prevention, preparedness, and response. The goal of Title VII of OPA 90 was to coordinate Federal research to encourage the development of new technologies to address oil spills. Despite the Interagency Committee's detailed research plan, there have been modest technological advances in oil spill cleanup technology since the law was enacted.

In 2007 the Cosco Busan spill highlighted our need for better oil spill response tools. And today, the BP Deepwater Horizon spill highlights the research and technology needs of oil spill cleanup again.

The purpose of this hearing is to focus on how to better prepare ourselves for these incidents through scientific research and better Federal coordination.

However, we face new challenges that require resources and our brightest minds to push the envelope of research and technology development. We face a future of oil exploration and transport at depths and in regions never before imagined. Spills will happen and we need proper tools to respond—to protect our economy, our environment, and our way of life. It is undeniable that the United States needs a more robust research and development strategy to reduce the environmental and economic impacts of oil spills.

I think that I speak for us all when I say that watching the BP Deepwater Horizon oil spill on TV and in the paper is frustrating and discouraging. The challenges before us are great. And the time to act is now.

Today we will hear from our expert panels of witnesses on how we can fill these gaps and move forward with an effective response to oil spills.

We have two excellent panels of witnesses who will discuss what is needed for an effective and coordinated Federal oil spill response as well as the research and technology needs for oil spill cleanup.

I thank all of you for being here with us today and now I recognize our Ranking Member, Mr. Inglis, for his opening statement.

Chairman BAIRD. With that, I recognize Mr. Hall for five minutes.

Mr. HALL. Mr. Chairman, I thank you, of course, for holding this hearing, and in the seven weeks since the April 20th explosion took the lives of 11 people in the rig Deepwater Horizon, our nation is still searching for answers on the causes of the explosion and is frustrated by the lack of progress in fully plugging the well and cleaning up the spill.

I would like to first offer my condolences to the families of those lost in this horrible incident. Second, it is worth noting that BP is ultimately responsible for this oil spill, they are responsible for repairing the damaged well, and as the owner of the mineral rights to drill for oil in the Mississippi Canyon Block 252, BP is also accountable for the cleanup costs. To date, BP has paid out almost $49 million in claims and will be paying millions more moving forward.

There have been suggestions that the Federal Government should play a more prominent role in this disaster such as taking over the process of capping the well. While I am frustrated with the lack of progress in efforts to contain the spill, I am still not sure the government has any more expertise in this area than the oil company. From the beginning of any incident, the company responsible should be responsible for fixing their equipment and working with the appropriate authorities to clean up the damage caused by it. After they correct their loss, then the Federal Government should bill them for the loss they caused.

There are many in this Administration who argue that we should end offshore drilling altogether. This proposal of course will not solve the problem of oil spills and it only serves to shift drilling to other countries along with thousands of U.S. jobs. Rather, it is far more productive for the Federal Government to advance research and development to help industry not only drill responsibly but also more effectively clean the water and land after spills. The Outer Continental Shelf, the OCS, is one of the Nation's greatest resources for energy. The volume of oil coming up from the sea floor illustrates that this country still has valuable domestic resources as long as we have the technological feasibility to tap into them in a responsible manner.

I have long believed that the OCS must be a part of our national energy policy, which is why I have been a supporter of oil and gas development in deepwater environments. My primary goal in advancing the Ultra Deepwater and Unconventional Resource program into law is to encourage the development of technologies required to reach these vast resources in a way that prevents the loss of life and economic and environmental damage we have witnessed in the last couple of months. It is much more desirable to prevent a spill than to deal with the aftermath of one.

Beyond research into better drilling technology, we should also invest in research to ensure that we have the state-of-the-art tools to clean up the damage from a spill as quickly as possible, and it is very clear from the current response that the resources being employed, containment booms, dispersants and in situ burns are decades-old technologies. While there have been many improvements in these technologies since their inception, limitations still exist. There have been thousands of suggestions and proposals given to BP and the Federal Government on how to clean up this

spill. Of those thousands, are any worth deploying would have to be a question I would have to ask. Are these new technologies there that can be used for this spill? If so, why are the agencies involved in cleaning up oil spills not aware that they exist? What technologies have been developed from the millions of dollars these Federal agencies have spent in research in development in the last 20 years? How do we know what research needs exist if we do not even know what technology is already out there? I hope some of our panelists will be able to answer these questions.

Mr. Chairman, thank you. I yield back.

[The prepared statement of Mr. Hall follows:]

PREPARED STATEMENT OF REPRESENTATIVE RALPH M. HALL

Mr. Chairman, thank you for holding this hearing today. In the seven weeks since the April 20th explosion took the lives of 11 people on the rig Deepwater Horizon, our nation is still searching for answers on the causes of the explosion and is frustrated by the lack of progress in fully plugging the well and cleaning up the spill. I would like to first offer my condolences to the families of those lost in this horrible incident.

Second, it is worth noting that BP is ultimately responsible for this oil spill. They are responsible for repairing the damaged well, and as the owner of the mineral rights to drill for oil in the Mississippi Canyon Block 252, BP is also accountable for the clean up costs. To date, BP has paid out almost $49 million in claims and will be paying millions more moving forward. There have been suggestions that the Federal Government should play a more prominent role in this disaster, such as taking over the process of capping the well. While I am frustrated with the lack of progress in efforts to contain this spill, I am not sure the government has any more expertise in this area than the oil company. From the beginning of any incident, the company responsible should be responsible for fixing their equipment and working with the appropriate authorities to clean up the damage caused by it.

There are many in this Administration who argue that we should end offshore drilling altogether. This proposal, of course, will not solve the problem of oil spills, as it only serves to shift drilling to other countries along with thousands of U.S. jobs. Rather, it is far more productive for the Federal Government to advance research and development to help industry not only drill responsibly, but also more effectively clean the water and land after spills. The Outer Continental Shelf, or OCS, is one of the nation's greatest resources for energy. The volume of oil coming up from the sea floor illustrates that this country still has valuable, domestic resources as long as we have the technological feasibility to tap into them in a responsible manner. I have long believed that the OCS must be a part of our national energy policy, which is why I have been a supporter of oil and gas development in deepwater environments. My primary goal in advancing the Ultra-deepwater and Unconventional Resource program into law is to encourage the development of technologies required to reach these vast reserves in a way that prevents the loss of life and economic and environmental damage we have witnessed in the last couple of months. It is much more desirable to prevent a spill than to deal with the aftermath of one.

Beyond research into better drilling technologies, we should also invest in research to ensure that we have state of the art tools to clean up the damage from a spill as quickly as possible. It is clear from the current response that the resources being employed—containment booms, dispersants, in-situ burns—are decades-old technologies. While there have been many improvements in these technologies since their inception, limitations still exist.

There have been thousands of suggestions and proposals given to BP and the Federal Government on how to clean up this spill. Of those thousands, are any worth deploying? Are there new technologies that can be used for this spill? If so, why are the agencies involved in cleaning up oil spills not aware that they exist? What technologies have been developed from the millions of dollars these Federal agencies have spent on research and development in the last 20 years? How do we know what research needs exist if we do not even know what technologies are already out there? I hope some of our panelists will be able to answer these questions.

Chairman BAIRD. Thank you, Mr. Hall.

I would like to recognize the chairman of the Full Committee, Mr. Gordon from Tennessee.

Chairman GORDON. First, Chairman Baird, let me thank you for holding this important hearing. I know Mr. Hall has had an interest in this for a long time, but Ms. Woolsey really was the one that had foresight and she brought forth a bill last year which has come out of your Subcommittee and I think will be a good base for us to build upon to try to get action here.

Tragically, as we all know, 11 lives were lost on April 20th, and the livelihoods of many along the Gulf Coast will be affected for years to come by the oil that continues to flow 51 days later.

To date, there have been 13 Congressional hearings on the spill. However, this Committee is the first to look at the scientific and technological tools we need to effectively remove the oil from the water and clean up our ocean, marshes, and shorelines.

Furthermore, I expect that the Committee will hold a similar hearing on the science and technology needs for spill prevention and mitigation at the wellhead.

The BP Deepwater Horizon oil spill is an unprecedented tragedy, but oil spills happen in this country and around the world every day. We must push the envelope of research and technology to learn how to better respond to these incidents. The lack of an effective response to this spill highlights the need for a more reliable and standardized approach to response and remediation. We need to eliminate the guesswork, and go into spills knowing which tools are most effective in certain conditions.

For example, a Norwegian company has made innovative strides in oil boom technology. If there are standards and technologies we can learn from other countries, or from our own university and industry scientists, we need to leverage them. We need to tap every resource of knowledge available to us.

I understand it takes time and resources to research and develop new technologies and I am glad that we have two panels of experts to help us begin this conversation today. Thank you all for being here, and I yield back the balance of my time.

[The prepared statement of Chairman Gordon follows:]

PREPARED STATEMENT OF CHAIRMAN BART GORDON

Good morning. I want to thank the Energy and Environment Subcommittee for holding such an important hearing this morning.

Tragically, eleven lives were lost on April 20th, and the livelihoods of many along the Gulf coast will be affected for years to come by the oil that continues to flow now 51 days later.

To date, there have been 13 Congressional hearings on this spill. However, this Committee is the first to look at the scientific and technological tools we need to effectively remove the oil from the water and cleanup our ocean, marshes, and shorelines.

Furthermore, I expect that the Committee will hold a similar hearing on the science and technology needs for spill prevention and mitigation at the wellhead.

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or from our own university and industry scientists, we need to leverage it. We need to tap every resource of knowledge available to us.

I understand it takes time and resources to research and develop new technologies and I am glad that we have two panels of experts to help us begin this conversation today.

Thank you all for being here and I look forward to your testimony.

Chairman BAIRD. Thank you, Chairman Gordon.

I want to also extend my respect and appreciation for Ms. Woolsey, who was certainly prescient in her legislation of last year and we hope that perhaps we can move that along with some other bills later on.

If there are other Members who wish to submit opening statements, those statements will be added to the record at this point.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Good Morning. Thank you, Mr. Chairman, for holding today's hearing to discuss research and technology needs for recovery and cleanup of oil spills, such as the Deepwater Horizon disaster in the Gulf of Mexico.

The explosion of the Deepwater Horizon oil rig in April 2010 has resulted in the largest oil spill in U.S. history and an environmental and economic disaster for the Gulf Coast region. While British Petroleum (BP) appears to have captured some of the oil gushing from the broken well, we are still faced with a massive spill that may harm ecosystems and economies all along the Eastern Seaboard. We must examine the circumstances surrounding the explosion of the Deepwater Horizon rig and the response of BP and the Federal Government to this disaster. In addition, we must look at the technology available to address oil spills today and how research and development can improve our ability to respond to disasters like this in the future.

I am interested in how the Federal Government and the private sector can work together to develop technologies necessary to increase our speed in responding to oil spill disasters. BP took six weeks to secure the containment cap onto the spilling well, allowing millions of gallons of oil to fill the Gulf and contaminate beaches. Even with the cap in place, oil continues to leak and will likely not stop until relief wells are drilled within the next two months. Even when the leak stops, oil will continue to spread and harm the shoreline. We must improve the technology available to address the spills and the speed with which companies can access and utilize that technology to address the leak, contain the spread of oil, and clean contaminated areas.

Further, it is imperative that the Federal Government and private industry inspect and test new technology before deploying it in deep water. Under the Bush administration, there were no requirements for companies to test and certify equipment and technology before beginning to drill. The blowout preventer on Deepwater passed through several international companies and was never tested at 5,000 feet before it was put in use in the Gulf. Both BP and Transocean had no experience with a failure of these dimensions at this depth and no idea how to address the leak. As we work to develop technology to prevent leaks and improve clean-up, we must test and demonstrate new products to understand what can go wrong and how to fix problems before they become disasters on the scale of Deepwater.

I welcome our panel of witnesses and I look forward to their testimony.

I will inform my colleagues and the witnesses that it is our goal with two panels to try to finish with this panel at about 11:30, so I will ask my colleagues to keep their questions short. I will be strict with the five minute time frame, and that will give us ample time for both panels. We could obviously go on all day, I am sure, on this important topic.

Panel I:

With that, it is my pleasure to introduce our first panel of witnesses. Mr. Douglas Helton is the Incident Response Operations

Coordinator for the Office of Response and Restoration within the National Ocean Service at NOAA. Captain Anthony Lloyd is the Chief, Office of Incident Management and Preparedness for the U.S. Coast Guard. Ms. Sharon Buffington is Chief of the Engineering and Research Branch for Offshore Energy and Minerals Management Program at the Minerals Management Service, and Dr. Albert Venosa is the Director of the Land Remediation and Pollution Control Division of the National Risk Management Research Laboratory within the Office of Research and Development at EPA.

As our witnesses know, we will have five minutes for spoken testimony followed by questions alternating between both sides of the aisle.

Mr. Helton, please begin.

STATEMENTS OF DOUGLAS HELTON, INCIDENT OPERATIONS COORDINATOR, OFFICE OF RESPONSE AND RESTORATION, NATIONAL OCEAN SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

Mr. HELTON. Thank you, Mr. Chairman and Members of the Subcommittee, for the opportunity to testify about NOAA's role in response to the Deepwater Horizon oil spill.

My name is Doug Helton. I am the Incident Operations Coordinator for NOAA's Office of Response and Restoration. During spills, I help to manage emergency response efforts, focusing on NOAA's role as the primary scientific advisor to the U.S. Coast Guard.

This event started with the tragic loss of the 11 crew members. Like the rest of the public, I am saddened by those events and frustrated as the spill continues to spread and disrupt communities and resources across the Gulf region.

I came before this Committee almost a year ago today to talk about the risks of oil spills and oil spill research needs. As you mentioned, that hearing was prompted by the spills in San Francisco and also New Orleans. Those relatively modest spills caused concerns about the adequacy of response technologies. Now with this spill, we are faced with an incident that ultimately may prove to be thousands of times larger in terms of volume, impacts as well as the social and economic impacts. But all of the research priorities I mentioned last year in my testimony are still valid today, including questions about dispersant usage, modeling of deepwater releases and addressing the social and human dimensions of oil spills.

NOAA has responded to thousands of oil spills and has a long history of making science-based decisions. My office was called over 200 times last year to provide emergency support. We have three primary roles during spills. We serve as a science advisor to the Coast Guard and we provide trajectory analyses and overflights. We identify sensitive areas and we conduct shoreline surveys to guide cleanups. We also conduct damage assessments to restore natural resources injured by the spill. And finally, we represent the Department of Commerce in spill response decision making through the national response team.

My office was notified of the fire onboard the Deepwater Horizon at 2:24 a.m. on April 21st. Two hours later, we issued our first oil spill forecast. Since then, we have issued more than 260 of those

forecasts, surveyed hundreds of miles of shorelines, flown hundreds of overflights to track the oil. All of my division staff, including all 11 of our regional scientific support coordinators, are working on the spill, and we have even recalled retired personnel to assist.

In addition to my program, hundreds of additional NOAA personnel are working on ships, aircrafts and shorelines and command posts across the region to help with the spill. I don't have time to list all the things that NOAA is doing but those include the weather and satellite data to track the spill and to support planning. We are working on the sea turtle and marine mammal strandings. We are collecting and analyzing fish and shellfish for seafood safety. We are piloting the ships and aircraft that are being used to track the surface and subsurface oil.

I would like to talk for a minute about additional research needs. The public has very high expectations for prompt and effective cleanup, and responders must be equipped with the appropriate tools to meet those expectations. A robust research and development program can improve how we respond, and Congress recognized that need when they passed the Oil Pollution Act of 1990, but the R&D envisioned under OPA has not been achieved. With fewer large spills and competing national priorities, there has been a decline in oil spill research in both the public and private sector.

NOAA's most significant efforts in this oil spill research works through a partnership with the University of New Hampshire, and Dr. Kinner in the second panel will talk about those benefits, but they include many of the things that are issues here, including issues of dispersants and deepwater well blowouts.

While that research has been beneficial, more work is needed as the Deepwater Horizon spill demonstrates a need to understand how oil behaves and moves and disperses in the water column. There is a need for understanding oil and dispersant interactions with marine life and habitats, and there is a need for understanding the long-term effects of oil spills.

Finally, the human dimensions of how we can better help the communities that are affected by spills is a key aspect of research.

So in conclusion, the Deepwater Horizon will affect the Gulf region for years to come. We are not going to be able to prevent the impacts but we can use science to help improve our response decisions. And when spills happen, there is a rush of science, but quality research takes time as well as continued and sustained resources. While we are working with all haste, it is important to ensure that that science is accurate and we must continue this work between spills so we can develop the tools and understanding before, rather than during, the next big spill.

So I would like to conclude there, and thank you for allowing me to testify, and I would be happy to answer any questions.

[The prepared statement of Mr. Helton follows:]

PREPARED STATEMENT OF DOUGLAS HELTON

Thank you, Chairman Baird and Members of the Committee, for the opportunity to testify on the Department of Commerce's National Oceanic and Atmospheric Administration's (NOAA's) role in the response to the Deepwater Horizon oil spill and NOAA's role in oil spill research and development.

My name is Doug Helton and I am the Incident Operations Coordinator for the Emergency Response Division in NOAA's Office of Response and Restoration

(OR&R). I appreciate the opportunity to discuss the critical roles NOAA serves during oil spills and the importance of our contributions to protect and restore the resources, communities, and economies affected by this tragic event. Before I move on to discuss NOAA's efforts, I would first like to express my condolences to the families of the 11 people who lost their lives in the explosion and sinking of the Deepwater Horizon platform.

NOAA's mission is to understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social, and environmental needs. NOAA is also a natural resource trustee and is one of the Federal agencies responsible for protecting, assessing, and restoring the public's coastal natural resources when they are impacted by oil spills, hazardous substance releases, and impacts from vessel groundings on corals and seagrass beds. As such, the entire agency is deeply concerned about the immediate and long-term environmental, economic, and social impacts to the Gulf Coast and the Nation as a whole from this spill. NOAA is fully mobilized and working tirelessly to lessen impacts on the Gulf Coast and will continue to do so until the spill is controlled, oil is cleaned up, natural resource injuries are assessed, and restoration is complete.

My testimony today will discuss NOAA's role in the Deepwater Horizon response and natural resource damage assessment process associated with the Deepwater Horizon oil spill, for which BP is a responsible party; NOAA's role in oil spill research; and opportunities to strengthen the Federal response to future events through research and development.

NOAA'S ROLES DURING OIL SPILLS

NOAA has three critical roles mandated by the Oil Pollution Act of 1990 and the National Contingency Plan:

1. During the emergency response, NOAA serves as a conduit for scientific information to the Federal On-Scene Coordinator. NOAA provides trajectory predictions for spilled oil, conducts overflight observations of oil on water, identifies highly valued or sensitive environmental areas, and conducts shoreline surveys to determine clean-up priorities.
2. As a natural resource trustee, NOAA conducts a joint Natural Resource Damage Assessment (NRDA) with co-trustees to assess and restore natural resources injured by the oil spill. NRDA also assesses the lost uses of those resources, such as recreational fishing, canoeing, and swimming, with the goal of implementing restoration projects to address these injuries.
3. Finally, NOAA represents the Department of Commerce in spill response decisionmaking activities through the National Response Team.

Response

The U.S. Coast Guard (USCG) is the Federal On-Scene Coordinator and has the primary responsibility for managing coastal oil spill response and clean-up activities in the coastal zone. During an oil spill, NOAA's Scientific Support Coordinators deliver technical and scientific support to the USCG. NOAA's Scientific Support Coordinators are located around the country in USCG Districts, ready to respond around the clock to any emergencies involving the release of oil or hazardous substances into the oceans or atmosphere. Currently, NOAA has all of its Scientific Support Coordinators located throughout the country working on the Deepwater Horizon oil spill.

With over twenty years of experience and using state-of-the-art technology, NOAA continues to serve the Nation by providing its expertise and a suite of products and services critical for making science-based decisions. Examples include trajectory forecasts on the movement and behavior of spilled oil, overflight observations, spot weather forecasts, emergency coastal survey and charting capabilities, aerial and satellite imagery, and real-time coastal ocean observation data. Federal, state, and local entities look to NOAA for assistance, experience, local perspective, and scientific knowledge. NOAA's Office of Response and Restoration (OR&R) was called upon for scientific support 200 times in 2009.

Natural Resource Damage Assessment

Stewardship of the Nation's natural resources is shared among several Federal agencies, states, and tribal trustees. NOAA, acting on behalf of the Secretary of Commerce, is the lead Federal trustee for many of the Nation's coastal and marine resources, and is authorized by the Oil Pollution Act of 1990 (OPA) to recover damages on behalf of the public for injuries to trust resources resulting from an oil spill.

OPA encourages compensation in the form of restoration of the injured resources, and appropriate compensation is determined through the NRDA process.

Since the enactment of OPA, NOAA, together with other Federal, state, and tribal co-trustees have recovered approximately $500 million worth for restoration of natural resources injured by oil, hazardous substances and vessel groundings.

National Response Team

The National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the National Contingency Plan, is the Federal Government's blueprint for responding to both oil spills and hazardous substance releases. The purpose of the National Contingency Plan is to develop a national response capability and promote overall coordination among the hierarchy of responders and contingency plans. NOAA represents the Department of Commerce on the National Response Team and works closely with regional response teams and local area committees to develop policies on dispersant use, best clean-up practices and communications, and to ensure access to science-related resources, data, and expertise.

NOAA'S RESPONSE AND DAMAGE ASSESSMENT EFFORTS

NOAA's experts have been assisting with the response to the Deepwater Horizon oil spill from the beginning, providing coordinated scientific services when and where they are needed most.

At 2:24am (central time) on April 21, 2010, NOAA's OR&R was notified by the USCG of an explosion and fire on the Mobile Offshore Drilling Unit Deepwater Horizon, approximately 50 miles southeast of the Mississippi Delta. The explosion occurred at approximately 10:00pm on April 20, 2010. Two hours, 17 minutes after notification by the USCG, NOAA provided our first spill forecast predictions to the Unified Command in Robert, Louisiana. NOAA's National Weather Service Weather Forecast Office in Slidell, LA received the first request for weather support information from the USCG at 9:10am on April, 21, 2010 via telephone. The first graphical weather forecast was sent at 10:59am to the USCG District Eight Command Center in New Orleans.

Support from NOAA has not stopped since those first requests for information by the USCG. Over the past 7 weeks, NOAA has provided scientific support, both on-scene and through our headquarters and regional offices. NOAA's support includes twice daily trajectories of the spilled oil, weather data to support short and long range forecasts, and hourly localized 'spot' forecasts to determine the use of weather dependent mitigation techniques such as oil burns and chemical dispersant applications. We develop custom navigation products and updated charts to help keep mariners out of oil areas. NOAA uses satellite imagery and real-time observational data on the tides and currents to predict and verify oil spill location and movement. To ensure the safety of fishermen and consumer seafood safety, NOAA scientists are in the spill area taking water and seafood samples. In addition, NOAA's marine animal health experts are providing expertise and assistance with stranded sea turtles and marine mammals.

To facilitate on-the-ground understanding of the spill's impacts, NOAA is awarding grants for rapid response projects to monitor the impacts of the oil spill on Louisiana's coastal marshes and fishery species through the Sea Grant Program. To support the local communities as they deal with the economic, social, and environmental impacts of the spill, the Gulf Coast Sea Grant Programs are hosting a series of open forums across the Gulf where citizens have the opportunity to interact with industry, government, and university representatives. NOAA-organized volunteer beach clean-ups to remove debris from state beaches are helping to facilitate the cleanup of oil along the shoreline.

With multiple agencies supporting a diverse array of research projects in response to the Deepwater Horizon oil spill in the Gulf of Mexico, it is important to coordinate research activities to ensure the best use of limited resources. NOAA's Gulf Coast Sea Grant Programs are developing a web site to serve as a central database listing ongoing research activities and identifying funding opportunities for oil-spill related research, whether conducted by government, academic, or privately-supported scientists. The website's intent is to provide a single, comprehensive view of research activities in the Gulf that are being undertaken in connection with the Deepwater Horizon oil spill and to foster coordination of these efforts.

At the onset of this oil spill, NOAA quickly mobilized staff from its Damage Assessment Remediation and Restoration Program to begin coordinating with Federal and state co-trustees and the responsible parties to collect a variety of data that are critical to help inform the NRDA. NOAA is coordinating the NRDA effort with the

Department of the Interior (another Federal co-trustee), as well as co-trustees in five states and representatives for at least one responsible party, BP.

While it is still too early in the process to know what the full scope of the damage assessment will be, NOAA and co-trustees continue to collect data in the Gulf and across the five states. This data will be used to determine what natural resources have been injured and what human uses have been lost due to the spill. Several technical working groups comprising NOAA, Federal and state co-trustees, and representatives from one responsible party (BP) are gathering existing scientific information and developing and implementing baseline (pre-spill) and postimpact field studies for multiple resource categories. Hundreds of miles of coastal shoreline were surveyed by air and samples were taken to determine baseline levels prior to the oil hitting land, to identify where the oil has made landfall to support clean-up activities. Resources being assessed include fish and shellfish, bottom-dwelling plant and animal life, birds, marine mammals, turtles, and sensitive habitats such as wetlands, submerged aquatic vegetation or seagrasses, beaches, mudflats, bottom sediments, deep and shallow corals, chemosynthetic organisms, and the water column. Some of these resources may be included within National Estuarine Research Reserves and National Marine Sanctuaries. In addition, NOAA and co-trustee field teams are determining how human uses, including cultural uses, and natural resource services are being impacted.

Needless to say, for both the response and the NRDA, offices throughout NOAA are mobilized and hundreds of NOAA personnel are dedicating themselves to assist with this unprecedented effort.

OPPORTUNITIES TO STRENGTHEN FEDERAL RESPONSE THROUGH RESEARCH AND DEVELOPMENT

When passed in 1990, OPA envisioned a robust oil spill research and development program coordinated by the Interagency Coordinating Committee (ICC) on Oil Pollution Research. OPA recognized the need for research and created the ICC to coordinate and direct a dedicated program on oil pollution research, technology development, and demonstration among industry, universities, research institutions and Federal agencies, state governments and other nations, if appropriate. To date, funding has been provided through various state and Federal agencies and industry for oil pollution research. While coordinated interagency research activities are occurring, important research questions remain.

Achievement of the comprehensive and collaborative research and development program envisioned by OPA can only increase the effectiveness of our Nation's oil spill response and restoration capabilities. While existing research has resulted in advancement of some research technologies, more must be done to strengthen our Nation's response capabilities. A renewed commitment of the ICC to focus on the most pressing research needs—particularly deepwater releases and releases in cold/icy waters—is one place to start. The Administration is committed to this effort.

NOAA'S OIL SPILL RESEARCH EFFORTS

Strong science is critical to effective decision-making to minimize the economic impacts and mitigate the effects of oil spills on coastal and marine resources and associated communities.

OPA grants NOAA the authority to carry out research and development. NOAA's most significant effort in oil spill research was in 2004–2007 through a partnership with the University of New Hampshire's Coastal Response Research Center. Research at the Coastal Response Research Center focused on spill preparedness, response, assessment, and implementation of optimum oil recovery strategies. The partnership brought together the resources of a research-oriented university and the field expertise of NOAA's OR&R. In addition, through the Coastal Response Research Center, NOAA worked with partners to address other pressing research areas including the behavior of submerged oil, human dimensions of spills, assessment and restoration of ecosystem services, environmental tradeoffs, integrated modeling, and methods associated with in-situ burning approaches in coastal marshes to minimize further injury to resources. Other NOAA partners have supported more limited spill response research using NOAA funds, including the Cooperative Institute for Coastal and Estuarine Environmental Technology at the University of New Hampshire, and some Sea Grant partners. For example, Louisiana Sea Grant funded a research project to study the effectiveness of oil remediation techniques in a brackish intertidal marsh after Hurricane Katrina.

ACTIVITIES TO IMPROVE FUTURE RESPONSE AND RESOURCE ASSESSMENT EFFORTS

The Deepwater Horizon oil spill is a grave reminder that spills of national significance can occur despite the many safeguards and improvements that have been put into place since the passage of OPA. Although the best option is to prevent oil spills, the risk of oil spills remains a concern given the offshore and onshore oil infrastructure, pipes, and vessels that move huge volumes of oil through our waterways. If a spill does occur, responders must be equipped with the appropriate tools and information. An effective response, based on solid science and smart decision-making reduces environmental and socioeconomic impacts, as well as clean-up costs. Research and development and technological innovation by the public or private sector in the following areas would greatly enhance the tools and technologies available in the event of a spill.

- ***Oil Fate and Behavior from Deepwater Releases***
  Our ability to know where the oil is located is limited by what we can see and detect. As the Deepwater Horizon oil spill is demonstrating, there is a need to understand how oil behaves and disperses within the water column when released at deep depths. The emerging advancement in modeling three dimensionally can greatly enhance response operations and mitigation efficacy. NOAA's surface trajectory models predict where the oil on the surface is going based upon wind, currents, and other processes, and visual overflights validate where it is now. NOAA is currently employing facets of deep water oil spill models that were developed in part from the findings of the MMS DeepSpill Joint Industry Research Project done in 1999–2000 with international participation. However, we still understand little about the movement of oil deep in the ocean or the movement of dispersed oil that is suspended in the water column. The enhancement of three dimensional models will improve our ability to predict the movement of oil at depth and allow us to direct precious resources to validate the model's trajectory. Currently, NOAA is working to implement FY 2010 funds to enhance three dimensional models.
- ***Technology for Oil Detection in the Water Column and on the Seafloor***
  Research on new technologies for rapid and accurate detection of oil in deep water and plumes in the mid-water is needed. This would include the development of technologies to enhance our understanding of the fate and transport of oil, and to better understand the effects of oil on mid-water and deep water benthic habitat. There also appears to be some utility in applying existing technologies in a new and unique way to reach these same goals. For example, in limited research applications, modern multibeam echo sounders have been able to detect oil in the water column and on the seafloor. In addition, sensors on autonomous underwater vehicles and gliders are capable of detecting the presence of oil and gas in the water column. Whether provided by new technologies, or through re-examining the capabilities of current technologies, highly accurate information on the precise location of spilled oil would be of significant benefit to a spill response, such as Deepwater Horizon oil spill. Timely understanding of the precise location of the spilled oil would allow responders to position their activities and better utilize limited resources to maximize our contributions to protect and restore the resources, communities, and economies affected by these tragic events.
- ***Surface Observations and Trajectory Models***
  Real-time data on currents, tides, and winds as well as sustained observations of physical and chemical parameters of the whole water column are important in driving the models that inform the trajectory forecast for the spilled oil. As the Integrated Ocean Observing System generates more data from technological advances like high frequency radar, the prediction of oil location can be improved by pulling these observations into trajectory models in real-time. Through the collaborative efforts of the U.S. Integrated Ocean Observing System (IOOS), two of the three radars along the northern Gulf of Mexico coast were quickly re-established and made operational and now all three are delivering surface current data. Because we cannot predict where a spill will occur, data delivery from high frequency radars is envisioned to be part of a seamless national system.
  Data collected by space-based synthetic aperture radar can be used to produce high resolution images of the Earth's lands and oceans and can also be used in all types of weather, as it can "see through" clouds and darkness. Current use of NOAA-generated experimental products suggest that data from space-based synthetic aperture radar can assist in detecting and refin-

ing the areal extent of oil, which would provide valuable information to help determine where response efforts and resources should be deployed.

Current hydrographic surveys carry out sustained observations of the whole water column in the Gulf of Mexico, Florida Bay, Florida Keys, and will be extended if the oil or dispersant spread through the Strait of Florida and into the Gulf Stream. These surveys, along with satellite observations and numerical models, allow monitoring of currents and features responsible for the transport of oil and dispersant. A sustained observing system for this region would allow NOAA to provide predictive information about how the spill may impact the East Coast of the United States.

- ***Long-Term Effects on Species and Habitats***

  Spilled oil can remain in the sediments along the shoreline and in wetlands and other environments for years. More than 20 years later, there are still toxic levels of sub-surface oil in Prince William Sound from the Exxon Valdez spill. Research is needed to improve our understanding of the long-term effects of oil on sensitive and economically important species and habitats. Continued research is also needed to determine the effects of oil and dispersants that are suspended in the water column on mid-water and pelagic species, as well as research on the effects of oil on deep water corals, chemosynthetic communities (animal communities living in the deep sea on dissolved gases and benthic habitats) and benthic habitats. Important interagency studies are currently underway which will provide valuable information on the sensitivity and/or resilience of these deepwater communities and can inform response actions.

- ***Data Management Tools for Decision Making***

  The key to effective emergency response is efficiently integrating current science, information technology, and real-time observational data into response decision-making. NOAA has developed the Emergency Response Management Application (ERMA), a web-based information management application, to facilitate preparedness, response, and restoration decision-making for oil spills and for other coastal hazards. ERMA integrates real-time observations (e.g., NOAA National Buoy Data Center data, weather data, shoreline data, vessel traffic information, etc.) with archived data sources (e.g., NOAA's National Oceanographic Data Center's historical data) in an easy to use, Google-based format to aid in evaluating resources at risk, visualizing oil trajectories, and planning rapid tactical response operations, injury assessment and habitat restoration. Having access to retrospective data is critical to bring value to real-time observational data being collected.

  NOAA is currently using certain components of the Gulf of Mexico ERMA for the Deepwater Horizon oil spill response to help manage the common operational picture for all command posts. While still under development, when the Gulf of Mexico ERMA is fully operational it will provide a more dynamic and automated tool allowing for greater access, and provide more layers of data and high resolution photography. ERMAs allow users to navigate through different layers of information to reveal actual data and magnify areas of geographic interest—ultimately improving decision-making. For example, ERMA could provide a picture of diverse shoreline development (e.g., industry, residential, protected habitats, tourist/ recreational use), information on routine shipments of oil and chemicals through the Gulf, and the proximity' of wildlife management areas and conservation easements. Currently, ERMA is fully operational in the U.S. Caribbean and New England.

- ***Natural Resource Protection Tools***

  Environmental Sensitivity Index (EST) database and map products provide information that helps reduce the environmental, economic, and social impacts from oil and hazardous substance spills. ESI maps include information on biological resources (such as birds, shellfish beds, and endangered species), sensitive shorelines (such as marshes, tidal flats, and marine sanctuaries), and human-use resources (such as public beaches, parks, and drinking water intakes). ESI maps are one tool that spill responders can use to identify priority areas to protect from the spreading oil, develop cleanup strategies to minimize impacts to the environment and coastal communities, and reduce overall cleanup costs. NOAA's goal is to update ESI maps approximately every ten years to ensure responders have up-to-date information.

- ***Research to Improve Tools for Assessment and Restoration***

  Current techniques to assess and restore injured natural resources need to be constantly updated and refined. As our understanding of complex ecosystems evolves, so should our modeling tools and restoration techniques. For

example, currently, site-specific protocols for assessing injuries to unique, high-value habitats such as those found in the Arctic are needed. In addition, research and tools to better assess and quantify natural resource services—such as water filtration and capture, flood protection, carbon sequestration, recreation, and education—across a range of habitat types can help ensure the public is fully compensated and the environment fully restored.

- ***Air Quality Impacts***
  In addition to its marine responsibilities, NOAA is also responsible for predicting the air quality impacts from oil and hazardous substance spills. The characteristics of pollution released from large areas of burning oil and the widespread evaporation of oil are significantly different from routine air quality/atmospheric dispersion scenarios. Research and development of improved tools to estimate the characteristics of compounds entering the atmosphere, and integration of those tools with NOAA's existing atmospheric modeling capabilities, would significantly improve NOAA's ability to predict smoke and chemical concentrations in the atmosphere resulting from such incidents.
- ***Oil in Arctic Environments***
  Continued acceleration of sea-ice decline in the Arctic Ocean as a consequence of global warming may lead to increased Arctic maritime transportation and energy exploration that in turn may increase the potential of oil spills in the Arctic. Recent studies, such as the Arctic Monitoring and Assessment Programme's Oil and Gas Assessment, indicate that we currently lack the information to determine how oil will behave in icy environments or when it sinks below the surface. We also lack a basic understanding of the current environmental conditions, which is important for conducting injury assessments and developing restoration strategies. Research is needed to better understand the challenges of spill response in Arctic waters and the most effective tools and techniques to utilize in such environments.
- ***Human Dimensions***
  Research is needed on how to incorporate impacted communities into the preparedness and response processes to help to address the human dimensions of spills, including social issues, community effects, risk communication methods, and valuation of natural resources. Transparency and communications can be improved to share information with impacted communities on how and why decisions are made, and the breadth of response and NRDA activities that have been and will be undertaken for the Deepwater Horizon oil spill.

CONCLUSION

As this Committee is well aware, research takes time. A major research cruise can take a year to plan. A model can take years to develop and validate. A report can take months to get right. The Deepwater Horizon oil spill is causing harm that will impact coastal environments for years to come. Applying the latest science and continued research and development efforts in the public and private sectors can improve our response decisions, thereby reducing injury to our Nation's economy and environment.

I would like to assure you that we will not relent in our efforts to protect the livelihoods of affected Gulf Coast residents and mitigate the environmental impacts of this spill. In the wake of such an event, we are reminded of the fragility of our coastal ecosystems and the dependence of coastal economies on the health and prosperity of our seas. Thank you for allowing me to testify on NOAA's response and damage assessment efforts and areas for future research. I am happy to answer any questions you may have.

BIOGRAPHY FOR DOUGLAS HELTON

Douglas (Doug) Helton is the Incident Operations Coordinator for the National Oceanic and Atmospheric Administration's (NOAA) Emergency Response Division. The Division provides scientific and technical support to the Coast Guard during oil and chemical spill responses. The Division is based in Seattle, WA, but manages NOAA response efforts nationally. Mr. Helton has worked on oil spills, shipwrecks, abandoned vessels, and emergency response efforts in almost all coastal states, ranging from Maine to American Samoa. Mr. Helton recently completed an 18 month leadership program in NOAA that included 3 months as the Acting Director of NOAA's Marine Debris Program, and 4 months with the Port of Seattle. Mr. Helton also spent 6 months with the U.S. Senate Commerce Committee. In that capacity he worked on several bills including Ballast Water Management, Coral Reef Conservation, Oil Pollution, Coast Guard reauthorization, and other ocean-related

legislation. Mr Helton is also the U.S. representative to the International Maritime Organization 's working group on oil and chemical pollution. Prior to his current position, Mr. Helton headed NOAA 's Damage Assessment Center (DAC) which allows NOAA to place regional scientists and contractors on-scene quickly after an oil or chemical spill to collect perishable biological and economic data and to initiate damage assessment studies to support legal claims for restoration. Mr. Helton received a BA from Reed College in 1985 and an MS from the U.W. School of Fisheries in 1991. Mr. Helton was a John Knauss Sea Grant Fellow in 1991–1992.

Chairman BAIRD. Thank you, Mr. Helton.

Captain Lloyd.

STATEMENTS OF CAPTAIN ANTHONY LLOYD, CHIEF, OFFICE OF INCIDENT MANAGEMENT AND PREPAREDNESS, UNITED STATES COAST GUARD

Captain LLOYD. Good morning, Mr. Chairman and distinguished Members of the Committee. I am grateful for the opportunity to appear before you to discuss Federal and Coast Guard oil spill response research objectives and accomplishments.

The Coast Guard has been the lead Federal agency for oil and hazardous materials pollution incidents in the coastal zone since 1968. I have been personally involved in oil and hazmat prevention and incident response for the majority of my career. As a marine safety professional and first responder, I carry that perspective into my roles as Chairman of the national response team for the Deepwater Horizon incident and Chairman of the Interagency Coordinating Committee on Oil Pollution Research, otherwise known as the Interagency Committee, to lead ongoing efforts to, among other things, address research and development issues, coordination and planning.

The passage of OPA 90 represented a significant paradigm shift for the Coast Guard. This historic legislation provided the Nation with the means to immediately access and distribute funding for oil spill response efforts. It imposed specific requirements on the responsible party and provided a process to restore the marine environment to its pre-incident condition. With this legislation came annual funding for the Coast Guard and other agencies to enhance, among other things, oil spill prevention response and research and development.

Based on the lessons learned from Exxon Valdez, the Coast Guard's oil pollution R&D efforts have focused on four primary research areas: prevention, salvage and onboard countermeasures, spill planning and response management, spill detection and surveillance, oil containment and recovery and alternative countermeasures. Notable Coast Guard R&D accomplishments resulting from these focused efforts over the past two decades to also include: the development of a vessel of opportunity skimming system which is being employed in response pervasively as we speak, procedures for commercial vessels, and shipboard oil recovery system for Coast Guard buoy tenders. Also, there have been informed requirements, prototype and tested capabilities for fast water response, temporary storage devices, oil and water separation systems, in situ burning techniques and fire boom evaluations, among other things such as decision support tools for incident management.

With regard to marine pollution prevention and response overall, spill number volume continues to drop. A recently revised Congres-

sional Research Service report on oil spills affirms that spill volumes have dropped by 50 percent since 1995. This figure is much higher going back to the early 1970s, and this drop has been attributed to the increase in liabilities for oil shipment, increased Federal authorities and the advent of double hulls. Double hulls bear a particular mention due to the upcoming OPA 90 phase-in of additional requirements to ensure all oil-carrying vessels are double hulled by 2015.

In addition to implementing the Coast Guard's own oil pollution R&D program, the service chairs the 13-member Interagency Coordinating Committee on Oil Pollution Research, the Interagency Committee. Section 7000 of OPA 90 established the Interagency Committee for two reasons: to prepare a comprehensive coordinated Federal oil pollution research and development plan, and to promote cooperation with industry, universities, research institutions, state governments, and other nations. We have submitted our latest report in December of 2009 which embodied the OPA 90 approach of the whole of government, a team-based approach to spill response and preparedness. This is key to the improvement, whether we can improve our ability to respond to oil spills nationwide. This collaboration ensures progress is made in advancing oil pollution research and technology across a wide range of issues, and this cross-pollination of ideas between industry and government ensures the latest policy issues and technology breakthroughs are realized as well.

We have a wide range of opportunities to conduct this interaction. We have done this through a variety of conferences and meetings throughout the last year in preparation for a revision to the 1997 plan. It is clear that the interaction will drive the incident and further clarity emerging from where we need to go in spill prevention and response and restoration. This interaction is also driven through a variety of meetings and interaction with private industry, spill control association and other individuals.

The future focus for the Coast Guard will continue to be on submerged oil, the Arctic and deepwater environments. These meetings will be taking place over the next year as we try to revise our plan, and I thank you for the opportunity to testify this morning.

[The prepared statement of Captain Lloyd follows:]

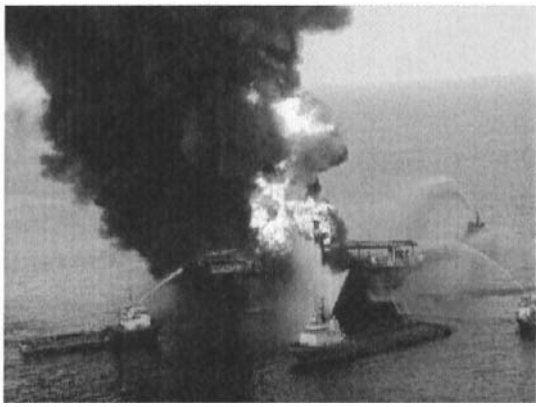
PREPARED STATEMENT OF ANTHONY S. LLOYD

Good morning Chairman Baird and distinguished Members of the Committee. Thank you for the opportunity to testify before you on the BP/Deepwater Horizon oil spill.

On the evening of April 20, 2010, the Transocean-owned, BP-chartered, Marshall Islands-flagged Mobile Offshore Drilling Unit (MODU) Deepwater Horizon, located approximately 72 miles Southeast of Venice, Louisiana, reported an explosion and fire onboard. This began as a Search and Rescue (SAR) mission—within the first few hours, 115 of the 126 crewmembers were safely recovered; SAR activities continued through April 23, but the remaining 11 crewmembers were never found.

Concurrent with the SAR effort, the response to extinguish the fire and mitigate the impacts of the approximately 700,000 gallons of diesel fuel onboard began almost immediately. After two days of fighting the fire, the MODU sank in approximately 5,000 feet of water on April 22. On April 23, remotely operated vehicles (ROVs) located the MODU on the seafloor, and. on April 24, BP found the first two leaks in the riser pipe and alerted the Federal Government. Within the first 24 hours, the Coast Guard's Federal on Scene Coordinator (FOSC) confirmed with representatives from the Oil Spill Liability Trust Fund (OSLTF) that funds were avail-

able to speed the Federal response to the threat of an oil spill. ROVs continue to monitor the flow of oil.



As the event unfolded, a robust Incident Command System (ICS) response organization was stood up on April 23 in accordance with the National Response Framework (NRF) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). ICS provides a common method to develop and implement tactical plans to effectively manage a multi-agency response to an emergency, such as an oil spill. The ICS organization for this response includes Incident Command Posts and Unified Commands at the local level, and a Unified Area Command at the regional level. It is comprised of representatives from the Coast Guard (FOSC), other Federal, state, and local agencies, as well as BP as a responsible party.

The Federal Government has addressed the BP/Deepwater Horizon Oil Spill with an all-hands-on deck approach from the moment the explosion occurred. On the date of the explosion, a command center was set up on the Gulf Coast to address the potential environmental impact of the event and to coordinate with all state and local governments. After the MODU sank on April 22, the National Response Team (NRT)—led by the Secretary of Homeland Security and comprised of 16 Federal agencies including the Coast Guard, other DHS offices, Department of Interior (DOI), the Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA),—as well as Regional Response Teams (RRT), were activated.

On April 29, Secretary Napolitano declared the event a Spill of National Significance (SONS), which enhanced operational and policy coordination at the national level and concurrently allowed the appointment of Admiral Thad Allen as the National Incident Commander (NIC) for the Administration's continued, coordinated response. The NIC's role is to coordinate strategic communications, national policy, and resource support, and to facilitate collaboration with key parts of the Federal, state and local government.

The NIC staff is comprised of subject matter experts from across the Federal Government, allowing for immediate interagency collaboration, approval and coordination. While the FOSC maintains authorities for response operations as directed in the National Contingency Plan, the NIC's primary focus is providing national-level support to the operational response. This means providing the Unified Command with everything that they need—from resources to policy decisions—to sustain their efforts to secure the source and mitigate the impact. This will be a sustained effort that will continue until the discharges are permanently stopped and the effects of the spill are mitigated to the greatest extent possible. Beyond securing the source of the spill, the Unified Command is committed to minimizing the economic and social impacts to the affected communities and the nation.

UNIFIED RECOVERY EFFORTS

The Unified Command continues to attack the spill offshore. As of June 2, 2010, over 14.2 million gallons of oily water have been successfully recovered using mechanical surface cleaning methods. Further, approximately 738,000 of surface dispersants have been applied to break up the slick, and over 120 controlled burns have been conducted when weather conditions allowed. In addition to the ongoing offshore oil recovery operations, significant containment and exclusion booms have

been deployed and staged strategically throughout the Gulf region. These booms are used to protect sensitive areas including: environmental and cultural resources, and critical infrastructure, as identified in the applicable Area Contingency Plans (ACPs). To date, almost two million feet of boom have been positioned to protect environmentally sensitive areas. Fourteen staging areas have been established across the Gulf Coast states and three regional command centers. The Secretary of Defense approved the requests of the Governors of Alabama (up to 3,000), Florida (up to 2,500), Louisiana (up to 6,000), and Mississippi (up to 6,000) to use their National Guard forces in Title 32, U.S. Code, status to help in the response to the oil spill.

VOLUNTEERISM AND COMMUNICATION WITH LOCAL COMMUNITIES

A critical aspect of response operations is active engagement and communication with the local communities. Several initiatives are underway to ensure regular communications with the local communities.

1. Active participation and engagement in town hall meetings across the region with industry and government involvement.
2. Daily phone calls with affected trade associations.
3. Coordination of public involvement through a volunteer registration hotline (1–866–4485816), alternative technology, products and services e-mail (horizonsupport@aol.com), and response and safety training scheduled and conducted in numerous locations.
4. More than 21,596 inquiries received online via the response website (*www.deepwaterhorizonresponse.com*) with more than 19,000 inquiries completed. (As of June 2, 2010.)
5. Over 60 million page hits on response website.

6. Almost 1,000 documents created/posted to response website for public consumption.
7. News, photo/video releases, advisories to more than 5,000 media/governmental/private contacts.
8. Full utilization of social media including Facebook, YouTube, Twitter and Flickr.
9. Establishment of Local Government hotlines in Houma, LA (985–493–7835), Mobile, AL (251–445–8968), Robert, LA (985–902–5253).

MODU REGULATORY COMPLIANCE REQUIREMENTS

43 U.S.C. § 1331, et seq. mandates that MODUs documented under the laws of a foreign nation, such as the Deepwater Horizon, be examined by the Coast Guard. These MODUs are required to obtain a U.S. Coast Guard Certificate of Compliance (COC) prior to operating on the U.S. Outer Continental Shelf (OCS).

In order for the Coast Guard to issue a COC, one of three conditions must be met:

1. The MODU must be constructed to meet the design and equipment standards of 46 CFR part 108.
2. The MODU must be constructed to meet the design and equipment standards of the documenting nation (flag state) if the standards provide a level

of safety generally equivalent to or greater than that provided under 46 CFR part 108.

3. The MODU must be constructed to meet the design and equipment standards for MODUs contained in the International Maritime Organization Code for the Construction and Equipment of MODUs.

The Deepwater Horizon had a valid COC at the time of the incident, which was renewed July 29, 2009 with no deficiencies noted. The COC was issued based on compliance with number three, stated above. COCs are valid for a period of two years.

COAST GUARD/MMS JOINT INVESTIGATION RESPONSIBILITIES

On April 27th, Secretary Napolitano and Secretary of the Interior Ken Salazar signed the order that outlined the joint Coast Guard-MMS investigation into the Deepwater Horizon incident.

Information gathering began immediately after the explosion—investigators from both agencies launched a preliminary investigation that included evidence collection, interviews, witness statements from surviving crew members, and completion of chemical tests of the crew. The aim of this investigation is to gain an understanding of the causal factors involved in the explosion, fire, sinking and tragic loss of 11 crewmembers.

The joint investigation will include public hearings, which have already begun in Kenner, LA. The formal joint investigation team consists of equal representation of Coast Guard and MMS members. The Coast Guard has also provided subject matter experts and support staff to assist in the investigation.

LESSONS LEARNED FROM PAST RESPONSES

The Coast Guard has been combating oil and hazardous materials spills for many years; in particular, the 1989 major oil spill from the EXXON VALDEZ yielded comprehensive spill preparedness and response responsibilities.

In the 20 years since the EXXON VALDEZ, the Coast Guard has conducted SONS exercises every three years. In 2002, the SONS Exercise was held in New Orleans to deal with the implications of a wellhead loss in the Gulf of Mexico. In that exercise, the SONS team created a vertically integrated organization to link local response requirements to a RRT. The requirements of the RRT are then passed to the NRT in Washington, DC, thereby integrating the spill management and decision processes across the Federal Government. The response protocols used in the current response are a direct result of past lessons learned from real world events and exercises including SONS.

Although the EXXON VALDEZ spill shaped many of the preparedness and response requirements and legislation followed to this day, other significant events since 1989 have generated additional lessons learned that shape our response strategies. The Coast Guard and EPA FOSCs have accessed the OSLTF to respond to over 11,000 oil spills or significant threats of an oil spill in the 19 years since the establishment of the Fund. The liability and compensation regime contained in Title Ito the Oil Pollution Act of 1990 is well rehearsed and integrated into the FOSC's daily operations. Use of the Fund, oversight of the responsible party's obligation to advertise for and receive claims from those damaged by oil pollution, and cost recovery from the responsible party of all Federal funds expended are all part of the pollution response exercise cycle.

These functions were most recently exercised during the Spill of National Significance (SONS) 2010 exercise that took place in Maine in March 2010.

Nearly 600 people from over 37 agencies participated in the exercise. This exercise scenario was based on a catastrophic oil spill resulting from a collision between a loaded oil tanker and a car carrier off the coast of Portland, Maine. The exercise involved response preparedness activities in Portland, ME; Boston, MA; Portsmouth, NH; Portsmouth, VA; and Washington, DC. The response to the SONS scenario involved the implementation of oil spill response plans, and response organizational elements including two Unified Commands, a Unified Area Command, and the NIC in accordance with the National Contingency Plan and national Response Framework. The exercise focused on three national-level strategic objectives:

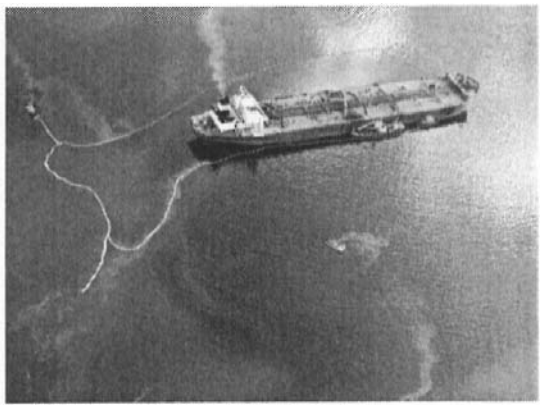
1. Implement response organizations in applicable oil spill response plans
2. Test the organization's ability to address multi-regional coordination issues using planned response organizations
3. Communicate with the public and stakeholders outside the response organization using applicable organizational components

The SONS 2010 exercise was considered a success, highlighting a maturity of the inter-agency and private oil spill response capabilities and the importance of national-level interactions to ensure optimal information flow and situational awareness. The timely planning and execution of this national-level exercise have paid huge dividends in the response to this potentially catastrophic oil spill in the Gulf of Mexico.

ROLE OF THE OIL SPILL LIABILITY TRUST FUND

The Oil Spill Liability Trust Fund (OSLTF), established in the U.S. Treasury, is available to pay the expenses of Federal response to oil pollution under the Federal Water Pollution Control Act (FWPCA)(33 U.S.C. § 1321(c)) and to compensate claims for oil removal costs and certain damages caused by oil pollution as authorized by the Oil Pollution Act of 1990 (OPA) (33 U.S.C. § 2701 et seq.). These OSLTF expenditures will be recovered from responsible parties liable under OPA when there is a discharge of oil to navigable waters, adjoining shorelines, or the Exclusive Economic Zone (EEZ).

The United States established an exclusive economic zone, the outer limit of which is a line drawn in such a manner that each point on it is 200 nautical miles from the baseline from which the breadth of the territorial sea is measured. The U.S. EEZ is the largest in the world, containing 3.4 million square miles of ocean and 90,000 miles of coastline.



The OSLTF is established under section 9509 of the Internal Revenue Code (26 USC § 9509), which also describes the authorized revenue streams and certain broad limits on its use. The principal revenue stream is an 8 cent per barrel tax on oil produced or entered into the United States (see the tax provision at 26 U.S.C. § 4611). The per barrel tax increases to 9 cents for one year beginning on January 1, 2017, and the per barrel tax expires at the end of 2017. Other revenue streams include oil pollution-related penalties under 33 U.S.C. § 1319 and § 1321, interest earned through Treasury investments, and recoveries from liable responsible parties under OPA. The current OSLTF balance is approximately $1.5 billion. There is no cap on the fund balance but there are limits on its use per oil pollution incident. The maximum amount that may be paid from the OSLTF for any one incident is $1 billion. Of that amount, no more than $500 million may be paid for natural resource damages (26 U.S.C. § 9509(c)(2)).

OPA further provides that the OSLTF is available to the President for certain purposes (33 U.S.C. § 2712(a)) including Federal removal costs, claims for uncompensated removal costs and damages, and payment of select Federal administrative, operating and personnel costs addressed by the OPA.

NATIONAL POLLUTION FUNDS CENTER FUNDING AND COST RECOVERY

The National Pollution Funds Center (NPFC) is a Coast Guard unit that manages use of the OSLTF, making available the emergency fund for Federal removal as well as trustee costs to initiate natural resource damage assessment. The NPFC also pays qualifying claims against the OSLTF that are not compensated by the responsible party. Damages include real and personal property damages, natural resource damages, loss of subsistence use of natural resources, lost profits and earnings of

businesses and individuals, lost government revenues, and net costs of increased or additional public services that may be recovered by a state or political subdivision of a state.

In a typical scenario, the FOSC, Coast Guard, or EPA accesses the emergency fund to carry out 33 U.S.C. § 1321(c), that is, to remove an oil discharge or prevent or mitigate a substantial threat of discharge of oil to navigable waters, the adjoining shoreline or the EEZ. Costs are documented and provided to NPFC for reconciliation and eventual cost recovery against liable responsible parties. Federal trustees may request funds to initiate an assessment of natural resource damages and the NPFC will provide those funds from the emergency fund as well.

OPA provides that all claims for removal costs or damages shall be presented first to the responsible party. Any person or government may be a claimant. If the responsible party denies liability for the claim, or the claim is not settled within 90 days of being presented, a claimant may elect to commence an action in court against the responsible party or to present the claim to the NPFC for payment from the OSLTF. OPA provides an express exception to this order of presentment for state removal cost claims. Such claims are not required to be presented first to the responsible party and may be presented directly to the NPFC for payment from the OSLTF. These and other general claims provisions are delineated in 33 U.S.C. § 2713 and the implementing regulations for claims against the OSLTF in 33 CFR Part 136. NPFC maintains information to assist claimants on its website at *www.uscg.mil/npfc*.

NPFC pursues cost recovery for all OSLTF expenses for removal costs and damages against liable responsible parties pursuant to Federal claims collection law including the Debt Collection Act, implementing regulations at 31 CFR parts 901–904 and DHS regulations in 6 CFR part 11.

Aggressive collection efforts are consistent with the "polluter pays" public policy underlying the OPA. However, the OSLTF is intended to pay even when a responsible party does not pay.

THE EMERGENCY FUND AND DEEPWATER HORIZON

The OSLTF consists of two major components, the main fund, or Principal Fund, and an Emergency Fund.

The Emergency Fund is available for Federal On-Scene Coordinators (FOSCs) to respond to oil discharges and for Federal natural resource trustees to initiate natural resource damage assessments, pending reimbursement by the Responsible Party. The Emergency Fund is authorized to receive an annual $50 million infusion of funds through an apportionment from the OSLTF Principal Fund. In addition, the Emergency Fund may receive an advance of $100 million from the Principal Fund to supplement Emergency Fund shortfalls. (See 33 U.S.C. § 2752(b)).

In FY 2010, the Emergency Fund has already received its annual $50 million apportionment. On May 3, 2010, since the initiation of the BP/Deepwater Horizon response, it received the statutorily authorized $100 million advance. These funds have been used to support the ongoing response efforts of 27 Federal entities as well as response funding provided directly to the affected states.

While all funds expended will be billed to BP and, ultimately, recovered, these funds are deposited into the principal fund, not the emergency fund. As of June 1, 2010, obligations against the Emergency Fund for Federal response efforts totaled $93 million. At the current pace of BP/Deepwater Horizon response operations, funding available in the Emergency Fund will be insufficient to sustain Federal response operations within two weeks. Should this occur, the FOSC will not be able to commit additional funds for the agencies involved to provide critical response services, including for logistical, scientific and public health support.

On May 12, the Administration proposed a legislative package that will: enable the Deepwater Horizon Oil Spill response to continue expeditiously; speed assistance to people affected by this spill; and strengthen and update the oil spill liability system to better address catastrophic events. The bill would permit the Coast Guard to obtain one or more advances—up to $100 million each—from the Principal Fund within the OSLTF to underwrite Federal response activities taken in connection with the discharge of oil associated with the BP Deepwater Horizon spill. This provision would ensure that the Emergency Fund has sufficient resources to support the Federal response. To enhance the ability to address generally the harms created by oil spills as well as to strengthen and update these laws, the bill would, for any single incident, raise the statutory expenditure limitations for the OSLTF from $1 billion to $1.5 billion and for natural resource damage assessments and claims from $500 million to $750 million.

LIABILITY LIMITS AND FINANCIAL RESPONSIBILITY

The Administration's May 12 legislative package also includes significant increases to OPA liability limits for vessel and facility source oil discharges, particularly relating to liability for oil removal costs.

Current law provides that a vessel's liability limit for oil removal costs and damages is a single fixed amount based on the vessel gross tonnage and vessel type. There are also certain fixed minimum amounts that may apply. Beginning in January 2007, the Coast Guard has annually reported on the adequacy—or rather, the inadequacy—of vessel liability limits. In the most recent 2009 Report on Oil Pollution Act Liability Limits, the Coast Guard's NPFC concluded as follows:

The NPFC continues to anticipate the OSLTF will be able to cover its projected non-catastrophic liabilities, including claims, without further increases to liability limits. However, **increases to liability limits for certain vessel types would result in a more equitable division of risk between the Fund and responsible parties, have a positive impact on the balance of the Fund, and reduce the Fund's overall risk position [emphasis added]**.

The limited data available indicates, as in previous reports, that increasing liability limits per incident for single hull tank ships, tank barges and non-tank vessels greater than 300 gross tons in particular would result in a more balanced cost share between responsible parties and the Fund while positively impacting the Fund's balance.[1]

Companies participating in offshore drilling, shipping, and other activities currently covered by Oil Pollution Act liability caps must demonstrate that they have the financial capacity to address anticipated clean-up costs and damages from their operations. Oil and other companies participating in offshore drilling activities should be strictly liable (jointly and severally) and responsible for all of the damages their activities could impose on persons, businesses, and the environment, thereby not only ensuring full compensation in the event of a spill, but also greatly aiding the prevention of future spills in the first place. Similarly, oil spill liability caps established by the Oil Pollution Act of 1990 for activities other than offshore drilling activities, such as shipping, should be reviewed and increased as appropriate to more fully reflect the spill risk associated with those activities. We look forward to working with Congress to change liability rules going forward and implement those changes within a reasonable transition period.

OPA CLAIMS PROCESS AND DEEPWATER HORIZON

BP and Transocean acknowledged in writing on May 10 their responsibility to advertise to the public the process by which claims may be presented; the NPFC has directed the responsible parties to use one phone number and one process so as not to confuse claimants, and all claims are being processed centrally through BP. As of May 31, 30,619 claims have been opened with BP, and more than $39 million has been disbursed; no claim has been denied, though many have yet to be processed.

So far, the majority of claims have been for lost income and lost profits for individuals and small businesses; as more oil comes ashore, property damage claims will likely increase. The interagency community continues to oversee BP's claims process. BP has set up 30 claims processing centers throughout the affected region, with over 480 managers and claims adjusters in the field. BP has also established a 1–800 number that is available 24/7, as well as web-based claims submission capabilities. While OPA 90 requires the responsible party to advertise and accept claims, NPFC has asked BP to be responsive to additional requests for information or action to ensure the claims process is meeting the needs of the citizens of the Gulf. The NPFC is in daily communication with BP regarding its claims administration and is raising concerns as they emerge. For example, in response to an NPFC request, BP is now providing translation services in Vietnamese and Spanish in certain communities, as well as on the 1–800 phone line. BP has also established a mediation capability for claimants who desire.

That said, we do not yet have complete, ongoing transparency into BP's claims process including detailed information on how claims are being evaluated, how payment amounts are being calculated, and how quickly claims are being processed. We are working with BP's senior executives to make sure we have the information we and appropriate representatives of State governments need to meet our responsibilities to the public.

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[1] The full Limit of Liability report is available on the NPFC web site at: *http://www.uscg.mil/npfc/docs/PDFs/Reports/Liability_Limits_Report_2009.pdf*

BP's current claims capacity can take in 6,000 claims per day, while the current rate is well under 2,000. BP reports that it can surge to a capacity of taking in 15,000 claims per day, with over 2,500 adjusters and managers in the field in a matter of days. However, BP has not responded to all of NPFC's requests for data. BP currently provides daily summary data on claims that does not provide enough visibility into the claims process to fully view claims amounts and processing times.

Claims can be paid for the following damages (33 U.S.C. § 2702(b)):

Unreimbursed Removal Costs
Real or Personal Property Damage
Loss of Profits or Earning Capacity
Loss of Government Revenue
Cost of Increased Public Services
Natural Resource Damages
Loss of Subsistence Use of Natural Resource Damages (NRD)

Claims can be submitted within the following statute of limitation:

For Removal Costs: six years after date of completion of all removal actions.
For Damages: three years after the date on which the injury and its connection with the discharge are reasonably discovered with due care.
For NRD: three years from the date of completion of the NRD assessment.

As stated earlier, claimants who are denied by a responsible party can bring their claims directly to the NPFC for adjudication. If the NPFC finds the damage to be OPA-compensable and pays it, the cost of that claim will be billed to BP and recovered. In enacting these provisions, Congress made it clear that the Fund was available to pay so that claimants would not be required to go through costly litigation to be compensated. Fund payments are aggressively recovered from responsible parties to the fullest extent of the law consistent with the "polluter pays" policy underlying OPA, but the Fund remains available as the ultimate insurer for compensation of removal costs and damages under the OPA.

There are a number of advantages to claimants of having a responsible party pay the claims. BP can pay for more than just OPA compensable damages if it chooses, and BP may be liable for other damages, such as personal injury, covered by other laws. BP may also choose to pay a claim with less documentation than the government would be required to obtain. Further, BP can negotiate claim settlement, and is offering mediation services.

CONCLUSION

Through the National Incident Command, we are ensuring all capabilities and resources—government, private, and commercial—are being leveraged to protect the environment and facilitate a rapid, robust cleanup effort. Every effort is being made to secure the source of the oil, remove the oil offshore, protect the coastline, include and inform the local communities in support of response operations, and mitigate any impacts of the discharge.

Thank you for the opportunity to testify today. I look forward to your questions.

BIOGRAPHY FOR ANTHONY S. LLOYD

Captain Anthony Lloyd assumed his current position as Chief, Office of Incident Management and Preparedness in July of 2007. He formerly served as the Commanding Officer of the Pacific Strike Team in Novato, CA from June of 2004 until June of 2007. Captain Lloyd is the program manager for incident planning and preparedness policy for the Coast Guard. This includes overseeing the Coast Guard's implementation of all risk and all hazards incident management guidance as well as focusing on response operations for oil and chemical pollution incidents. In developing Coast Guard guidance in these areas, Captain Lloyd works with other Federal and industry partners to ensure alignment. In addition, he supervises a 60-person staff that includes oversight of the National Response Center (NRC), provides programmatic guidance for the National Strike Force, and serves as the Vice Chair to the National Response Team (NRT). Captain Lloyd also serves as the Vice Chair to the International Oil Spill Conference Committee; Chair of the Interagency Coordinating Committee on Oil Pollution Research; is a Board Member of the Spill Control Assoc. of America (SCAA) and is a member of the API Spills Advisory Group.

Captain Lloyd began his Coast Guard career as a deck watch officer on the U.S. Coast Guard Cutter Salvia (WLB 400) home ported in Mobile, AL. As a Deck Watch Officer and later as Operations Officer, Captain Lloyd was involved in numerous responses including Hurricane Gilbert in Puerto Rico and the tank vessel Mega Borg casualty in the Gulf of Mexico. From 1990 to 1996, he served in both New Orleans

and Baton Rouge Louisiana where he obtained Marine Safety qualifications in inspections while conducting numerous operations and exercises. Upon transfer from Southeast Louisiana, Captain Lloyd served four years at the National Strike Force Coordination Center in Elizabeth City, NC, where he served as Operations Division Chief from 1998 to 2000. His responsibilities included ensuring operational support for the Coast Guard's National Strike Force response teams as well as providing leadership and direction for the Coast Guard's Public Information Assist Team (PIAT). Under Captain Lloyd's watch, the PIAT published their Joint Information Center (JIC) guidelines that are now a national standard for coordinating public affairs during incidents. Later, Captain Lloyd served as the Executive Officer at Marine Safety Office Memphis from July 2001 to May 2004. While at Memphis Captain Lloyd, acting as the alternate Captain of the Port and Federal On Scene Coordinator, led the Coast Guard response to the tragic collapse of the 1–40 Bridge at Webbers Falls, OK. He assumed command of the Pacific Strike Team in June 2004. Under his leadership, the Team responded to numerous pollution cases. These include the groundings of the cargo vessel AJMAN II in Guam, the cargo vessel Selendang Ayu near Unalaska Island, AK and a 21-day response to Utapoa, Thailand after the December 26th 2004 Tsunami.

Captain Lloyd graduated from the Coast Guard Academy in New London, CT and has a Master's Degree (MA) in National Security and Strategic Studies from the U.S. Naval War College. His personal military decorations include the Meritorious Service Medal, three Coast Guard Commendation Medals, and three Coast Guard Achievement Medals.

Chairman BAIRD. Thank you.

Ms. Buffington.

STATEMENTS OF SHARON BUFFINGTON, CHIEF, ENGINEERING AND RESEARCH BRANCH, OFFSHORE ENERGY AND MINERALS MANAGEMENT, MINERALS MANAGEMENT SERVICE

Ms. BUFFINGTON. Thank you, Chairman Baird and Members of the Subcommittee, for the opportunity to discuss oil spill research at the Department of the Interior related to oil and gas exploration on the Outer Continental Shelf. I have been asked to provide the Subcommittee with an overview of the role the Minerals Management Service has in oil spill research, including that of OHMSETT, the National Oil Spill Response and Renewable Energy Test Facility, and the activities and programs MMS has pursued since the passage of the Oil Pollution Act of 1990 to improve oil spill response technologies.

For more than 25 years, MMS has conducted oil spill response research to improve the technology. The activities of the MMS oil spill response research program comply with Title VII of the Oil Pollution Act of 1990. The research program brings together funding and expertise from government agencies, industry and the international community to collaborate research. The program operates through contracts with universities, government agencies, laboratories and private industry to assess technologies. Funding is appropriated from the Oil Spill Liability Trust Fund.

Current response research projects cover a wide spectrum of issues that include laboratory, mesoscale and full-scale experiments in 129 multiphase projects. Topic areas include physical and chemical properties of crude oil, remote sensing and detection of spilled oil, mechanical containment and recovery, chemical treating agents and dispersants, and in situ burning.

My written testimony highlights some examples of the technological advances of the MMS oil spill response research program that are currently being used to respond to the Deepwater Horizon oil spill. These include the following: the creation of a physical and

chemical properties of crude oil database with Environment Canada; a Project Deep Spill experiment that was conducted in the Norwegian Sea to gather data to verify a deep sea release model; an oil spill thickness sensor to map out the extent of this oil slick and the oil thickness distribution and then to send this information to the response personnel; the development and testing of a grooved drum skimmer which improved recovery by over 200 percent; the development of a standard test protocol for skimmers to measure the effective daily recovery capacity; and in situ burn research technology to determine the emissions to air and water, to evaluate equipment, conduct smoke plume modeling, and to extend the window of opportunity for in situ burns by using chemical herders and emulsion breakers. These also include the use of chemical dispersants, including applying them and their effectiveness, and OHMSETT, the National Oil Spill Response and Renewable Energy Test Facility.

OHMSETT is a unique oil spill response research facility located at the U.S. Naval Weapons Station Earle, in Leonardo, New Jersey. It is government owned, contract operated and available for use by government, industry and academia. The facility is critical to oil spill response technology development in the United States. It is the only facility in the world that allows for full-scale oil spill response testing, training and research conducted with a variety of oils in a marine environment and under controlled conditions.

The oil spill response activities for the Deepwater Horizon incident indicate that additional oil spill response research is necessary. The Department of the Interior and MMS look forward to working with Congress and the Interagency Coordination Committee on Oil Pollution Research to focus our efforts on needs that have come to light from the Deepwater Horizon incident.

The preliminary review of oil spill response activities for the Deepwater Horizon incident indicate that three main additional oil response needs are necessary to focus on. One is mechanical equipment. Booms and skimmers need to be developed to work in the high currents and rough seas. Also, faster skimmers are needed. Deepwater subsea containment devices need to be tested and perfected, worst-case discharge calculations and assumptions need to be reviewed and industry needs to substantiate their volumes.

Thank you for the opportunity to present an overview of the MMS oil response research program and the OHMSETT facility. I will be happy to respond to any questions.

[The prepared statement of Ms. Buffington follows:]

PREPARED STATEMENT OF SHARON BUFFINGTON

Thank you, Chairman Baird, Ranking Member Inglis, and Members of the Subcommittee, for the opportunity to discuss oil spill research at the Department of the Interior related to oil and gas exploration on the Outer Continental Shelf (OCS). I have been asked to provide the Subcommittee with an overview of the role the Minerals Management Service (MMS) has in oil spill research, including that of Ohmsett—The National Oil Spill Response and Renewable Energy Test Facility, and the activities and programs MMS has pursued since the passage of the Oil Pollution Act of 1990 to improve oil spill response technologies.

The MMS is the bureau within the Department of the Interior responsible for the management of the Nation's renewable energy, oil, natural gas, and other mineral resources on the OCS as well as the energy and mineral revenues from the Federal OCS and Federal onshore and American Indian lands. The tragedy and the massive spill associated with the Deepwater Horizon have underscored the importance of

Secretary Salazar's reform agenda. The MMS has three distinct missions that are to be separated for the benefit of effective energy development, enforcement and revenue collection. The Secretarial Order that was signed on May 19, 2010 will establish the Bureau of Ocean Energy Management, the Bureau of Safety and Environmental Enforcement, and the Office of Natural Resources Revenue.

Currently, it is the MMS that has jurisdiction over approximately 1.7 billion acres of the OCS, on which there are about 7,400 active oil and gas leases. Key missions for both our conventional and renewable energy programs include safety, protection of the environment, coordination with affected state and local governments and Federal agencies, and a fair return for the use of OCS lands. MMS works with other Federal agencies, state and local governments, industry, and academia to achieve a common objective to maintain high standards for safety and environmental protection and to meet national economic, security and energy policy goals. In Calendar Year 2009, the OCS was a significant source of oil and natural gas for the Nation's energy supply, providing about 570 million barrels of oil and 2.4 trillion cubic feet of natural gas, accounting for about 31 percent of the Nation's oil production and 11 percent of domestic natural gas.

Whenever oil is being handled—whether in tankers, pipelines, or production facilities, onshore or offshore, in the U.S. or abroad—spills are a possibility. For that reason it is imperative that U.S. and international agencies work together to prepare for oil spills in a comprehensive manner. This preparation includes continued improvement in response technology and procedures.

Overview

For more than 25 years, MMS has conducted oil spill response research (OSRR) to improve capabilities for detecting and responding to an oil spill. The major focus of the program is to improve the knowledge, technologies and methodologies used for the detection, containment, and cleanup of oil spills that may occur on the OCS. The OSRR program is a cooperative effort bringing together funding and expertise from research partners in Federal Government, industry, academia and the international community to collaborate on research projects. The OSRR program operates through contracts with universities, government agencies and laboratories and private industry to assess technologies and to perform necessary applied research. The findings resulting from the research are disseminated through a variety of public forums such as workshops, conferences, peer-reviewed publications and the internet. The intent is to make this information widely available to oil spill response personnel and organizations world-wide.

The MMS coordinates oil spill research closely with the National Oceanic and Atmospheric Administration (NOAA), the U.S. Coast Guard (USCG), and the Environmental Protection Agency (EPA) through participation on the National Response Team and on the Interagency Coordination Committee for Oil Pollution Research. This allows the MMS to foster collaborative research at the national and international level, optimize current and future research initiatives, minimize research duplication, and ensure that the needs of the OCS program are addressed. Partnering has reinforced MMS's oil spill response research and has encouraged oil spill technology development efforts by academia and industry. The MMS has participated in the exchange of technological information with Canada, France, Germany, Japan, Norway and the United Kingdom through cooperative research projects, workshops and technical meetings.

The activities undertaken by the MMS OSRR program comply with the research and development provisions of Title VII (33 USC Sec. 2761–2762) of the Oil Pollution Act of 1990 (OPA–90). The OPA–90 authorized up to $28 million annually for oil spill research across the Federal agencies, subject to appropriations. The MMS funding for oil spill research activities is appropriated from the National Oil Spill Liability Trust Fund and for the past ten Fiscal Years has been between $6 and $7 million. To date, MMS has funded over 120 projects directly related to oil spill research. These projects cover topics ranging from oil behavior in water, chemical treating agents, remote sensing, spill response in arctic environments, mechanical containment options and in-situ burning.

The Ohmsett facility, which is discussed later in more detail, is a 600-foot long test tank managed by MMS, has been integral to many of these projects, and remains an important tool for MMS, academia and the oil spill response industry.

MMS plans and implements OSRR projects that have multiple phases in a stepwise approach over several years, enabling MMS to secure cooperative funding from private industry as well as countries that have offshore regulatory programs. The MMS OSRR program monitors and works with other agencies and industry whenever possible through active partnering. More than 40 percent of the OSRR

projects are jointly funded projects, where MMS partners with other stakeholders to maximize research dollars.

Information derived from the OSRR program is directly integrated into MMS's offshore operations and is used to make regulatory decisions pertaining to permitting and approving plans, safety and pollution inspections, enforcement actions, and training requirements. The MMS as well as U.S. and foreign government agencies and organizations worldwide use the results from the OSRR program and Ohmsett in making planning, regulatory, and emergency response decisions.

MMS Oil Spill Response Research

Many technical advances in oil spill response can be attributed to relevant multiphase research projects that involve scientists worldwide. Applied research and the development of response strategies traditionally involve a combination of laboratory small-scale tests, meso-scale tank and basin experiments, and full-scale field trials. The MMS has used this approach to develop, initiate, and conduct more than 200 meaningful oil spill response research projects. In light of the ongoing spill in the Gulf, however, it is obvious that much work remains to be done.

Once the MMS has identified a research need or data gap in spill response, we initiate and conduct a scoping project to define the current state-of-the-art for this technology or methodology. The results from these scoping projects are used to develop a systematic approach required to successfully address the data need. Communicating the results from these projects to government agencies and private industry is the next step to build consensus on the future research direction. A carefully focused work plan or agenda encompassing a priority list of projects is developed. It is generally beyond the capabilities of any one organization to fund these projects in their entirety. International cooperation, including governmental and industry participants, is needed to make substantial progress in the most important research and development areas. Given the specialized nature and limited number of researchers actively working on oil spill response, it is essential to involve different centers of expertise on a global scale. The MMS has initiated many successful jointly funded projects (national or international) to leverage our program funds and expand the scope of the project to develop innovative or new technological advancements to detect, contain, and clean up oil spills in the marine environment.

Ohmsett—The National Oil Spill Response and Renewable Energy Test Facility

Ohmsett is a unique oil spill response research test facility located at the U.S. Naval Weapons Station Earle, Leonardo, New Jersey. The term Ohmsett is an acronym for Oil and Hazardous Materials Simulated Environmental Test Tank. It is the only facility in the world that allows for full-scale oil spill response testing, training and research conducted with a variety of oils in a marine environment under controlled conditions.

Ohmsett was originally constructed and operated by the EPA from 1973 until it was closed in 1988. The U.S. Navy acquired Ohmsett in March of 1989 just a few months before the Exxon Valdez oil spill in Prince William Sound, Alaska. That event prompted renewed interest in responding to oil spills, and within a year OPA–90 was signed into law. That same year, Ohmsett was formally mandated for use as a testing facility under the control of MMS. With additional financial support from the USCG and Environment Canada, MMS began a two-year restoration project for Ohmsett, and dedicated the facility in July of 1992.

The facility is critical to oil spill response technology development in the U.S. and is a vital component of the MMS nationwide oil spill research program. Ohmsett plays an essential role in developing the most effective response technologies, as well as preparing responders with the most realistic training available before an actual spill. Ohmsett is a government owned, contractor operated facility; and is available for use by state, Federal, and foreign government agencies, industry and academia.

The Ohmsett facility represents a necessary intermediate step between small scale "laboratory testing" and open water testing of equipment. Ohmsett is used to test and evaluate mechanical response equipment such as oil spill containment booms and skimmers and temporary storage devices. We can test and evaluate fire resistant containment booms using an air-injected propane burner system that realistically simulates in situ burning at sea. The Ohmsett facility allows for testing and evaluation of remote sensing instruments under a wide range of conditions. Sensors can be mounted on the Ohmsett Bridge or on the tower above the tank. The tank is also large enough that aircraft and helicopters can fly over a test oil slick to evaluate sensor performance.

The Ohmsett facility also conducts realistic dispersant effectiveness testing through the design and development of a calibrated, referenced and realistic test protocol and subsequent testing under cold and temperate conditions using fresh and weathered crude and fuel oils. The National Research Council strongly supported the use of wave tank testing in their recent review of chemical dispersants. Ohmsett is the world's largest wave-tank complex presently conducting such research and is the logical venue for bridging the gap between laboratory and field testing. MMS has added the capability to conduct effectiveness testing on a variety of chemical treating agents, dispersants and emulsion breakers and sorbent products. All equipment tests are conducted in accordance with the American Society of Testing and Materials (ASTM) standards and guidelines.

Ohmsett is also the premier training site for spill response personnel from state and Federal Government agencies, private industry and foreign countries. While receiving state of the art training, students use full-size equipment with real oil in varying oceanographic conditions to increase their recovery proficiency. Publication of the Ohmsett Gazette, the facility's semi-annual newsletter, keeps the oil spill community abreast of recently conducted facility activities. Ohmsett's website, found at *http://www.ohmsett.com*, describes the testing that the facility conducts and gives objective results of the research conducted.

MMS Oil Spill Response Research

The following are some examples of the information and technological advances of the MMS OSRR Program that are currently being used to respond to the Deepwater Horizon oil spill.

1. **Physical and chemical properties of crude oil**
   Crude oils differ greatly in physical and chemical properties, and these properties tend to change significantly during a spill with physical weathering, biodegradation and emulsification. Such properties have a direct bearing on oil recovery operations, influencing the selection of response methods and technologies applicable for cleanup, including their effectiveness and capacity. Knowledge of the ultimate fate and behavior of oil should drive countermeasure decisions.

Since the early 1990s, the MMS and Environment Canada (EC) have jointly funded research to analyze different types of crude oil and oil products and include this information in a searchable database. The database currently has information on more than 475 different oil types. It is available at *http://www.etc-cte.ec.gc.ca/databases/OilProperties/oil_prop_e.html*.

The physical and chemical properties from several Gulf of Mexico crude oils contained in the catalog closely resemble the oil being released at the Deepwater Horizon site. This information is currently being utilized by various government and industry spill modeling groups to determine the fate, behavior and transport of the oil.

2. **Project "Deep Spill"**

In June 2000, the Deep Spill experiment (a jointly funded project initiated by the MMS that included 23 different oil companies) was conducted in the Norwegian Sea and included four controlled discharges of oil and gas from a water depth of 844 meters. Empirical data was obtained for verification and testing of numerical models for simulating accidental releases in deep waters. The experiments were also used to test equipment and methodologies for monitoring and surveillance, and evaluation of the safety aspects of accidental releases of gas and oil in deep waters. Spill models currently being used by the Unified Command for the Deep Water Horizon oil spill were developed with data and algorithms gathered from project Deep Spill.

3. **Oil Spill Thickness Sensor**

One of the most important initial steps in response to an oil spill at sea is the assessment of the extent of the oil slick and the quantity (i.e. thickness) distribution of oil within it. A critical gap in spill response was the lack of capability to measure and map accurately the thickness of oil on water and to rapidly send this information to response personnel in the command post.

Over a three-year period (2005–2008), the MMS and the California Department of Fish and Game, Oil Spill Prevention and Response (DFG/OSPR) jointly funded a research program to remotely measure and map the thickness of an oil slick using a portable multispectral and thermal camera the information gathered is electronically transmitted to a secure server that can be accessed by first responders. This new remote oil spill mapping and detection technology has

been used in California three times in the past year to assist in response operations. It is currently being used for the Deepwater Horizon oil spill. The system acquires, processes and disseminates digital Geographic Information System compatible oil slick thickness maps in near real time and transmits this information directly to response personnel in the command post to assist with operational response decisions and deployment of manpower and response countermeasures.

4. **Mechanical Containment and Recovery**
In most countries, mechanical recovery of spilled oil is the first and preferred response option. A containment boom is normally used in combination with an oil recovery skimmer. MMS research has focused on methods to improve the effectiveness of equipment and techniques for the mechanical recovery of oil spills. Research on the processes of oil adhesion to the surface of oil skimmers improved recovery efficiency by 20 percent, however further research demonstrated that changing the surface pattern of the drum improved recovery efficiency by over 200 percent. Results from this research project were patented and there are at least six types of grooved skimmers being commercially sold around the world. Several of the grooved skimmers are being used by the Unified Command in the Deepwater Horizon oil spill.

5. **Development of Standard Test Protocols**
The USCG and the MMS have collaborated in an effort to develop a standard protocol for testing oil skimmers. The American Society of Testing and Materials (ASTM) subcommittee on skimmers recently adopted the standard methodology (ASTM F631–99 (2008)) for measuring the effective daily recovery capacity (EDRC) for a given skimmer system. The USCG uses EDRC as a key component in rating and regulating the oil spill response capability of responsible parties and oil spill removal organizations. Skimming systems being used for the Deep Water Horizon response have been tested at Ohmsett using this new ASTM protocol.

6. **In Situ Burn Research**
MMS was designated as the lead agency for in situ burn research (ISB) in the Oil Pollution Research and Technology Plan prepared under the authority of Title VII (33 USC Sec. 2761–2762) of the OPA–90. Between 1995 and 2003, the MMS partnered with the National Institute of Standards and Technology to conduct more than ten different ISB research projects involving hundreds of laboratory, small and full-scale and at sea burn experiments. Emphasis was on the emissions to air and water, equipment evaluations including fire resistant booms, smoke plume modeling, and research to extend the "Window of Opportunity" through the use of chemical herders and emulsion breakers.

The technology to effectively predict downwind smoke plume trajectories and monitor particulate concentrations has evolved with the MMS ISB research program. Smoke plume models and monitoring protocols have been developed and are available. A Large Outdoor Fire Plume Trajectory model (ALOFT) was developed to predict and analyze the downwind distribution of smoke particulates and combustion products from large burns. Two versions are available: one for flat terrain and the other for mountainous terrain. Monitoring capability can be readily deployed to support in situ burn operations.

To disseminate results of eight years of intensive ISB research, the MMS assembled a comprehensive compendium of scientific literature on the role of in situ burning as a response option for the control, removal and mitigation of marine oil spills. All operational aspects of burning are covered in detail. The MMS has distributed more than 5,000 ISB–CD sets worldwide. Results from the MMS ISB research program are currently being used to make operational decisions on use of burning as a countermeasure for the Deep Water Horizon oil spill.

Results from the MMS ISB research program are currently being used to make operational decisions on use of burning as a countermeasure for the Deep Water Horizon oil spill.

7. **Chemical Dispersants**
The use of chemical dispersants is another important option in oil spill response. In the past seven years, fifteen major dispersant research projects were conducted at Ohmsett addressing five critical operational areas including: quantifying the major factors limiting dispersant performance, improving monitoring of dispersant effectiveness, addressing specific operational questions related to the physical and chemical properties of dispersants and the interaction of treated hydrocarbons with physical removal devices such as skimmers, scaling-up

from bench tests to full-scale field testing, and addressing site-specific performance questions (i.e. Arctic versus temperate Gulf of Mexico). More information, including publications of Ohmsett research, can be found on the Ohmsett web page, available at: *http://www.mms.gov/tarprojectcategories/ohmsett.htm*

Future Oil Spill Response Research

The oil spill response activities for the Deepwater Horizon oil spill indicate that additional oil spill response research is necessary. The Department of the Interior and MMS look forward to working with Congress and the Interagency Coordination Committee on Oil Pollution Research to focus our efforts on needs that have come to light from the Deepwater Horizon oil spill.

Conclusion

Mr. Chairman, this concludes my prepared statement. Thank you for the opportunity to present an overview of the MMS's oil spill response research program and the Ohmsett facility. I would be happy to respond to questions you or Members of the Subcommittee have.

BIOGRAPHY FOR SHARON BUFFINGTON

Ms. Sharon Buffington has been the Chief, Engineering Research Branch for more than seven years. In that capacity, Ms. Buffington supervises a multi-disciplinary staff of scientists and engineers who manage oil spill response research, safety of operations research, and renewable energy research. Ms. Buffington received a degree in Petroleum and Natural Gas Engineering from the Pennsylvania State University prior to working for MMS.

Chairman BAIRD. Thank you, Ms. Buffington.

Dr. Venosa.

STATEMENTS OF ALBERT VENOSA, DIRECTOR, LAND REMEDIATION AND POLLUTION CONTROL DIVISION, NATIONAL RISK MANAGEMENT RESEARCH LABORATORY, OFFICE OF RESEARCH AND DEVELOPMENT, ENVIRONMENTAL PROTECTION AGENCY

Dr. VENOSA. Thank you, Mr. Chairman and Members of the Science and Technology Committee. I am Dr. Albert Venosa, Director of the Land Remediation and Pollution Control Division of EPA's Office of Research and Development. It is a pleasure to be here today to discuss EPA's oil spill research program, its accomplishments and future research plans.

I have been with the Agency for 41 years, and for the last 21 I have led EPA's oil spill research and development program. Its objective is to provide environmental managers with the tools, models and methods needed to mitigate the effects of oil spills in all ecosystems with emphasis on the inland environment and to conduct human and ecotoxicity research to understand the impacts that oil spills pose to environmental receptors. The research includes development of practical solutions to mitigate oil spill impacts on freshwater and marine environments, development and publication of remedial guidance for cleanup and restoration of oil-impacted environments, determination of the latent effects of oil contamination in the environment through effective modeling of oil transport in a variety of settings, and developing definitive understanding of the toxicity impacts to ecosystems and humans exposed to hydrocarbons from spills.

So why does oil spill research need to be continued? The answer to this question has been made clear by the recent devastating and continuing oil spill in the Gulf of Mexico. Numerous questions have

been raised on the effectiveness of dispersants, their inherent toxicity, the toxicity of dispersed oil and how to deal with the shoreline and wetlands that are now being impacted as the spill moves to shore. Consequently, continued research is vital to find more effective ways to respond to both traditional petroleum spills and spills of non-traditional alternative fuels and fuel blends.

With regard to our past and current research, EPA's research has resulted in new protocols for testing the effectiveness of commercial oil spill treating agents, guidance documents for implementing bioremediation in different environments, a clearer understanding of the impact and persistence of non-petroleum oil spills in the environment, and development of new spill treatment approaches, especially for wetlands and marshes.

The Deepwater Horizon spill is raising questions about the inherent problems associated with current spill mitigation technologies. EPA's approach to addressing these questions is to encourage such innovative approaches as green chemistry and the development of new, less toxic dispersants and other physical, chemical, biological and combination techniques for treating oil spills.

In terms of our future research, because of the Deepwater Horizon spill, future research will necessarily involve some major refocusing of effort. Some key issues resulting from this incident have raised new concerns about the effectiveness and toxicity of dispersant use, especially in the deep sea. The following examples involving dispersants highlight the needs in this area. The needs are not listed in any priority order.

The first is that we need to understand mechanistically the differences among the various types of oil in terms of their dispersible properties. Second, we need to better define the important conditions controlling or affecting the dispersibility of oil including temperature, mixing energy, salinity and deep sea hydrostatic pressure. Third, we need to determine if a dispersant can be developed that will disperse oil trapped in oil and water emulsions. This includes how to demulsify them to make them more amenable to mitigation technologies. Fourth, a better understanding is needed to determine the minimum droplet size required to prevent recoalescence, so that the dispersed oil remains suspended in the water column. This includes development of models and monitoring techniques to track the movement of dispersed oil plumes in the deep sea. Fifth, deep sea injection is a new treatment approach to mitigate the spill impacts from deep sea blowouts. We need a better understanding of the effectiveness and ecotoxicological effects of underwater dispersion injection. And sixth, we need to define the underwater fate and effects of deep sea injection, including transport and impacts of spilled oil, dispersed oil and dispersants per se on human health and the environment.

So in conclusion, EPA's oil spill research program is an applied practical program that is designed to address real and important emergency spill response and environmental protection challenges based on high-quality sound science. EPA's research informs regulatory decision making and policy development for oil spill prevention, preparedness and response programs. EPA's oil spill research work is important to the protection of the environment from the harm associated with oil spills. Research accomplishments have

been timely as the Agency has developed a better understanding of how dispersants work, how to protect wetlands and marshes with innovative sorbent technology and how best to implement bioremediation in a variety of environments. Aspects of this research have contributed to discussions of the current Gulf spill in terms of providing answers to questions posed by the media, the government management and regional response teams. The research program has been productive, successful and pertinent both nationally and internationally.

Thank you for the opportunity to address the Committee. I am happy to answer your questions.

[The prepared statement of Dr. Venosa follows:]

PREPARED STATEMENT OF ALBERT D. VENOSA

Good morning. I am Dr. Albert D. Venosa, Director of the Environmental Protection Agency's (EPA) Land Remediation and Pollution Control Division in EPA's National Risk Management Research Laboratory, Cincinnati, Ohio. It is a pleasure to be here today to discuss EPA's oil spill research program.

For the past 21 years, I have led EPA's oil spill research and development program. The objective of this program is to conduct basic and applied research in both the laboratory and the field in the area of spill response technology development.

Section 7001 of the Oil Pollution Act of 1990 (33 USC 2761) established an Interagency Coordinating Committee on Oil Pollution Research (ICCOPR), chaired by the USCG, to coordinate a comprehensive program of oil pollution research and development among 13 Federal agencies in cooperation and coordination with industry, academia, research institutions, state governments, and other nations. The ICCOPR was mandated to coordinate research and development in innovative oil pollution technology, oil pollution technology evaluation, oil pollution effects research, demonstration projects, simulated environmental testing, and a regional research program. This was accomplished effectively both in-house in each agency as well as through coordinated research grants to non-Federal institutions mentioned above. The program has been successful, but much more still needs to be done to improve our response capabilities to national disasters such as the current Deepwater Horizon tragedy that has impacted the rich ecosystem of the Gulf of Mexico.

Why does oil spill research need to be continued?

The answer to this question has been made clear by the recent, devastating, and continuing oil spill in the Gulf of Mexico. Numerous questions have been raised on the effectiveness of dispersants, their inherent toxicity, the toxicity of dispersed oil, and how to deal with the shoreline and wetlands that are now being impacted as the spill moves to shore.

A 2006 study presented at the Freshwater Spills Symposium reported that, from 1980 to 2003, more than 280 million gallons of oil of all types (about 12 million gallons/year) were discharged to the inland waters of the U.S. or its adjoining shorelines in about 52,000 spill incidents. Little is known about the effect of spills of biodiesel, emerging biofuels, or by-products from their manufacture on watersheds. Waterborne transportation of oil in the U.S. continues to increase, and the volume of oil spilled from tank barges has remained constant at approximately 200,000 gallons spilled each year. EPA is also concerned about spills from pipelines and above ground storage tanks that could contaminate surface waters. These are the major sources of inland oil spills nationwide.

An oil discharge to the waters of the U.S. could affect drinking water supplies; sicken and/or kill fish, animals, and birds; foul beaches and recreational areas; and persist in the environment, harming sensitive ecosystems. Consequently, research is necessary not only to continue to find effective ways to mitigate and respond to petroleum spills but also to understand the potential adverse human health and ecological consequences of spills of alternative fuels and non-petroleum oils and to develop effective clean-up tools to mitigate these adverse consequences. Recent research on vegetable oils and biodiesel blends suggests that the biodegradability and environmental persistence of these oils is very complex[2]. Developing an understanding of the potential environmental impacts associated with spills of these oils requires fundamental research. Such fundamental research is critical in providing sound science to inform decision-making and field applications.

EPA's Role in Spill Response

The National Oil and Hazardous Substance Pollution Contingency Plan (NCP), which has been in effect for 41 years, established a successful oil spill response framework defining the roles of Federal agencies. Under the NCP, the EPA or USCG provide Federal On-Scene Coordinators (FOSCs) for the inland and coastal zones, respectively, to direct or oversee responses to oil spills. Other Federal agencies with related authorities and expertise may be called upon to support the FOSC. At the national level, these Federal agencies coordinate their activities through the National Response Team (NRT). The NRT is comprised of 15 Federal departments and agencies and is chaired by EPA and vice-chaired by the USCG. The NRT coordinates emergency preparedness and response activities for oil and hazardous substance pollution incidents and provides Federal resources, technical assistance, and policy guidance as defined in the NCP. The Science and Technology Committee, which is the NRT's science arm and of which I am a participating member, provides a forum for the NRT to fulfill its delegated responsibilities in research and development. Users of and sometimes collaborators in our research include multi-agency regional response teams, EPA's environmental response team, EPA and USCG FOSCs, and other government agencies such as NOAA, Fish and Wildlife Service, and states. Not only do these U.S. organizations rely significantly on EPA's research results, the international community does as well.

Past and Current Research

EPA's research includes development of practical solutions to mitigate spill impacts on freshwater and marine environments; development of remedial guidelines that address the environment, type of oil (petroleum and non-petroleum oils), and agents for remediation; and modeling fate and effects in the environment. Spill mitigation research includes bioremediation, chemical and physical countermeasures, and human and ecotoxicity effects. Fate and effects research focuses on modeling the transport of oil in a variety of settings with application to field situations.

The work described above has resulted in new protocols for testing the effectiveness of commercial oil spill treating agents; guidance documents3 for implementing bioremediation in different environments such as wetlands, salt marshes, and sandy shorelines; a clearer understanding of the impact and persistence of non-petroleum oil spills in the environment (i.e., vegetable oils, animal fats, and biofuel blends); and development of new treatment approaches. Important on-going research is helping to understand oil persistence long after the initial spill incident, such as the Exxon Valdez oil that still lingers in certain areas of Prince William Sound, Alaska. We need to understand if the lingering oil still poses an environmental threat to the habitat and the resources at risk. If it does, we must learn why it still lingers and develop means to remove this lingering oil to safeguard the ecosystem.

Ten years ago, EPA began conducting research on non-petroleum oil such as vegetable oils and animal fats. This anticipatory research investment will be invaluable as the national emphasis on biofuels development takes hold because vegetable oils are the primary feedstocks for biodiesel production. Contrary to some claims, we have found that these oils are not readily biodegradable in the environment because of the complexity of chemical interactions among saturated and unsaturated fatty acids.

The Deepwater Horizon spill is raising questions about the inherent problems associated with current spill mitigation technologies. One approach to addressing these questions is to encourage such innovative approaches as green chemistry in the development of new, less toxic dispersants and other physical-chemical techniques for treating oil spills.

Future Research

Future research will necessarily involve some major refocusing of effort and coordination with other agencies that have leading roles in some of the following areas of research. Some key issues as a result of the Deepwater Horizon incident have raised new concerns about the effectiveness and toxicity of dispersant use, especially in the deep sea, so the following examples involving dispersants highlight needs in this area. The needs are not listed in any priority order.

- *Defining factors of spilled oil that control dispersibility*. Oil type is a key factor that needs to be studied in greater depth. We know less about the dispersibility of heavy refined products such as the IFO 180 and 380 fuel oils, bunker C, No. 6 fuel oil, and even No. 2 fuel oil compared to crude oils. We need to understand mechanistically the differences among the various types of oil in terms of their dispersible properties. We also need to understand how water-soluble dispersants differ from oil-soluble ones. We know very little

about the biodegradability of dispersants and their constituents in saltwater, which is supposed to be their ultimate fate in the environment. We must increase our understanding of oil properties as they affect dispersibility (weight; viscosity; pour point; percentage of asphaltenes, polar compounds, and toxic components such as aromatics (PAHs), etc.).

- *Understanding the natural conditions under which spilled oil is dispersible*. These factors include temperature (dispersion may be less effective at low temperatures), mixing energy (wave energy on the water surface is needed for effective dispersion of oil into the water column, but little is known about deep sea injection into rapidly moving oil from a blowout); salinity; sub-sea conditions (dissolved oxygen; hydrostatic pressure; water solubility and composition of dispersants and their constituents; and toxicity to water column species both at the surface, within the water column above and below the pycnocline, and at extreme depths).
- *Effectiveness of dispersants on weathered emulsions*. If a water-in-oil emulsion ("mousse") occurs as a result of high-energy mixing, the resulting mousse has properties that prevent dispersion into the water column. We need to understand those properties and develop methods to mitigate them to make the mousse more dispersible. Very little research has been conducted in this area. Research is needed to determine if it is possible for a dispersant to be developed that will disperse oil trapped in water-in-oil emulsions.
- *Coalescence and resurfacing of dispersed oil droplets*. We know that the smaller the dispersed oil droplets, the less inclined they will be to re-coalesce. However, we still do not know exactly how large they must be for re-coalescence to take place. This would be an important property to know and understand as it might affect our ability to improve dispersant treatment. Study of this property would be best done in a wave tank that produces reproducible conditions between experiments. Alternating high energy and quiescent conditions to allow re-coalescence to occur would provide invaluable evidence on conditions for re-coalescence.
- *Quantification of horizontal and vertical diffusion of treated oil*. We know that vertical diffusion transports droplets deeper into the water column, while buoyancy makes them return to the surface. Wave energy decreases with depth of the water. Diffusion also decreases under the influence of vertical density stratification. Our knowledge of vertical and horizontal diffusion of dispersed oil in water is still very limited. We need better understanding of dispersed oil diffusion in seawater below and above the pycnocline to enable better model development of dispersed oil plumes in deep sea.
- *Research on the ecotoxicological effects of underwater injection of dispersants*. This is a new area that developed directly as a result of the Deepwater Horizon spill in the Gulf. Additional research is needed to determine the ecotoxicological effects of dispersants and dispersed oil in the deep sea.
- *Environmental fate, effects, and transport of released crude oil, dispersed oil, and dispersants on human health and the environment*. Spills, explosions, fires, and blowouts can have multiple environmental and public health impacts. Operational discharges of produced water, drill cuttings, and mud have chronic effects on benthic (bottom-dwelling) marine communities, mammals, birds, and humans. Humans can be affected by occupational exposure to oil and other chemicals while participating in response and cleanup operations, or by environmental exposure such as ingesting oil-contaminated seafood. Marine mammals are affected by the oiling of their fur and skin, and through consumption of oil-contaminated foods (e.g., mussels), or via inhalation of fumes that have liver, kidney, and central nervous system toxicity. The marine mammals most commonly affected include seals, sea otters, walruses, sea lions and whales, manatees and dugongs (in tropical waters), and polar bears in the Arctic. Sea otters are particularly vulnerable as they feed near the surface, have little blubber, and depend upon an intact fur coat to maintain their body temperature. Research is needed to better understand these impacts and how to mitigate the effects of an oil spill before it has affected the species at risk, including humans. Ecotoxicity research is needed in areas beyond human health effects, including research about effects on animals and other aspects of the environment.
- *Short and long term benefits and impacts of various spill management strategies, practices, and technologies*. The various spill management strategies in use today include mechanical removal techniques (use of sorbents, booming and skimming operations), *in-situ* burning, dispersants, and bioremediation.

Mechanical removal techniques are the first line of defense used in response. However, such methods are highly variable in terms of effectiveness, and they depend on where the spill occurred. *In-situ* burning can be more effective, especially in wetlands where the oil can be concentrated and more easily burned. Dispersants can be effective on open water and used over large areas because of the way they are applied conventionally (overflights by fixed wing aircraft). One major requirement is the need for good mixing (wave energy). Dispersants are much less effective under quiescent conditions. Bioremediation can be very effective on sandy marine shorelines, wetlands, and salt marshes, but it is much slower (weeks to months or more), and bioremediation is not usually considered a first response. All these techniques could be improved with better research and more scientific understanding.

Finally, EPA's Environmental Response Team (ERT) plays a key role in testing and validating monitoring equipment in collaboration with the MMS at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) Facility in New Jersey to understand oil monitoring systems under the Special Monitoring and Response Technologies (SMART) protocol. This interaction allows ERT and the Coast Guard to be trained on oil spill monitoring equipment for detecting oil in the water column.

Summary and Conclusions

In conclusion, I want to emphasize that EPA's oil spill research program is an applied, practical program that is designed to address real and important emergency spill response and environmental protection challenges based on high quality, sound science. Our research informs EPA's regulatory decision-making and policy development for oil spill prevention, preparedness, and response programs and the National Response Team. EPA's oil spill research is important to the protection of the environment from oil spills. The research has been timely as we have developed a better understanding of how dispersants work (quantification of mixing energy needed for optimum dispersion and biodegradability of dispersed oil at several temperatures)[4–12], how to protect wetlands and marshes with innovative sorbent technology, and how best to implement bioremediation technology in a variety of environments. All of this research is useful for the current Gulf spill in terms of providing answers to many questions raised by EPA decision-makers, the Regional Response Teams (RRTs), the public, and the news media. It is imperative that EPA's Research and Development program continue to support oil spill response and prevention through its expertise and the knowledge gained through its research. It is critically important that EPA's research program in this area continues and evolves to address the needs identified to protect our natural resources and cleanup the environment following such disasters.

Thank you for the opportunity to testify today. I am happy to answer your questions.

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BIOGRAPHY FOR ALBERT D. VENOSA

Dr. Venosa is the Director, Land Remediation and Pollution Control Division, National Risk Management Research Laboratory in EPA's Office of Research and Development. He leads the Agency's science and research programs of the Division and conducts research in his area of expertise, which is oil spill remediation and mitigation. From 1990 to 2010, Dr. Venosa served as Senior Research Scientist and Program Manager, Oil Spill Research Program. Dr. Venosa's 21 years of work in this area include being a team leader of a science team in the Alaska Oil Spill Bioremediation Project involved with assessing effectiveness of nutrient formulations in the field. In 1990 he led an independent analysis of commercial inocula in multiple field plots on one of the Prince William Sound islands. Prior to his work on oil spill remediation, he served as EPA's National Program Manager for the Pathogen Equivalency Program and prior to that as National Program Manager for Municipal Wastewater Disinfection Program.

Dr. Venosa holds a Doctor of Philosophy degree in Environmental Science, a Master of Science degree in Environmental Engineering, and a Bachelor of Science degree in Microbiology from the University of Cincinnati. His research interests and expertise include development of protocols for testing the effectiveness of commercial bioremediation, dispersant, surface washing agent, and solidifier products for treating spills of crude oil or refined products in seawater, freshwater, beach sediments, wetlands, and soils. He has also been involved in developing methods for microbiological and chemical analysis of oil and improved scientific and practical understanding of the mechanisms of biodegradation of petroleum hydrocarbons, especially polycyclic aromatic hydrocarbons. Dr. Venosa led three important field studies on oil spill bioremediation, one on the shoreline of Delaware in 1994, one on a freshwater wetland on the shoreline of the St. Lawrence River in Quebec in 1999, and a third on a salt marsh in Nova Scotia in 2001. These projects led to the development of two guidance documents for bioremediation of sandy marine shorelines, freshwater wetlands, and salt marshes. He also led research on the use of bagasse as a sorbent for wicking oil from the subsurface of a wetland to the surface where aerobic biodegradation can take place. The latter research is timely as it is being considered for use in the current Gulf oil spill. Dr. Venosa has received many awards for his work, including one gold medal and two bronze medals, several STAA awards for publications, and he has been lead author on numerous peer-reviewed scientific publications.

DISCUSSION

Chairman BAIRD. Dr. Venosa, thank you. I want to thank our witnesses for staying well within the time and I encourage my colleagues to follow this example. I will recognize myself for a few minutes and then proceed with Mr. Hall.

First of all, I want to thank you all for being here today. You must be keeping very long hours, and I also thank you for all the work leading up to today. And that goes not only for those of you who are here but all of your colleagues in the field, and please pass our appreciation on to them because I know how hard you folks are working and I know how important the mission is.

I just want to make one observation. You know, these signature events like Exxon Valdez, now like this blowout in the Gulf, tend to focus our attention in the short run as a society and then we sort of move on. Ultimately, this well will be capped, but the damages will be there for decades, and I think it is important to recognize we are all contributing to this. Our dependence on fossil fuels adds to this, and it is satisfying, I suppose, to point fingers at BP, but all of us in this room consume these products, and until we make a commitment to reduce that, we are going to continue to face these risks.

My other comment is, I have seen the advertising from BP, which quite understandably has a slogan that says something like "We will make this right." The facts are, they can't make it right. They just can't. Our next panel will talk about the lasting damages and we need to be clear about this. This is not something that throwing a lot of money or technology at is going to make right. Once this happens, the damages are long lasting: eleven lives lost, millions of acres of valuable wetlands, marshes and coastal zones are destroyed. And so we need to be clear: we are trying to minimize and reduce damage, but we are not going to make this right. We are going to try to make it less bad but it is going to be very, very bad.

A Possible Lack of Information on Deepwater Drilling

I want to ask this question. Dr. Venosa, you talked on the one hand about project research that has made progress in our understanding, but also on the other hand about areas where we still need knowledge. Before we approve a drug in medical research, we look at side effects, we do a whole lot of risk analysis. There are stages, as you know, in drug trials. My question as I heard your list of what we still need to know, is did we approve this drug of deepwater drilling before we fully understood the effects on the patient?

Dr. VENOSA. Well, we do have a procedure that we have to—that vendors have to follow in terms of getting their products listed and they have to get listed on the NCP [National Contingency Plan] product schedule, and dispersants were probably the number one technology that we thought would be best used to mitigate the impact of this huge spill because——

Chairman BAIRD. Let me approach it a little differently. I mean, I understand you have done research on the dispersants but, you know, as I listened to Ms. Buffington's analysis, we have analysis, some study in Norway, I guess, of behavior of oil at deepwater. Do we really know how well—did we know well enough what kind of lasting impacts this would have before we approved this deepwater drilling? In other words, were there so many unknowns about how oil behaves at depth, how underwater deep sea plumes perform, did we just say look, we want the oil that is down there, we may not know enough about the consequences but let us go ahead and approve the drilling? That is open to everybody.

Dr. VENOSA. This is a brand-new approach. We have never had to deal with a deep sea blowout like this before, especially at 5,000 feet below the surface. So no, we don't know what the long-term

effects are going to be or we didn't know it 51 days ago either, but there is a risk and there is a benefit to everything you do. No matter what you do, there is going to be something that is going to be damaged, so we have to try to weigh the risks of the decisions we make versus the benefits that we hope we will make.

Chairman BAIRD. My concern as I listen to the testimony, as I have it and studied it, is I don't know that we knew the risks very well. I think we were focused on the benefits and we didn't look at the risks.

Anybody else want to address that issue? Captain Lloyd.

Captain LLOYD. Yes, sir. One thing I would say is, OPA 90 remains a solid foundation to work from. I think we have a system of preparedness, a planning regime that is in that set of laws that is sort of a foundational approach and so when you look at something new and unique like deepwater operations, it certainly lends itself to the potential for a need for a reevaluation of the issues that may result, which is essential to what is going to happen in this case. So we do recognize that the foundation that was laid in OPA 90 is very solid and provides an opportunity for us to form up rapidly.

Chairman BAIRD. Thank you. One thing that would be helpful, I won't ask for it now, but if anybody has got access to a concise document showing how the research conducted since OPA 90 has informed better practices in this cleanup, that would be very helpful so we can see what have we learned that we are applying in this case that we didn't know before.

I recognize Mr. Hall for five minutes.

CAUSES OF THE DEEPWATER HORIZON SPILL

Mr. HALL. Mr. Chairman, thank you, and I want to thank Mr. Venosa for getting right to the point here. You are dealing with something that has probably never happened before. We don't know why it happened and we apparently don't know what to do about it.

At his speech in Pittsburgh last week, President Obama suggested that the core cause of the oil spill was a lack of government regulation. That is something we have all been trying to run from, too much government regulation, but specifically he attacked Republicans for an approach that he said, "gutted regulations and put industry insiders in charge of industry oversight." And he also said that under the Bush Administration, if you are an oil company, you probably get to play by your own rules regardless of consequences to everyone else. Now, I don't recollect President Bush trying to put 9/11, the cause of it on Clinton, and I think these are the words of—and there is a reckless accusation made by President Obama, who turns out to be a real and certified non-expert on this matter. The President is clearly eager to put blame on others. However, we still don't understand precisely what went wrong. Question: How much do we actually understand about what went wrong? Question: Do we know what happened from a technical standpoint? If so, do we understand how much of the failure was due to inadequate or faulty technology, poor implementation of safety protocols or inadequate or ineffective regulatory system? And with respect to the regulatory system, do we know what to what extent the lack

of regulations might have contributed to the disaster as opposed to ineffective regulations or effective regulations that simply were not followed? I am not going to ask you to answer that. I only have five minutes. But I will be submitting that to you in writing and give you a reasonable time to give me those answers.

In the small time that I have left, I might just ask a question. Why is there a current influx of ideas and solutions for cleanup technologies, some of which are considered to have real potential, according to the representatives of the Unified Command, which are not considered or developed by government agencies prior to the current spill? And what technologies have been developed from the millions of dollars the Federal agency investment in research and development in the last 20 years since Exxon Valdez spill and Oil Pollution Act of 1990? Any of the four of you that want to tackle that, I would appreciate it.

Captain LLOYD. On the first one with regard to technology coordination, there have been many offers of ideas and technology proposals and so for that reason, in addition to what BP has at their website, the Coast Guard in coordination with the other agencies of the Interagency Committee have set up a broad agency announcement to receive those ideas so that they can be looked at and determined on the merits of the proposal. We have received over 100 of those right now and there have been other ad hoc proposals that have been received. They get a reply back and they are now being looked at by the Coast Guard's research and development center.

Mr. HALL. I thank you. I only have about a minute and 40 seconds. Would one of the others of you like to address that?

Mr. HELTON. I will take one. Representative Hall, one of the issues that Chairman Baird also brought up was, what have we learned since the Exxon Valdez, and obviously much of the research we have done in the last 20 years was driven by lessons learned from that incident. One of the things that we have done is, we have done a lot of work on sensors to detect oil at sea. We have also done work on improving cleanup technologies on the shorelines. One of the things we know from Exxon Valdez and other spills is that the cleanup can sometimes cause more harm than the spill itself, so trying to design effective cleanups that protect the shoreline but don't cause additional damages has been a big lesson learned in the last 20 years.

Mr. HALL. Well, I thank you for that, and, you know, from maybe an ignorant view of it, it seems to me that either the Federal Government ought to oversee the cleanup or BP, and of those two, BP is much more reliable financially because the Federal Government is broke. So they caused it, so I think they should have told BP to correct it, and when they correct it, we are going to send you the charge for everything else you have caused to date. That simplifies it, and I even yield back the last 20 seconds of my time. Thank you, Mr. Chairman.

Chairman BAIRD. Thank you, Mr. Chairman.

Mr. Gordon is recognized.

INTERNATIONAL AND BEST PRACTICE COORDINATION

Chairman GORDON. Thank you, Chairman Baird.

As I mentioned earlier, this BP spill is a historic tragedy. However, there are spills of different natures happening—I won't say daily, but frequently every year. It is my understanding that there has been an international spill control organization that was incorporated in London in 1984 as a nonprofit dedicated to improving worldwide preparedness for response to oil and chemical spills. I would like to better understand what that organization does, what our U.S. interface is with that organization, and what technologies we are, you know, learning from other countries and how we are using those. Go right ahead.

Mr. HELTON. Thank you, Mr. Chairman. One of the things that NOAA does do is participate in international forums with a number of countries. I am a delegate to the International Maritime Organization. We meet twice a year to discuss hazardous and noxious substances and also oil pollution response, and that is a mechanism for exchanging information on incidents like this. No one country has, thankfully, the experience to deal with these kinds of incidents, but I note that last year in Australia, there was a large oil blowout, and the past meeting of the IMO committee that I am on did focus on some of the lessons learned from that incident and was very beneficial in the initial stages of this incident in understanding what kinds of fates and effects we might expect to see. So there is a lot of exchange on incidents and lessons learned, and the oil spill community is a fairly small community, even internationally. So we see our colleagues, even here at this incident, and we have individuals from multiple other countries helping to solve and assess this incident.

Chairman GORDON. Is there any kind of international best practices protocol for something like this?

Mr. HELTON. The IMO does prepare manuals and standards. The United States has a different format for how we deal with oil pollution response that drives some of the—because we have a much more of a focus on the "polluter pays" model than some of the international standards. But in terms of the base technologies of how——

Chairman GORDON. So if they don't do "polluter pays," what are they doing?

Mr. HELTON. There is an international liability regime[1] that a number of other countries belong to that is a different structure, and in those places often it is the country that does the response and seeks reimbursement from this international liability regime.

Chairman GORDON. And we are not a part of that?

Mr. HELTON. No, sir.

Chairman GORDON. And do you have an opinion as to whether we should be?

Mr. HELTON. I don't have an opinion. I know that our system is considered to be very strong and many other countries look at our models for how we do work here, in part because of the liability caps that the international regime has.

Chairman GORDON. Does anyone else want to address that?

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[1]The International Oil Pollution Compensation (IOPC) funds are only applicable to tanker spills. See Appendix 2.

Captain LLOYD. Yes, sir. With regard to best practice coordination, another aspect of that interaction is conferences where papers are submitted and they are reviewed and they may or may not have technical merit and it is private industry, government, state, local and international. This goes back also to the regime set forth in OPA 90 which is based on the "polluter pays" principle. We can give you the details. We are a signatory to the OPRC, which is the international treaty, but we use the OPA 90 regime, and we can provide those details for the record.

[The information follows:]

U.S. COAST GUARD INSERT REGARDING THE OPRC

In July 1989, a conference of leading industrial nations in Paris called upon the IMO to develop further measures to prevent pollution from ships. This call was endorsed by the IMO Assembly in November of the same year and work began on a draft convention aimed at providing a global framework for international co-operation in combating major incidents or threats of marine pollution.

Parties to the Oil Pollution Preparedness, Response and Co-operation (OPRC) convention are required to establish measures for dealing with pollution incidents, either nationally or in cooperation with other countries. To date there have been 11 meetings of the Response Planning Cooperation-Work Group. This group has devised and promulgated an international treaty (USA ratified and internationally in effect) which defines minimum strategies and responsibility for Administrations in dealing with pollution clean-up. The USCG has been an active participant to this treaty and the guidelines and resources associated with it. For example, the U.S. delegation recently submitted papers titled: A Field Guide for Oil Spill Response in Ice and Snow; Shoreline Assessment Manual and Dispersant Use Guidelines.

The Coast Guard also provides a leading role in the following annual meetings of responders and response technology vendors: The Clean Gulf Conference, The Clean Atlantic Conference, the Clean Pacific Conference and the International Oil Spill Conference. Papers are submitted, peer reviewed and presented at these conference. The following are a few of the topics presented at these events: Incident Action Plans; Marine Firefighting and Salvage case studies and Transitioning vessel casualty events to marine pollution response operations.

These events, along with annual mandatory oil spill response exercises (tabletop and on water mobilization) as well as regularly scheduled meetings and Regional Response Team meetings (semi-annually) offer excellent opportunities for local, state and, Federal agency personnel to meet and work together on oil and hazardous chemicals response topics as well as policy and coordination issues.

Coast Guard and Federal Maritime Commission regulations require outer continental shelf facilities with capacity >1,000 barrels and every vessel carrying oil as cargo or vessels greater than 300 tons that carry oil as fuel to have a Certificate of Financial Responsibility (COFR) as a demonstration of financial ability to pay for an oil spill resulting from the oil they carry. The COFR is in essence a bond signifying that an insurer has been arranged to provide the funding likely to arise from a pollution incident from the vessel or facility covered. COFR's have specific dollar amount coverage's stipulated in regulation which are fixed at $75 million for facilities but vary for ships based on tonnage. Courts can eliminate the caps for polluters found guilty of negligence or willful misconduct.

Our approach of having private companies bear the burden for marine accidents that they may cause is seen as a best practice. In a lot of other countries, the Nation tries to bear that response and in many instances they struggle with that.

Chairman GORDON. Do smaller companies have to put up some kind of bond? I mean, it is fine to say that the polluter pays, but if you have someone who is broke, then what do we do?

Captain LLOYD. Well, and that is what the purpose of the Oil Spill Liability Trust Fund is. There are planning requirements and applicability requirements in OPA 90 for those that ship or store oil, and that would drive their planning and their contracting for those means.

Chairman GORDON. Does anyone else want to make a brief comment on that? If not, I yield back the balance of my time.

Chairman BAIRD. Thank you, Mr. Gordon.

I recognize Mr. Ehlers.

MMS SPILL PREPAREDNESS

Mr. EHLERS. Thank you, Mr. Chairman, and Ms. Buffington, you have escaped unscathed so far, so I will see what we can do for you.

One thing that strikes me about the whole issue, one thing I have learned in my research as a physicist is that anything that can go wrong will, and it seems to me that was not—that was a new concept to a lot of the people working on this.

The other saying that I learned from my mother, an ounce of prevention is worth a pound of cure. In a case like this, it is probably an ounce of prevention is worth $100 million of cure. I am just astounded that people seem surprised that this oil spill could happen. I just assumed it would happen at some point. There is no evidence that it wouldn't.

And secondly, the surprise that there is this plume of oil forming, and I remember as a child hearing about the gushers in Texas. If you tap into a source of oil that is under pressure, which many of them are, particularly at great depths, this is going to happen, and I am just surprised there hasn't been greater expectation of this and better preparation for dealing with it. It is great now to use this as an experiment on how to clean up, how to stop it and so forth, but all of that should have been done before, and I am just amazed that there isn't a greater regulatory mechanism that says you will do this.

Having said that, I know that MMS has been active in deepwater oil spill response research. I am wondering why you haven't specifically addressed the research recommendations from Project Deep Spill and why you were not better prepared to deal with something of this magnitude, and I am not taking the burden off BP by asking you this. The entire industry should have been asking that question. I would appreciate your comments on that.

Ms. BUFFINGTON. Representative Ehlers, it is true, we had Project Deep Spill in the Norwegian Sea, and it provided data to look at the spill models, and it was in 800 meters of water. The information from that is being applied in the Deepwater Horizon incident. I think what is surprising is the amount of time this is going on.

Mr. EHLERS. In what way? What would you have expected?

Ms. BUFFINGTON. I would have expected the spill to be not as long as this.

Mr. EHLERS. And for what reason?

Ms. BUFFINGTON. That it would have been capped by now.

Mr. EHLERS. And how would you have proposed capping it?

Ms. BUFFINGTON. I don't have that information in front of me, and, you know, we can get back with some more information to you, but——

Mr. EHLERS. BP had no plans about capping?

Ms. BUFFINGTON. They have the oil spill response plan, and I guess they have been trying different techniques but they haven't been successful obviously.

Mr. EHLERS. I am just surprised they are continuing to drill if they haven't solved that basic problem. Frankly, the entire corporation is at risk because of a lag to do so.

Ms. BUFFINGTON. There is much more research gaps that we need to look at for deepwater for oil spill response in deepwater, and the lessons learned from this incident will be applied back into the research program.

Mr. EHLERS. Yes, a bit late, however. I am just terribly bothered about the lack of foresight, both of our government and of BP, and of course, BP will pay a price for that, perhaps even the failure of the corporation at the rate it is going. But it is very distressing to me that something like this was not foreseen and expected and plans in place to deal with it. I just don't see much evidence of that.

I am also surprised that people are surprised that the oil would go to the top and spread as rapidly as it did. Again, that is to be expected just from the simply chemistry and physics of that situation. So I think there is a lot of people at fault here.

One last comment. On 60 Minutes, they had one of the workers who quoted someone, quoted a BP person who said, "we are going to go ahead and do it, we know it will be safe", et cetera. Is there a record of that and will that person be punished?

Chairman BAIRD. Mr. Ehlers, I am going to—your five minutes is up, but I am going to be very strict on this today. I am sorry, my friend.

Mr. EHLERS. That is really too bad. This is the best question yet.

Chairman BAIRD. I know. You will just have to time it better next time. You can of course submit questions for the record. I think it is an excellent question, but in the interest of allowing my colleagues all to ask questions, Ms. Woolsey is recognized for five minutes.

THE FEDERAL OIL SPILL RESEARCH ACT AND AGENCY RESPONSIBILITY

Ms. WOOLSEY. Thank you, Mr. Chairman.

Thank you all for being here today—not an easy task but you can all be glad you are not Admiral Allen. Imagine, he hasn't stopped talking for weeks now. So difficult.

Oil spill prevention and mitigation is more than important to me and the people I work for because we have to protect our environment, we have to protect our coastal economies. But in my district, we were severely affected by a minor spill in November of 2007. The container ship Cosco Busan collided with the San Francisco Bay Bridge and released 58,000 gallons of oil into the San Francisco Bay and this was considered a minor spill, and, compared to the Gulf of Mexico, it certainly was a minor spill. But this spill spread rapidly. It affected large areas of the north coast, the Golden Gate Bridge National Recreation Area, Point Reyes Seashore, Gulf of the Fairlawns, Monterey Bay national marine sanctuaries. The beaches of Marin County were soiled. The Federal parklands were sullied, and restoration projects were threatened. So this ex-

perience showed me, and this was 2007, that we had some real questions when we were through with this, and my major question was well, who is in charge here, and that is why I introduced H.R. 2693, the Federal Oil Spill Research Act, and of course here in this Committee, we are responsible for science and research and development, but my question was really bigger than that. I mean, who is in charge? Because we have to coordinate Federal research and development. We have to coordinate the cleanup and the prevention. There is so much that I think was left unanswered at that point and is more than unanswered for me today.

So I need to ask you—well, I have a little side thing I want to say. No matter who is in charge, if the operators do not play by the rules, it really doesn't matter. If they are going to shortcut the system, if they are going to ignore signs that there could be a problem, if they are not going to care particularly about the safety of their workers, it doesn't matter how good our system is.

But my question for you, and I would like to start with Mr. Helton and go down, if we do need a better coordinated Federal research and development effort for oil spill technology, which agency should lead the effort for research and development? And we need an umbrella agency. I mean, we have got, what, 15, 17 agencies, you know, that are responsible here. Which particular agency should be responsible, Mr. Helton?

Mr. HELTON. Thank you. NOAA is a science agency and we understand the oceans and the atmosphere and we can contribute a great amount to the research for oil pollution, but oil pollution response is more than just understanding what is happening in the ocean. It is also how to design ships to be safer, how to design engineering controls such as the blowout preventers to be safer. So I think it is important the way that we have it structured now with the Coast Guard as the lead of this interagency group with contributions from the other agencies as they can contribute. My agency can certainly contribute with effects on fish and wildlife and water columns, but we don't have the skills to design double-hulled tankers and to design better safety systems. So I think what is most important is that, whatever system we have, that it is funded, and that we have the assets and the enthusiasm between spills to carry on the research that is needed.

Ms. WOOLSEY. Captain Lloyd, do we need 15, 17 agencies to deal with this?

Captain LLOYD. Thank you, ma'am. The reality is, it is a complex issue. Each agency has authority and jurisdiction. The Coast Guard is the lead Federal agency for coordinating a response, for example, or for preparedness efforts. For the R&D effort, I think it was envisioned as they created OPA 90 that practitioners would be looking for things that work, so we recognize the need to update the technology plan that was brought up prior to the last hearing. So we are making an effort to do that, to lead that and use the team-based approach because we rely on NOAA, for example, for our science support and on EPA for their broad technical capabilities for toxicity and things like that. So it does require all of the whole of government approach, which is what we used for preparedness, which is what we used for response, and in past discussions we have tried to describe R&D as a subset of preparedness, so it flows

well to use a team-based approach, but also to have a lot of initiative moving forward.

Ms. WOOLSEY. Well, every team needs a captain, and——

Chairman BAIRD. Ms. Woolsey.

Ms. WOOLSEY. —that is a problem.

Chairman BAIRD. Thank you very much.

Ms. WOOLSEY. Oh, am I over?

Chairman BAIRD. Yes, indeed. I am sorry.

Mrs. Biggert.

Mrs. BIGGERT. Thank you, Mr. Chairman. Before I begin my question, I was just thinking about this. Have you considered doing a Codel for this committee to go down there?

Chairman BAIRD. We have, actually, been discussing that possibility. We are trying to decide how we would be constructive rather than just one more group of Members of Congress in the region. So we are——

Mrs. BIGGERT. That is always very important, but I think this Committee is very important.

Chairman BAIRD. I think it is a good suggestion. We are in discussions on that very subject.

ECOLOGICAL IMPACTS OF OIL AND DISPERSANTS

Mrs. BIGGERT. Thank you.

Listening to all of you, and you all, you know, seem to have a lot of input into this, and maybe—and talking about a team, but it seems like we have such a problem here of whether this, you know, well is going to be able to be capped, and it seems like, have we brought in the best and the brightest of all the minds that could deal with this as far as, you know, getting together from the industry and from the government? I know I have been contacted by several people that have ideas, but trying to get those ideas to you—you say well, it is very easy, it is coordinated, but it is not. You know, I have gone to Governor Jindal, gone to BP, and it makes it so—I think we need more of a coordination there too to get the ideas and get them going. Here are people that might have, you know, the absorption capability and they can't get through to anybody or the dispersal. I don't know how that works.

So Mr. Helton, does NOAA have any analysis indicating what the oil impact in the Gulf regions would have been without the use of dispersants?

Mr. HELTON. Well, I think it is important to recognize that this oil is being released from the sea floor. It has a mile to travel before it reaches the surface. It is a light crude oil and a large fraction will disperse naturally, even without the contribution of the dispersants at the sea surface and the sea floor. We are obviously looking at the tradeoffs of dispersant use, and we don't have all the answers about and all the information we need to make those tradeoffs. But everyone has seen the pictures in the last week of oiled pelicans and oiled marshes; no one wants to see that, either. So we are in a very tough situation. We don't have all the answers but we are trying to make the best decisions we can.

Mrs. BIGGERT. But it seemed like there was a question of whether the states could put up sandbags to try and protect their wetlands and try and keep it off the shores and yet the government

said no, you know, you can't do that, and I think this is a real problem of disconnect between the groups.

Mr. HELTON. I think that every response alternative has tradeoffs and has collateral impacts, and even something like putting a boom on a shoreline can cause harm. We want to make sure we use those appropriately. I think it is unfortunate that we are in the situation where we are essentially building a fire truck while we are in the middle of the fire, and there is obviously lots of technology out there, lots of very smart people who are contributing, and we need to adapt the information we are getting from all the vendors and the public who have good ideas. At the same time, we need to continue that thinking and that effort between spills. It is not a very effective process to try to design things in the middle of the spill.

Mrs. BIGGERT. It is not, but we don't know how long this is going to last either.

Mr. HELTON. Right.

Mrs. BIGGERT. And maybe then I will turn to Dr. Venosa. What kind of R&D effort exists in terms of the next-generation dispersant? Are you—is there research going on right now trying to find what we can use that would be better?

Dr. VENOSA. Thank you. Not at the moment, but as I mentioned in my oral testimony this morning, we are going to be giving serious consideration to the use of green chemistry to develop less toxic or nontoxic dispersants in the future and so we will be—our administrator has asked Congress for additional research funds, and I am sure that that will be part of it to ask our colleagues from academic institutions to come up with some ideas.

Mrs. BIGGERT. Does anything exist right now for the subsea application?

Dr. VENOSA. Well, the dispersants that are being used right now. It doesn't make that much difference whether they are used in the subsea or whether they are used on the surface. What you need is energy to mix the dispersant with the oil, and that is happening at the deep sea, and from all the data that I have seen so far, it appears to be working. The plumes that you hear about are mostly dispersed oil because the particle sizes are very small and that is why they are staying in the deep sea. They are not rising to the surface. And so Mr. Ehlers was right. If there were no dispersant added to this deep sea, then all this oil would be surfacing most likely.

Mrs. BIGGERT. Thank you. I yield back.

Chairman BAIRD. I thank you.

Mr. Garamendi.

RESEARCH ACTIVITIES IN CALIFORNIA AND COAST GUARD PREPAREDNESS

Mr. GARAMENDI. Thank you very much, Mr. Chairman. Thank you for the hearing and for the witnesses.

First, there was some discussion from our Ranking Member about what happened. I would draw the Committee's attention to some studies that are underway from the Center for Catastrophic Risk Management. Several universities are involved in this, one based at the University of California-Berkeley. I will pass that in-

formation on. It is exceedingly important that we gain knowledge about how the incident occurred, what the failures were and what can be done to prevent or to reduce the risk, keeping in mind that stuff will happen.

My question goes directly to Captain Lloyd. Captain, are you familiar with the California oil response program?

Captain LLOYD. Somewhat, yes, sir. I have had interaction with them in the past.

Mr. GARAMENDI. For the Committee's edification, California has had for almost two decades now a specific in-place program ready to deal momentarily with any incident of oil spill in harbors or along the coast. It is reasonably effective, prepositioned equipment, prepositioned personnel, and communications, although in the incident in San Francisco Bay, there was about a two-hour, three-hour hiatus, which was unfortunate. Nonetheless, my question to you, Captain, did such a response mechanism exist in the Gulf?

Captain LLOYD. Yes, sir. The preparedness framework envisioned by OPA 90 is similar, if I recall, to the California approach. There is planning standards. The equipment is required to be contracted. There are plans. The area contingency plans are a manifestation of the area committee's work to identify environmentally sensitive areas and then vessel and facility response plans are required to align with those plans for the vessels or facilities that are required to have plans. So there is a regime.

Mr. GARAMENDI. Did it work?

Captain LLOYD. I think OPA 90 remains a very solid approach to oil spill response and preparedness.

Mr. GARAMENDI. There is considerable doubt as to whether there was an immediate response or even within several weeks, a couple of weeks of the effort to contain the oil at the site.

Captain LLOYD. If you recall, I know you recall, sir, it started off as a serious, a very serious marine accident and fire and subsequent casualty and loss of life and so as the—in all these instances, sir, the challenge is to build, you know, essentially a multimillion-dollar organization in a very rapid fashion, and this is done with a fairly regular period approach for an oil spill. That is the challenge, to integrate the private capabilities that are required by law or reg, to integrate the local municipality and then the Federal——

Mr. GARAMENDI. Excuse me. I have but just another minute. My question now is, from this incident, is there a review of the successes and failures of the immediate response to contain the oil, and what is the time frame for that review?

Captain LLOYD. We conduct preparedness reviews. We did one for Cosco Busan. We conducted an incident-specific preparedness review and it is actually available. Our intent is to do something similar and we are working on that.

Mr. GARAMENDI. Are you gathering the necessary information? It is now, what, almost two months.

Captain LLOYD. We are still in the crisis phase for the response obviously. There is still an ongoing release, and the national commander's focus remains in mitigating the effects and working to, you know, control the source, so that is the primary focus right now, sir.

Mr. GARAMENDI. It seems to me that we should assume, in fact count on new spills occurring, and therefore we ought to be working not only to deal with the current issue but to plan for the next one, the gathering of information, what we right, what went wrong, what could have been done better, et cetera. Thank you very much for that.

Finally, MMS is in serious jeopardy, and the research programs at MMS have been questioned, and my question to you, Ms. Buffington, is, what resources do you have available in your research effort? And you have 10 seconds.

Chairman BAIRD. I am going to ask you to be very brief in that and submit written comments. You have 30 seconds at most for that.

Ms. BUFFINGTON. The oil spill response research that we get at MMS is between $6 million and $7 million a year rounded to the nearest million for the last ten years, and we have been able to do quite a bit with those funds. If we because of this incident received additional funds, then we would look at other efforts that needed to be done and supplement our strategic plan that we work on for the five-year period.

Chairman BAIRD. Thank you.

I am told by minority side that Mr. Diaz-Balart will be next because of his position on the Subcommittee.

CONTINGENCY PLANS AND THE EFFECTS OF OIL DISPERSANTS

Mr. DIAZ-BALART. Thank you very much, Mr. Chairman, and thank you all for being here. This is a huge disaster. A lot of people reference it to Katrina. Obviously with the exception of the loss of life, it may even long term be worse. This really is kind of like Katrina Oil.

I have two questions, Mr. Chairman, on Katrina Oil. First, a little while ago I heard that it is kind of like building a fire truck during a fire. Now, knowing that we have been drilling, that there has been drilling in deepwater, it is not the first well in deepwater, how it is possible that the so-called fire truck was not built before we had the fire? In other words, how it is possible that the equipment, the technology, contingency plans were not already available, tested, explored and have a contingency plan before you have a problem or was there the attitude that there is never going to be a problem, there is never going to be a fire? I mean, how is that possible, is one question, if I could get an answer.

The other one is the following about the dispersant, and we obviously know the impact of the oil on the surface to the fisheries, to wildlife, et cetera. But what is the long-term effect on these clouds of so-called dispersed oil that are in the water columns? What are the long-term effects? Do we know what the long-term effects are on the fisheries, on the wildlife, on the coral reefs, et cetera? Could that be worse than the effects that we already know about, what are horrendous, of the floating oil and what do we know about that? So those are the two questions, Mr. Chairman.

Captain LLOYD. For your first question, sir, I think it kind of goes back to, you know, the regime of preparedness that is laid out in OPA 90 is solid, but there is a recognition that building on that

and closing gaps, the gaps, for example, between Coast Guard and planning are issues to look at. We recognize that. But the preparedness responsibilities that the Federal on-scene coordinator has at the local level are taken very seriously. We have a systematic approach to exercises, interagency exercises, and those occur on a regular and frequent basis and then there is also requirements for plan holders to exercise their plans, so I think the issue is as we move forward, how do you build out that based on, you know, the clarity that has been provided by the Deepwater Horizon incident.

Dr. VENOSA. In regards to the second question, I am not a toxicologist. I can only tell you that, as I said before, whenever we plan a response, there are going to be risks and there are going to be benefits. The risks are that we don't know what the long-term effects of the deep sea dispersion injection are going to be, because most of the research that we have done in ecotoxicology has been acute toxicity, 96-hour bioassays and things like that. So we don't know what the long-term effects of exposure of these critters—both phytoplankton as well as the fish that eat them and the fish that eat those—are going to be over the long term. However, had we not done the dispersant treatment, then we would have 15,000 barrels of crude oil coming to the surface and oiling a lot more birds and affecting the wetlands even more.

Mr. DIAZ-BALART. Mr. Chairman, if I may follow up on that, you know, that is a little worrisome because you are basically—so we know what the effects are of the crude oil coming to the surface and oiling the animals but we do not know, right, what the long-term effects are of this thing floating around in the water column. Could it be worse than if it would have been allowed to just float potentially?

Dr. VENOSA. I can only speculate. I don't really know. I can't answer that question.

Mr. DIAZ-BALART. Right. So just so I understand, so here we are releasing hundreds of thousands of gallons, whatever the number is, you know, gallons of this chemical into the ocean not knowing what the effect is going to be long term, if it is worse or not. You know, that to me is inconceivable. I mean, it is inconceivable. This is not like, you know, water that you are throwing in there. These are chemicals.

Dr. VENOSA. But the idea behind dispersion is that it creates the small particles, okay, and then that allows microorganisms to degrade those particles over time and that could be relatively rapid.

Mr. DIAZ-BALART. But you are saying we don't know if that is worse or better.

Dr. VENOSA. Well, no. If the microorganisms degrade the oil, it is gone, so over time it will be better.

Mr. DIAZ-BALART. And you are certain of that?

Chairman BAIRD. Mr. Diaz-Balart, I am going to—I am being pretty strict. I will mention that I think one of our witnesses on the second panel may be able to address that precisely. This is a very important line of questioning.

Mrs. Dahlkemper.

HURRICANE IMPACTS

Mrs. DAHLKEMPER. Thank you, Mr. Chairman, and thank you for allowing me to join you as a Member of the Full Committee.

I certainly want to thank the panel here for all the work that you have been doing and I know many have been working very hard. Just on a personal note, my daughter is in the Coast Guard and stationed in the Pacific and is actually heading over to the Gulf Coast and I think will be there for many, many months.

As we are looking forward, obviously we know there were many regulatory system failures, there was modeling that should have been done, many pieces of research that were not done that should have been. But, as we are going into the hurricane season—and I am from Pennsylvania, so hurricanes aren't usually an issue for us, but it is a huge issue in this Gulf—and so as we look at the clean-up efforts as the hurricane season approaches, what sort of delays can we expect from the cleaning and capping operations if a hurricane comes into the Gulf? Have there been any forecast models for a hurricane hitting ground zero and the effects that that will have on the Gulf and/or the East Coast? And could that hurricane potentially throw that oil inland, you know, beyond the barriers where it currently would flow?

Mr. HELTON. Thank you. My agency obviously has a lot of interest in hurricanes. We are the Nation's weather forecaster, and we have been looking at the potential, what would happen if a hurricane came through. I am going to leave the operational aspects to Captain Lloyd about how a hurricane might affect the operations but from the physics of a hurricane, the potential for oil and hurricane interaction very much depends upon the path of the hurricane and whether it comes through where the primary slick is. There is a concern about if the hurricane comes through and there is oil near the shore, that the storm surge could carry oil into the shoreline, but that is typically what happens in a major hurricane regardless. If you recall during Hurricane Katrina, there were over eight million gallons of oil that were spilled from various tank farms and facilities and there were—so any major hurricane is going to cause damage to oil and coastal infrastructure and topple cars and boats. So there already is going to be a concern about contaminated debris in those storm surge waters. We don't have any reason to believe that a hurricane is going to pick up oil and carry it in the atmosphere. It is just going to be the storm surge waters that would have that concern right in the local area.

Mrs. DAHLKEMPER. Captain Lloyd?

Captain LLOYD. Yes, ma'am. Thank you. The technology package that is being applied would definitely be affected by a hurricane. There are efforts within the National Incident Commander staff to look at that, develop plans. It goes back to the challenges of developing an organization that can provide plans and subsequent different types of plans for something like a hurricane. They are looking at that. They are aware of that. Obviously, we remain very focused on hurricane planning in the Gulf Coast. So they recognize it will impact operations on the surface due to the need to demobilize. You see the offshore industry go through those steps whenever tropical storms come into the Gulf, so they have a series of

thoughts to consider as they plan for that eventuality. So it would likely impact it and then the requirement would then be to remuster very quickly.

BP RESEARCH FUNDING PRIORITIES

Mrs. DAHLKEMPER. I have one more question. BP has pledged $500 million to establish a fund to pay for research and development from independent scientists to ensure that this never happens again. What sort of oil cleanup technology and improved deepwater solutions would you recommend this money go towards? Who would like to answer that? Anyone?

Captain LLOYD. As the Chairman of the Interagency Committee, I think that the way you address a question like that is, you have to basically do an analysis and find out what it is important. I think obviously we want to focus on operations far from the shore. Deep sea, Arctic issues predominate, so there are some focus areas that have been coming to, you know, coming to the front as we have tried to reinvigorate the 1997 technology plan. So those are some areas that are starting to reveal themselves. There are probably others.

Mrs. DAHLKEMPER. Ms. Buffington, is $500 million enough to be able to do the kind of research we need to do to prevent this from happening again?

Ms. BUFFINGTON. It would be a good start to look at the mechanical equipment and the deepwater subsea containment devices and also at the worst-case discharge calculations and assumptions. I would have to give it more thought and analyze whether it is sufficient, but it would be a good start to look at that, particularly the containment equipment.

Mrs. DAHLKEMPER. Thank you. My time is expired.

FEDERAL RESEARCH FUNDING LEVELS

Chairman BAIRD. Mr. Rohrabacher is recognized for five minutes.

Mr. ROHRABACHER. Thank you very much, Mr. Chairman, and let me just note from the questions already asked and especially by Mr. Diaz-Balart, it is clear that—and Mr. Ehlers as well, I might add, it is clear that we were not prepared for this crisis and we do not even know, for example, whether or not for sure making sure the oil goes deeper than going to the surface is the best strategy for dealing with this type of problem. I would suggest, Mr. Chairman, that what this indicates is that the research that was necessary, the technology development necessary to make sure that we were prepared didn't happen, and let us note that this Committee is the committee that sets the priorities for this type of spending. So let us note why we aren't prepared. My staff indicates to me that we have spent $28 million annually through interagency coordination on oil pollution research, $28 million. Now, at the same time, we have been spending $2.5 billion on global warming research. Now, let us just note that. That is one percent of what we spend on global warming we have spent on research knowing that a problem like this someday would develop because we are at this moment dependent on oil and gas for our Nation's prosperity. We haven't done our job. Our priorities were wrong, and we need to

correct that. That can be done here. That can be done in this Committee.

Let me just note also that while we have not been spending the money on the research necessary to deal with a crisis like this and spent it elsewhere, we have also forced the oil industry to develop offshore oil in deepwater. Now, why are we developing oil in deepwater when there are other offshore and onshore, I might mention, but mainly let us talk about offshore developments in shallow water. It becomes dramatically more dangerous at 5,000 feet to drill a well than it does at 50 feet. However, the oil industry has been forced into deepwater because people have been concerned about their view, their view, posing as environmental concerns. They have been concerned about their view and forced us to depend on oil and gas that is being given to us in the most dangerous way. We have got to quit talking nonsense to each other in this Committee and make sure we get down to the realities of what happens when we prioritize spending and prioritize policies in this way.

So I would just ask our panel again if we indeed—have we been spending enough research to develop the technologies and the approaches to possible challenges like the one we face now? Could we have spent, for example—could this question of whether or not the oil sinking it down to a deeper level, whether or not we absolutely are sure that that is the best way to approach a challenge like this for the long-run concern for our environment? I would suggest—I am going to ask the question but I would suggest that we could have spent that money and answered some of these questions and been better prepared, but I will leave that to the—you have one minute to express your opinions on the opinions I just expressed. Thank you very much.

Chairman BAIRD. However, you are not obliged to. It is just an option.

Mr. HELTON. I would just add to your discussion of risk that the depth of drilling is not the only factor that we look at when we are considering risk, and certainly we are drilling in more and more remote locations, or talking about that, anyways. In some ways in the Gulf Coast, the proximity to the oil and gas industry there, we are 50 miles away from Port Fourchon that has all the assets to put out marine fires and bring in submersibles, and there are places in this country that are much less accessible to that kind of technology. So depth is just one consideration.

Chairman BAIRD. I thank the gentleman. I thank Mr. Rohrabacher.

What we are going to do, we had intended to try to recess this panel at 11:30, but we have two Members on each side who have been diligent and been here from nearly the beginning. With the witnesses' indulgence, we will go to about 11:45. That allows two more Members on our side and two more on the Republican side. That should make sure everybody gets covered.

With that, Mr. Tonko is recognized for five minutes.

FORECASTING SPILL IMPACTS

Mr. TONKO. Thank you, Mr. Chair, and thank you to the panel.

The first question I have is for Mr. Helton. You made comments about forecasts that NOAA incorporates into its work activities.

Are those forecasts that you would make at a time such as this when a spill has occurred? Do you forecast the amount of oil release into the waters?

Mr. HELTON. The forecasting I was referring to was forecasting the trajectory and the fate of the oil. It is not typically NOAA's mandate to evaluate how much has been spilled, but once oil has been spilled, one of the first questions is, "where is it going to go?" "How long will it take to get there?" and then "what is it going to harm when it gets there?"

Mr. TONKO. Does anyone quantify the amount of oil released other than BP?

Mr. HELTON. There is interagency, or it is not even interagency, it is a technical working group that is composed of agencies and academics that is working on the issue of flow rate. Typically the issue is not as complicated as this. When there is a tanker or barge accident, you have a known quantity and there are gauges and tanks that can be surveyed. So this is a very challenging——

Mr. TONKO. So it is challenging, but is there—this exercise being done, is there quantification——

Mr. HELTON. Yes.

Mr. TONKO. —from the agency's perspective——

Mr. HELTON. The effort——

Mr. TONKO. —in a comprehensive strategy? Is there a government response as to how much has been spilled?

Mr. HELTON. The effort is being led by the National Incident Command, which has directed the Director of the U.S. Geological Survey to take on this responsibility.

Mr. TONKO. And can they share with this Committee what those numbers look like?

Mr. HELTON. I believe that those numbers have already been shared publicly with the initial flow rate range was——

Mr. TONKO. But any updates that they have made?

Mr. HELTON. They are continuing to revise those. I am not sure what the status is of what those calculations are.

Mr. TONKO. The other is the Interagency Coordinating Committee on Oil Pollution Research—that is 13 different agencies, I believe you indicated? All government agencies, or are there academic or private sector groups that are involved?

Captain LLOYD. They are all government, sir, all Federal Government.

Mr. TONKO. And in terms of that committee, was it in 1997, I believe, that they issued a report calling for more technology?

Captain LLOYD. The 1997 plan set forth priorities in a tiered fashion level sort of three different kinds of levels, so they agreed to a plan to move forward, and that was——

Mr. TONKO. And how much have we seen as an increase in technology developed by the industry or by some institutions to respond to the issues of drilling here?

Captain LLOYD. Well, I think in general, technology has changed dramatically when you look at the use of satellites, computing power, sea keeping capabilities. Some technology has changed dramatically. Some has not.

Mr. TONKO. How much would the committee suggest that that 1997 challenge, how much has that been responded to? Has there

been an exponential investment curve upward in investment in research or technology?

Captain LLOYD. We would probably have to submit that for the record, sir.

[The information follows:]

U.S. COAST GUARD INSERT REGARDING RESEARCH INVESTMENTS

The 1997 Oil Pollution Research and Technology Plan is a strategic planning document for the Interagency Committee to address possible research areas in preparedness, response, and recovery. When the plan was drafted, the Interagency Committee developed 21 research subject areas that the members felt would be important for the next 5 to ten years. Each subject area was assigned to one of three priority levels. To date, a variety of research projects have been completed for all 21 research areas by either the Interagency Committee member organizations and/or by industry and academia. Subject areas extensively researched specifically by the Interagency Committee member organizations since the release of the 1997 plan include: dispersants; in-situ burning; restoration methods and technologies; spill impacts and ecosystem recovery; training readiness and evaluation; on-water containment and recovery; and decision support systems for contingency planning and response.

The Coast Guard does not have visibility on specific budget totals for the research and development programs of the other member organizations of the Interagency Committee, however, generally there has not been an exponential investment curve upward in oil spill research.

Mr. TONKO. If you could, please, and is it mostly in drilling and drilling deeper or are issues of public safety and the environmental protection also included in that? And if you could, proration how much was invested in all of those categories and break it down for us.

Captain LLOYD. Yes, I think the plan lays out a variety of categories, you know, that were looked at.

Mr. TONKO. And finally, we only have a minute left here, but there has been much criticism about the close relationship of some of these agencies to the industry where there really isn't a watchdog relationship. MMS has been cited in such a capacity where it is really not, you know, a stern taskmaster standing over the subject in review but rather kind of a cozier relationship. Can you respond to that?

Captain LLOYD. The liability, you know, OPA 90 was clear. The spillers are responsible to take care of accidents that they cause.

Mr. TONKO. Oh, I understand that, but the watchdog, how aggressive would you categorize the watchdog is in this equation?

Captain LLOYD. I would say we keep a tight focus on plans. All of the vessel response plans are approved by the Coast Guard, you know, local plans are approved by the Coast Guard.

Mr. TONKO. I ask this: while I note that the dispersants were recommended, there were certain dispersants recommended not to be used, and that was defied and still used. So I think it tells the public that there really isn't this stewardship over the industry.

Chairman BAIRD. Mr. Tonko, your time is expired. If you want to ask a particular question in writing to the panelists, I am sure they will have the opportunity.

Mr. Bilbray is recognized for five minutes.

MORE ON DISPERSANTS

Mr. BILBRAY. Thank you, Mr. Chairman. And Mr. Chairman, let me just say thank you for your approach on this. I think that your

leadership, the leadership of the Full Committee on this has been great bipartisan effort on this. I think that this situation, though, serves to remind us that there truly is a place for government and the private sector. I think, Captain, you guys have been getting beat up about why didn't the government just come in, take over and why can't the government do it better, and I think that the answer is, because there are limits to the ability of government, there is limited abilities of the private sector. There is expertise that we don't have in-house that we need to draw on the private sector. Is that fair to say?

Captain LLOYD. Yes, sir. I mean, BP, you know, owns, to quote Admiral Allen, "the means of production," for example.

Mr. BILBRAY. I am not just saying that. I am just saying the fact that how many people do we have on staff that have the experience of working with these wellheads to the level that we can draw on, even if it not BP, even if it was coming from somewhere else, de facto we would contract this out because of the expertise, right?

Captain LLOYD. That would be one approach.

Mr. BILBRAY. And I just want to point out the fact that we really ought to look at how do we make the team work together. I know from my air pollution background that when you had government-operated systems in the Soviet Union, they had more emissions coming off of those than all the private sectors around the world, but again, where did we fail in our oversight. The dispersants issue is what I would like to look at right now. Do we have a list of approved dispersants for the private sector to use? Is there a government list that says these are items that we approve for this use?

Dr. VENOSA. Yes, sir, there is. It is on the national contingency plan product schedule.

Mr. BILBRAY. Okay. Is the private sector today, or let us just say BP, are they using a dispersant that is not on one of the lists that we had as the government-approved procedures?

Dr. VENOSA. No.

Mr. BILBRAY. They are using what we have approved previous to this incident?

Dr. VENOSA. Correct.

Mr. BILBRAY. Then why I am continuing to hear all of the issues about that what they are using is not appropriate, not safe, may be environmentally damaging?

Dr. VENOSA. No matter what chemical you use, there is going to be something in it that is going to have some negative impact on the environment because it is a chemical, and there is no two ways, there is no getting around that.

Mr. BILBRAY. So even if we look at it, we have our government scientists look at it, we do—those of us in government have done this, there is still a limit to how much we can do in government to basically have a perfect answer. There is no, we are not going to find it even if we are the guys making the calls all the time.

Dr. VENOSA. That is correct. There is no perfect answer.

Mr. BILBRAY. So we are dictating the standard and we admit that in the world of reality, even our standards may have faults?

Dr. VENOSA. Yes, sir. That is correct.

Mr. BILBRAY. Okay. My question to you, when we developed this—I mean, the greatest environmental disaster from oil is prob-

ably not even on our shores. Everybody agrees to that. Offshore, the Niger Delta is probably—where they are saying 50 times more pollution has been dumped over there over the years than were in the Exxon Valdez. Have we looked at testing our dispersants in real-world applications like a test platform like the most polluted area of the world from oil as far as I know, the East Coast of Africa? Have we had any scientific government review of how this stuff works on different types of products and how long do we check this and what is the procedure? We have done the testing, we think it is good and we say these are approved, right? But have we tried to double-check our data, our files so we can go back to the constituency and say we have continued to review this dispersants list and we are comfortable with it?

Dr. VENOSA. Most of the work that has been done has been in the laboratory or at the pilot scale at the OHMSETT facility. We have a wave tank with our partners in Canada. Attempts have been made with some of the seeps that occur in Santa Barbara.

Mr. BILBRAY. We have a lot of them in Santa Barbara.

Dr. VENOSA. I know. But that oil is highly weathered and not amenable to being dispersed. So that is—I mean, that is about it.

Mr. BILBRAY. I appreciate that, and just for the record, the seepage problem in the Santa Barbara channel is not something new. The Tumash Indians for a thousand years have been using that to caulk their canoes. So as a surfer in that area, I know exactly—I think Dana Rohrabacher and I will show you the black on our feet sometimes, okay?

The real issue now is how do we move forward on this? And all I got to say is, I hope, Mr. Chairman, that we don't approach this as reacting to every disaster and not being proactive, and I appreciate, I just have to say sincerely, I really am sorry to see you are not going to be around in the future because I think you are a leader along with the Committee chairman at looking at being proactive, not being reactive to this, and overreacting on that line because I think that when we import oil, we are not only 10 times more likely to defile our own beaches but we are continuing the defiling of estuaries around the world because we basically out of sight, out of mind. I think that the failure here, a small part of the failure——

Chairman BAIRD. Mr. Bilbray.

Mr. BILBRAY. —is that we cannot assure the American people that our list was the best and that BP is using the best, and I think we need to look at that.

I yield back, Mr. Chairman.

Chairman BAIRD. Thanks, Mr. Bilbray. I want to commend Ms. Woolsey, who had the prescience to introduce the legislation mentioned before.

We will do Mr. Matheson and then we will finish with Mr. Olson.

DRILLING SAFETY STANDARDS ABROAD

Mr. MATHESON. Thank you, Mr. Chairman.

Ms. Buffington, this may not be directly related to Science Committee but I think it is in the longer term, and that is, can you explain to me if there are any other countries in the world who have

standards in terms of technology for deepwater drilling that are more rigorous than the standards employed by the United States?

Ms. BUFFINGTON. Representative Matheson, we have been working with other countries, particularly the U.K., Norway, Canada, Australia on an interagency basis both for research and for regulations to make sure we are coordinating with regulations, to make sure we are all using the best available and the safest technology.

Mr. MATHESON. Do other countries have more rigorous regulations than the United States?

Ms. BUFFINGTON. No, not to my knowledge.

Mr. MATHESON. MMS provided testimony to this Subcommittee in June of 1999. It was during a hearing called "The New Direction for Federal Oil Spill Research and Development," and in the testimony MMS stated, "The OHMSETT facility directly supports MMS's mission of ensuring safe and environmentally sound oil and gas development on the Outer Continental Shelf." How did MMS's past research on the OHMSETT facility help to ensure the safe and environmentally sound oil and gas development on the Outer Continental Shelf in light of where we are today?

Ms. BUFFINGTON. It was—the facility has tested—95 percent of the equipment that has been used has been tested there and the data that has been gathered has been tested at OHMSETT so it provided a means to train the responders, and I know the Coast Guard and other organizations get training at the OHMSETT facility.

Mr. MATHESON. I would hope it would be safe to say that we are no longer saying that this facility has ensured safe and environmentally sound oil and gas development, though, based on the current situation. Is that a fair statement?

Ms. BUFFINGTON. Has helped to ensure?

Mr. MATHESON. That is what MMS said to this Committee last year. "This facility has helped us create a much safer situation for Outer Continental Shelf development." We are now facing this huge disaster. I would suggest that MMS would at least be willing to say, well, maybe there is a little more to learn from this facility.

Ms. BUFFINGTON. There are definitely lessons to be learned from every incident, and this incident certainly will show from all the investigations the lessons learned and those will be put back into the research program.

Mr. MATHESON. I would say that is an understatement. There are a lot of lessons to be learned from here.

Let me ask a question of the panel here. We seem to see all these random comments about how much oil has been flowing. Does anyone here know what the number is these days, about how much oil has flowed out of this end of the Gulf from this problem? Anyone, NOAA, Coast Guard? Where are we now on how much oil has gone into the Gulf?

Mr. HELTON. I would say that the number is still being calculated. The response is enormous, and I would say that after every large spill, determining the amount spilled takes months to determine. In the case of the Ixtoc spill in 1979, I don't think it was determined until about a year after the spill ended, and even then there was a range. So we are never going to know precisely

how much was spilled. We are going to have a good range but that is the best——

Mr. MATHESON. Do we have some sense of a range now of how much water is—how much oil is flowing into the Gulf today? We have no idea?

Mr. HELTON. There are concessions being made. The flow team has put out initial estimates. Those have changed because of the recovery, the methods that are going on now to recover the oil from the sea floor. The risers change because of that, so there is a lot of things that have changed since the calculation was made, the preliminary calculation was made last week, I believe.

Mr. MATHESON. Mr. Chairman, I will yield back.

Chairman BAIRD. Thank you, Mr. Matheson.

I will recognize Mr. Olson in one second. I want to first recognize for just a comment to introduce material into the record. Mr. Luján has been here, and the Chair appreciates his willingness to forego his time for questioning, and I recognize Mr. Luján for a comment.

Mr. LUJÁN. Thank you very much, Mr. Chairman, and there are some questions that I will be submitting for Mr. Helton and for Ms. Buffington specifically with NOAA along the lines of the questioning of Mr. Matheson, the trajectory predictions for spilled oil. This is going to be critically important as we try to get to the bottom of what reports that have been recently released by BP through the acquisition I believe by Mr. Markey's office, and we need to make sure that we are able to count on NOAA to be able to understand exactly how much oil is coming out of there. Mr. Chairman, I certainly hope we can get this question that I will be submitting for the record answered. Under the Oil Pollution Act of 1990, OPA has the authorization to recover damages on behalf of trust lands, and the question I will be submitting, Mr. Chairman, is to truly inquire under current law if we have the ability to recover every penny in addition to the other portions that we have.

To Ms. Buffington, a question. With all of the engagement to technology as well that we should have for deep oil, the only test that appears that has been done was at 844 meters, not 5,000 feet. Going back to 2002, we saw that there were some of these wells that were in the Gulf that didn't have to have these contingency plans placed, and I certainly hope that MMS is going to conduct an audit to see which of these entities have not had a contingency plan placed, and I will be asking if we have any ability or if the technology that has been submitted or the plans that have been submitted have been tested. Because it is evident that BP submitted a plan for over 200,000 barrels a day and we still can't do anything. This has to be changed and we need to make sure we get to the bottom of that as well.

Thank you very much, Mr. Chairman.

Chairman BAIRD. Thank you, Mr. Luján, for your brevity, and appropriately, the gentleman from Texas, Mr. Olson, is recognized for final——

APPROVAL FOR LOCAL SPILL RESPONSE EFFORTS

Mr. OLSON. Thank you very much, Mr. Chairman, and thanks to our witnesses for coming today. We greatly appreciate your expertise and your insights, giving me those so I could be a better Mem-

ber of Congress. I want to also let you know that I know you are in uncharted territory. Nobody ever—unfortunately, it looks like we failed as a government to plan for this type of disaster in the deep wells and the depth at which that occurred. I just submit to you that governments can do this. I represent the Johnson Space Center, the home of human spaceflight, and Apollo 13 in many ways was like this, but they came together. Every person within the agency coordinated and brought those three astronauts home. And that is what I think has been lacking here, coordination. We weren't ready for this disaster, certainly on the Federal Government level, but I am also concerned with some of the things that happened between the Federal Government and the local governments, the state and the locals, particularly—I mean, one of the delays that has occurred over the last two months that stood out to me is the extended delays in approving Governor Jindal's request to build 40 miles of sand berms to protect his state's shoreline. It took weeks before he was finally able to receive the approval from the White House to construct those berms, and of course, during that time that well was still gushing. Could any of you comment on the reasons for this? Was it due to scientific concerns, environmental concerns, bureaucracy, the lack of planning? I mean, if so, what are those concerns so we can address them and make sure that the interagency process is ready to respond to state and local governments when crises like these happen.

Captain LLOYD. The national incident commander staff worked extensively on that question, sir, so we can submit to the record sort of the overarching challenges in making a decision like that. Obviously it does hit all of those issues, ecological and structural, and so we can submit that for you to give you the details of how the challenges surrounding a decision like that, sir, multiagency, Federal, state and local.

[The information follows:]

U.S. COAST GUARD INSERT REGARDING PERMITTING

The following timeline addresses the matter of permit timeline, issues resolved to approve the permit; and deliberations involved to get it issued. The number of agencies engaged totaled at least 16, included: Department of Interior (DOI), U.S. Fish and Wildlife Service (USFWS) (Breton NWR and Local Office), Minerals Management Service (MMS), LA Dept of Natural Resources, LA Dept of Wildlife and Fisheries, LA Office of Coastal Protection and Restoration, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Chitimacha Indians, State Historic Preservation Office, Environmental Protection Agency (EPA), Natural Resources Conservation Service, Mississippi Dept of Marine Resources, Council of Environmental Quality, the National Incident Command, U.S. Army Corps of Engineers (USACE) Mobile District, and the U.S. Coast Guard.

Permit Evaluation Timeline

Sand Barrier Permit the New Orleans District (MVN) 2010–1066–ETT

10 May 2010—New Orleans District (MVN) hosts presentation of conceptual barrier plan by Plaquemines Parish President Billy Nungesser. MVN later attends presentation of conceptual plan by Mr. Nungesser to BP at the UCC in Schriever, LA.

11 May 2010—MVN hosts teleconference with USFWS, NOAAINMFS, EPA, LA DWF, LA DNR, to discuss the conceptual barrier plan and consideration under Emergency permit NOD–20. MVN receives formal emergency request (a cover letter with basic plans) from LA Coastal Protection and Restoration Authority (CPRA) at 11:06 pm.

12 May 2010—MVN hosts meeting with USFWS, NOAA/NMFS, EPA, LA DNR–CMD, LA CPRA, PPPMD, dredging contractor, and consultants. Primary issues are contaminant management, project feasibility, effect on existing island stability (especially Chandeleur Islands because of nearshore borrow), impacts to fish & wildlife habitats, impacts to Breton NWR, ESA. MVN requests formal comment from agencies by COB 13 May 2010.

12 May 2010—MVN hosts teleconference with CEQ, NIC, DOI and EPA to discuss permit application NEPA compliance.

13 May 2010—MVN received formal comment on barrier plan from NOAA/NMFS, EPA & LDWF.

14 May 2010—MVN received formal comment from USFWS and NGO; all comments forwarded to CPRA. CPRA submits revised plans and responses to agencies' comments; clarifies proposal is an emergency action, not restoration project. Plans increase berm length from 90 to 128 miles and removes nearshore borrow. MVN launches internal technical project review with MVD and ERDC.

15 May 2010—MVN sends CPRA's revised plans/responses to state/Federal agencies for their review. MVN updates NIC on permit status.

17 May 2010—MVN hosts interagency meeting/teleconference on revised plans/responses from CPRA. MVN requests formal agency comment on revised plan by COB.

18 May 2010—MVN initiates preparation of draft EA, emergency permit, and special conditions.

20 May 2010—MVN completes preliminary draft permit/EA.

21 May 2010—MVN forwards findings from internal technical review to CPRA and hosts teleconference with CPRA to discuss. CPRA provides written responses to MVN findings. MVN forwards CPRA responses to interagency review team for comment.

23 May 2010—DOI responds to MVN on 5/21/10 transmittal. MVN updates draft EA/permit, including findings by technical review.

24–26 May 2010—MVN channels technical findings, legal review, resource agency input, public communication, etc. into preparation of the final permit decision.

27 May 2010—MVN completes EA and issues emergency permit to CPRA.

1 June 2010—CPRA signs permit acceptance.

3 June 2010—CPRA forwards signed acceptance document to MVN.

Primary Issues:

1. Technical project feasibility in achieving proposed design considering available sediments/berm location.
2. Initial nearshore borrow location would disrupt littoral transport, destabilize Chandeleur islands.
3. Disruption/alteration of circulation patterns could unintentionally increase oil penetration into threatened areas, and redirect its movement to locations otherwise having minimal threat.
4. Project construction timeline and longevity for containing oil threat.
5. ESA—turtles, piping plover, Gulf sturgeon, manatee.
6. Pipelines throughout the project area.
7. Cultural resources—Chitimacha Indians and historical.
8. Location at Breton NWR, consistency with USFWS management.
9. The project is of potential EIS significance.
10. Essential Fish Habitat (EFH) impacts.
11. Consequences to Federal navigation projects—local and national.
12. Depletion of sand resources critical for future coastal restoration projects.
13. Disturbance to nesting seabird colonies.
14. Clearance from MMS for offshore sites.
15. Use of potentially contaminated sediments.

Mr. OLSON. I appreciate that, Captain, but again, you know, we got the oil coming off and we have got to stop or prevent the damage that can be done, and it doesn't sound to me like putting sand on a beach is a big challenge, and we have got to do better than giving a couple of weeks when the government needs it now, now, now. And we have got to—you know, we have got to take chances here because again we are in uncharted territory.

Anybody else care to comment? There we go.

Mr. HELTON. I would just add that it is a complex issue, that every response technology has tradeoffs and piling up sand to block channels is going to be a concern for the path for fisheries into those inlets. There are concerns about the turtles that nest on those shorelines. There are concerns about the marshes, and then there are concerns about the efficacy: will they stay around long enough to be effective? So there are a lot of questions. That is why there was a lot of discussion among the agencies. Ultimately, I believe it was the Army Corps of Engineers that was coordinating that whole process.

Mr. OLSON. Thank you for that answer, and again, in a time of crisis, we have got to get moving. We don't have the time to do some of the due diligence that we would like to do. I mean, the oil is washing up on the beach and we have to do everything we can to stop that because that is the major problem we are faced with right then, which is a transition.

MORE ON DISPERSANTS

I know we talked a lot about dispersants. One thing that I have a concern about is the daily usage for the dispersants was just going, jumping radically all over the place. I mean, some days none of it was getting used and some days tens of thousands of gallons were being used, so my question is, is that a procedural process within the government that is preventing it or are there different things going on there, conditions of the blowout, inadequate supply, reserves for disaster, but why we are having such sort of big fluctuations in the use of dispersants?

Captain LLOYD. Yes, sir, that is a good question, and it is primarily operational considerations when you look at the weather and how things such as sea states can impact the methodology for delivering dispersants, whether you use them subsea, surface or aerial, so there is a significant operational challenge with regard to any type of oil spill technology that is applied, whether it is in situ burning or booming or skimming. And sea states and weather play a fairly significant role in that, and that is a big challenge, especially with regard to dispersants.

Mr. OLSON. Dr. Venosa, dispersant expert.

Dr. VENOSA. Well, that is an operational issue. I am a researcher. But I can tell you that my agency—when it came to the deep sea injections early on in the spill, there was one asset out there, the Brooks McCall ship, so when it was out there sampling and conducting its research, monitoring, it would be out there for three days and then come ashore. During the time when it was coming ashore, the EPA said that there will be no more injection until we get that asset back out a day later. So that was the reason why it was jumping up and down, because we wanted to have someone there at the site while the injection was going on.

Mr. OLSON. Thanks for that answer. Again, more prior planning and we would have avoided a lot of these problems. I know I am over my time, Mr. Chairman. Thank you very much.

Chairman BAIRD. Thank you, Mr. Olson.

With that, I want to again reiterate my thanks to the panel not only for their work today and excellent testimony but for your work

over a long period of time. We wish you much success, and with that, this panel is dismissed.

Chairman GORDON. Mr. Chairman, if I could just real quickly——

Chairman BAIRD. Yes, Mr. Gordon.

Chairman GORDON. I would like to ask, as we move forward with legislation, if this panel has recommendations that they would like to send us, please do that, either formally or informally. We want to really bring forth the best legislation we can, and your expertise will help us do that. Thank you.

Chairman BAIRD. Excellent point, Mr. Chairman, and please also, you have been offered questions by Mr. Luján and many others. As part of this, we would welcome your written response at your earliest convenience, and with that, the panel stands dismissed.

We will reconvene in five minutes with our second panel. Thank you very much.

[Recess.]

Panel I:

Chairman BAIRD. I will take time to reconvene. I want to thank our guests and our witnesses here, and I appreciate my colleagues' adherence to the time frame earlier that allowed us to move onto our second panel.

In our first panel we heard from government agency leaders. Now we will hear from scientific researchers and people involved in innovative efforts to try to clean up oil spills, and it is our pleasure to introduce our second panel. Dr. Jeffrey Short is the Pacific Science Director for Oceana, Dr. Samantha Joye, Professor of Marine Sciences at the University of Georgia, Dr. Richard Haut, Senior Research Scientist at the Houston Advanced Research Center, Dr. Nancy Kinner, University of New Hampshire, C–Director, Coastal Response Research Center, CRRC, and Mr. Kevin Costner, a Partner at Ocean Therapy Solutions.

As I did with the prior panel, I want to thank all of you, not only for your presence here today but for the many years of research and expertise you have put into this important issue, and I also acknowledge that many of you have been very, very busy over the last weeks and months, not only testifying before our committees of Congress but actually trying to actually do some research and work out in the field.

So thank you for your presence today. As our witnesses should know, we will try to keep the testimony as close to five minutes as we can. There is often a little bit of run over, and now that we have cleared our first panel, we may have a little bit more time for that. If you have additional comments, please offer those into the record.

Ms. Biggert has taken the place of Mr. Hall as Ranking Member. Did you want to offer any additional remarks, or shall we proceed?

Mrs. BIGGERT. Proceed.

Chairman BAIRD. With that, thank you, Ms. Biggert, we will proceed. Dr. Short, please begin.

STATEMENTS OF JEFFREY SHORT, PACIFIC SCIENCE DIRECTOR, OCEANA

Dr. SHORT. Chairman Baird, distinguished Members of the Committee, Ranking Member Biggert, good afternoon now, and thank you for the opportunity to appear before you today. My name is Jeffrey Short. I am Pacific Science Director for Oceana, a global conservation organization headquartered here in Washington, DC. Oceana's mission is to protect and restore our world's oceans for the sake of fish, wildlife, and the people who depend on them.

Having previously worked for the National Oceanic and Atmospheric Administration for 31 years as an oil pollution researcher, 20 of which were on the Exxon Valdez, I have a keen appreciation for our limited ability to deal with major oil spills.

Since the Exxon Valdez, we have had about one major oil spill every two years on average. Now we face a potentially catastrophic spill in the Gulf of Mexico, one that has painfully reminded us of how little we can do with them. Major spills always encourage people to think about better ways to clean them up. These ideas usually focus on better skimmers and oil collection devices at sea, better dispersants, and better biological treatments to degrade oil on beaches and in marshes. These ideas are welcome and should be encouraged through a more focused and sustained Federal research enterprise.

But as noted in our consensus statement, oil pollution researchers gathered at Baton Rogue a couple of weeks ago to evaluate dispersant use of the Deepwater Horizon blowout, once a spill exceeds a certain threshold, and we are far beyond that threshold today, it is simply not possible to fully contain it, no matter what you do.

The reason is not so much because we lack effective technologies for skimming, for dispersing, or degrading oil. It is because we lack effective means to apply them at the scale that is required. As noted by Coast Guard Admiral Thad Allen, most of the oil flowing in the Gulf is in tens of thousands of small patches of mousse spread out over thousands of square miles of ocean.

To keep it from hitting the shore someone has to find and keep track of them, send the right—and send the right equipment to deal with them, and this has to start from scratch each and every day as the patches wander around at sea unseen during the night.

We already have the technology for dealing with the oil once we find it. What we don't have is the satisfactory ways to keep track of it when we are faced with really large spills. The agency that is responsible for keeping track of it is NOAA's Office of Response and Restoration. They have been doing a heroic job, especially given that their staff has eroded by some 30 percent over the last decade largely due to budget cuts.

NOAA is also the agency with the most experience with restoration after oil spills, yet their access to funding for operations and research under the Oil Pollution Act of 1990, is restricted compared with other agencies. NOAA needs to have full and equal access to funds in the Oil Spill Liability Trust Fund without being penalized through scoring. And the tax that supports the fund should be increased.

More generally, I commend Representative Woolsey and Chairman Baird for introducing H.R. 2693, the Federal Oil Spill Re-

search Program Act, to amend the research provisions of the Oil Pollution Act of 1990. As noted in their act, NOAA is in the best position to lead research on oil spill response, litigation, and restoration. Given the weak link in keeping track of oil once spilled, it would make sense for NOAA to work even more closely with NASA and perhaps with the Air Force to develop better high-resolution sensors to detect oil at sea from high altitudes.

In addition, other resource agencies such as the Fish and Wildlife Service, the U.S. Geological Survey, as well as the Environmental Protection Agency need more support to allow them to do a better job of identifying habitats and species that are in harm's way when oil spills and other environmental catastrophes happen.

In closing, the United States Government has a responsibility to manage our Nation's resources wisely. Continued budget cuts for the agencies charged with carrying out these responsibilities has the effect of turning it over to the industries that benefit most from resource exploitation. This results in the regulatory situation that led to the Deepwater Horizon blowout, where the industry pretends that such accidents simply can't happen, and the government pretends that industry is the most reliable source of information for making regulatory decisions.

In the end, this socializes all the risks and privatizes all the profits. This is not the most responsible management of our nation's natural resources.

Again, I sincerely appreciate the opportunity to address you today, and I would be happy to answer any questions from the committee.

[The prepared statement of Dr. Short follows:]

PREPARED STATEMENT OF JEFFREY SHORT

Good morning. I am the Pacific Science Director for Oceana, an international marine conservation organization dedicated to using science, law, and policy to protect the world's oceans. Oceana's headquarters are in Washington, DC, we have offices in five states as well as Belize, Belgium, Spain, and Chile. Oceana has 300,000 members and supporters from all 50 states and from countries around the globe.

Prior to joining Oceana, I worked at the National Oceanic and Atmospheric Administration (NOAA) as an oil pollution research chemist for 31 years, including nearly 20 years studying the fate and effects of oil from the 1989 *Exxon Valdez* spill. Having experienced this major spill as a scientist, as a citizen and as a 41-year resident of Alaska, I have a keen appreciation for the devastation such events can cause. I want to express my deep appreciation to Chairman Baird and the members of the Committee for your invitation to share my perspectives on the long-term consequences of major oil discharges on the environment and on the communities and livelihoods that are invariably scarred by them. In particular, I speak here today to honor the memory of the eleven men whose lives were lost at the onset of the Deepwater Horizon tragedy, in the hope that my words may play some part, however small, in preventing additional loss of life in our quest for energy.

My invitation to comment here requested that I provide an historical perspective on oil spills and oil spill cleanup capacity, the short- and long-term ecological and social effects of spills and spill cleanup techniques, and the scientific research and monitoring that is needed to move forward effectively. I will address these three general issues in turn, and conclude with comments on gaps in the Federal oil spill response capacity and what is needed to support a coordinated Federal response going forward.

I. Historical Perspectives on Oil Spills and Oil Spill Cleanup Capacity

Recent Large Oil Spills in Waters of the United States

Although unusual, large marine oil spills cannot be considered as rare occurrences in waters of the United States. We are well aware of the 1969 Santa Barbara blow-

out, and since the 1989 *Exxon Valdez* spill which discharged at least 258,000 barrels of oil into Prince William Sound, Alaska, there have been another ten large (>5,500 barrels) oil spills in the U.S., about once every two years on average. Of these, four exceeded 45,000 barrels, and the Deepwater Horizon is on track to become one of the top ten largest accidental marine discharges in history. The Deepwater Horizon has already released more than 500,000 barrels of oil, and if not stopped may reach 1,200,000 barrels or more by August when relief wells will hopefully plug the leak. In comparison, the 1979 Ixtoc I blowout, the largest accidental marine oil discharge in history, released an estimated 3,200,000 barrels into Mexican waters also in the Gulf of Mexico.

In every case, large oil spills are the result of unique and unforeseen causes. The *Exxon Valdez* spill was famously the result of criminal negligence by the tanker captain. The 1990 *Mega Borg* spill (115,000 barrels) resulted from an explosion in the vessel's pump room during lightering. A combination of heavy rains and lax maintenance led to the 2006 Citgo Refinery spill (67,000 barrels). The 2008 New Orleans spill (60,000 barrels) followed the collision of a tanker with a barge on the Mississippi River. Most of these and other large spills in the U.S. are the result of a combination of human error and unfortunate circumstances.

Oil Spill Cleanup Capacity

Once a marine spill occurs, there are three basic initial response options: skimming, *in situ* burning and chemical dispersants (most of this section is a summary of Fingas 2000). While frequently very effective when applied to small spills, each of these approaches has substantial limitations. Their efficacy varies greatly not only with the type of oil involved, but also with the properties of the oil as it changes following release. Once released, the composition of oil changes (i.e. "weathers") as a result of evaporation, dissolution of the more water-soluble components, microbial degradation, photo-oxidation, and the absorption of water. Water absorption may be especially troublesome, because it can increase the oil viscosity dramatically, which may have profound effects on the effectiveness of response methods.

There are a number of designs for mechanical oil skimming devices, which vary considerably in capacity and efficiency. Once oil is herded off the surface by focusing booms usually towed by one or more vessels toward a mechanical skimming device, the skimming device then may accomplish oil removal by any of a variety of mechanical means, including adherence to adsorptive materials or conveyance to oil-water separators by drums, belts, brushes, oleophilic rope, suction or a combination of these. Oil-water separation may be accomplished by means of separation weirs, holding tanks or centrifugation. Depending on the type and weathering state of the oil involved and environmental conditions such as sea state and temperature, these methods range in effectiveness from nearly nil to 95%.

In situ burning may oxidize as much as 90% of the oil ignited. However, burning requires corralling the slick to thicknesses of at least 2 mm and preferably more, and the boom must be fireproof and is not available for corralling while burning is underway. Also, the oil must not have lost much of its complement of volatile components, or it will not ignite, so the window of opportunity for *in situ* burning is usually limited to the first couple of days after oil reaches the surface. In general, burning is simply not capable of removing more than a small proportion of the oil released from large-scale discharges, except in cases where oil is ignited at the onset by the accident producing the spill, in which case the benefits of relatively efficient oil removal may come at a cost of human injury and death, as occurred during the 1990 *Mega Borg* spill. During the 1989 *Exxon Valdez* spill, crew safety was a major concern that precluded intentional ignition of the slick while the oil was near the vessel.

Skimming and *in situ* burning require corralling oil within booms, and hence only work in mild weather conditions. For the Deepwater Horizon, the leakage estimates imply a rate of slick creation on the order of about 2 football fields per minute, appearing erratically within a circle nearly two miles across. The largest skimmers in the Gulf of Mexico can sweep about 10% of the area within this circle per hour, and most skimmers are considerably smaller. The slick created by the *Exxon Valdez* expanded at a rate of about a half a football field per *second*, for two and a half days. These expansion rates exceed the available skimming capacity considerably, especially when the need for boom maintenance between deployments is considered. Consequently skimming retrieved an estimated 8% of the oil spilled from the *Exxon Valdez* (Wolfe et al. 1994), and is intercepting only a small fraction of the Deepwater Horizon oil that reaches the sea surface.

Dispersants act by lowering the surface tension between the oil-water interface, decreasing the mixing energy needed to disperse the oil into tiny microdroplets. To work effectively, the dispersant must be applied under conditions of moderate mix-

ing energy, and the oil must not have weathered much. When effective, the microdroplets become entrained into the water column where they are much more susceptible to microbial degradation.

Dispersants are typically ineffective when applied to mousse or in calm conditions, and if the sea state is greater than a few feet it can be difficult to hit the slick when released from aircraft. Another limitation of dispersants is that when they do work, the large surface area of the microdroplets promotes back-extraction of the dispersant out of the oil, which may lead to re-aggregation of the oil and re-surfacing of a slick far from the point of dispersion.

Other methods that have been proposed to deal with oil released at sea include application of agents to sink the oil or to cause it to aggregate into a more easily collectible mass. By transporting oil from the surface to the seafloor, sinking agents merely change the site of toxic effects and are therefore not generally used. Gelling agents have also been proposed, but they have the disadvantage of requiring application of large amounts of the agent, and the resulting gelled mass may interfere with other response options such as skimming or *in situ* burning. The mass requirement alone precludes their large-scale application to big oil releases. Similarly, oil absorbent materials such as hair, hay, or polypropylene pads or strips may work well for small-scale applications, but become increasingly impractical to deploy and retrieve in larger-scale situations.

Even when used in combination effectively, response options at sea usually cannot be applied to more than a small fraction of the oil discharged during a large-scale release. The reason has more to do with the difficulty of bringing the necessary resources for applying these mitigation methods at the scale required than with limitations inherent to the methods themselves. All three at-sea response options require mild weather conditions and daylight, which all but guarantees they will not be able to be applied to much of the oil. New response technologies that are brought forward generally face the same challenges of delivering them on the scale, duration and at the rate needed to make a material difference during a large-scale release, and are therefore less effective than it might seem. Hence. most of the oil from large scale releases either drifts out to the open ocean where it slowly weathers to form tarballs that eventually sink to the deep ocean seafloor, or else impacts shorelines, where additional measures may be brought to bear to mitigate impacts.

The cleanup technologies most effective for shoreline remediation depend on the state of the oil when it contacts the shoreline and the nature of the shoreline contacted. Oil that forms tarballs that wash onto sand beaches may be simply picked up and disposed of, as was the case during the 2007 Hebei Spirit oil spill in the Republic of Korea. Despite very heavy fouling of beaches within a national park, nearly one million Koreans volunteered to help pick up the heavy oil residues from the impacted shorelines, and succeeding in removing nearly all the oil that came ashore. However, if the oil is not dealt with immediately, there is the risk that it will be mixed beneath sandy beaches by wave action where it can re-surface months or years later, or be transported to the immediately adjacent subtidal where it may persist for years and perhaps decades, both of which occurred following the 2002 *Prestige* heavy fuel oil spill that fouled the beaches and shorelines of northwest Spain.

Oiled shorelines may also be treated by wiping with oil absorbent materials, sometimes augmented by application of surface-washing agents and pressure washing equipment, or by application of bioremediation agents consisting of oil-consuming microbes mixed with the nutrients they need to grow. Beach scrubbing is labor intensive and usually fails to remove more than a small proportion of the oil present, even when augmented by surface-washing agents (Mearns 1996). Also, these agents, along with more aggressive washing methods such as high-pressure, hot- or cold-water washing may do more damage to the biological communities inhabiting the beach than the oil would (Mearns 1996). Less intrusive methods such as bioremediation can be very effective, but only provided the needed nutrients can be efficiently supplied for the time required for the oil to be completely consumed.

While a number of other approaches have been tried for removing oil from shorelines, all are costly, and none work very well. Only about 10% of the oil that impacted shorelines following the 1989 *Exxon Valdez* oil spill was removed, despite the efforts of over 10,000 cleanup workers laboring over two successive years and trying a wide array of approaches (Wolfe et al. 1994).

II. Ecological and Social Effects of Spills and Spill Cleanup Techniques

Ecological Effects of Spills and Cleanup Techniques

A. Impacts of Spills

Some of the most damaging effects of oil spills occur through the contact hazard they pose to wildlife transiting the sea-air interface or while foraging on oiled shorelines (Spies et al. 1996), especially oiled marshes. Even small amounts of oil adhering to the skin, hair or feathers of sea turtles, marine mammals and seabirds can seriously inhibit motion and reduce their ability to thermoregulate, both of which often kill the animals. Inhalation of volatile hydrocarbons near oil slicks can cause lung damage and induce narcosis leading to drowning.

Natural and chemically-enhanced dispersion of oil presents an ingestion hazard to wildlife, fish and other marine organisms that mistake oil for food (e.g. Carls et al. 1996). Large aggregations of surface oil such as mousse patties or tarballs may be ingested by sea turtles, marine mammals, and seabird and may kill animals directly or cause illness that increases vulnerability to predation. Oil microdroplets are efficiently accumulated by suspension feeders such as clams, barnacles, some kinds of zooplankton, and deepwater corals. Zooplankton may ingest oil droplets which become mixed with inorganic material from other prey and ejected as oily fecal pellets that sink to the seafloor (Conover 1971), where they may be scavenged by deepwater corals and other animals inhabiting the seafloor.

Most oils contain monocyclic and polycyclic aromatic compounds (MAC and PAC, respectively), which along with closely related compounds may be toxic to marine life in several ways. The MACs are among the most water soluble components of oils, and at sufficiently high concentrations (typically around 1 part per million, or ppm) can induce narcosis-like effects in fish leading to death (French-McKay 2002). PACs, which include polycyclic aromatic hydrocarbons and closely related compounds in which one or more of the aromatic carbon atoms is replaced by nitrogen, oxygen or sulfur, can be much more toxic and operate through different toxicity mechanisms.

In addition to being notoriously carcinogenic, PACs can cause developmental abnormalities in fish embryos and larvae at concentrations below one part per billion (ppb; Carls et al. 1999, Heintz et al. 1999). Some PACs can also cause toxicity through a phenomenon called photoenhanced toxicity (reviewed by Diamond 2003). This occurs when certain PACs are absorbed by skin cells or are accumulated into tissues of translucent organisms in the presence of ultraviolet radiation from sunlight, where they may catalyze the conversion of oxygen molecules inside cells into a much more reactive state that causes oxidative damage. Because the oxidative damage usually does not affect the PACs catalyzing the conversion, a single PAC molecule may convert tens of thousands of oxygen molecules, which may either kill affected cells outright or make them cancerous.[1] As with induction of developmental abnormalities, photoenhanced toxicity may be lethal to translucent organisms at PAC exposure concentrations of one ppb or less (Duesterloh et al. 2002).

Embryotoxic and photoenhanced toxicity effects are most likely in habitats where oil accumulates adjacent to limited volumes of seawater, restricted water circulation and high biological productivity, such as coastal salt-marshes. A relatively high ratio of oil to water along with restricted circulation increases the likelihood of toxic effects, and high biological productivity in those areas attracts animals.

Not all of the toxic components of oil have been identified. Evidence for toxicity to shellfish associated with unidentified components has been clearly demonstrated (Rowland et al. 2001), but because oil is such a complex mixture of compounds, identifying the components responsible poses a challenging research task. In addition, it is becoming increasingly clear that both identified and un-identified toxic agents in oils act through multiple toxicity mechanisms, many and perhaps most of which are poorly understood.

Being lipophilic (or "fat-loving"), hydrocarbons tend to bioaccumulate in lipid stores of organisms. This process can lead to concentrations in lipids that are one-thousand to one-million times greater than respective concentrations in ambient water (DiToro et al. 2000), increasing with the molecular mass of the hydrocarbon involved. Fortunately, vertebrates possess elaborate biochemical pathways for eliminating the aromatic compounds they absorb (Livingstone 1998), so these compounds do not tend to biomagnify up the food chain. Another result of this ability is that hydrocarbons tend to be difficult to detect in vertebrates, even following substantial exposure to them. Hence, monitoring fish for hydrocarbons is often uninformative,

[1] For this reason cleanup workers and others should therefore scrupulously avoid skin contact with crude oil, especially while in strong sunlight.

because most of the hydrocarbons accumulated have been transformed into metabolic products that are not detected by ordinary hydrocarbon analysis. Analysis should be directed toward the metabolites themselves in these cases.

B. Impacts of Cleanup Techniques

Of all the cleanup techniques available, application of dispersants poses the most serious threats to marine life. In themselves, dispersants are mildly toxic to sea life (see *www.epa.gov/med/Prods_Pubs/ecotox.htm*), comparable to the toxicities of household detergents. Their ingredients are readily biodegradable, which reduces their environmental lifetime considerably. The ingredients of some dispersants may pose inhalation, contact and other hazards to cleanup workers exposed to them during application, as well as to marine mammals that may be coated during aerial application. As with *in situ* burning, worker safety is the paramount concern with application of dispersants.

When used successfully, dispersants dramatically accelerate dissolution of the more toxic components of the oil they disperse (Fingas 2000), which may expose sea life to higher risk of toxic effects. Accumulation of oil microdroplets by suspension feeders is especially worrisome when dispersants are applied near the coast. Biological productivity in general increases dramatically as the coast is approached, and many suspension feeders, such as oysters, are important commercially. Risks to wildlife must be weighed against impacts that arise from no response, and are especially acute when sensitive and vulnerable habitats such as coastal marshes are threatened. Oil cannot be removed from these habitats without serious collateral damage, and if left in place it may continue to kill fish and wildlife for years and possibly decades. From this perspective, dispersants have a distinct advantage because they provide a measure of control over where and toxicity occurs.

A further concern regarding dispersant application has arisen in the context of the Deepwater Horizon blowout. Application at the leak source appears to have accelerated creation of deep-water oil plumes. While this reduces the amount of oil reaching the surface, microbial degradation of the oil carries a poorly understood risk of depleting the oxygen content of the water within such plumes. It is conceivable that this process may deplete oxygen to levels that are dangerous for sea life, and might lead to a submerged "dead zone". While this risk is presently thought to be unlikely, such oil dispersion plumes should be monitored carefully to evaluate such risks.

If oil reaches shorelines in a less-weathered, more fluid state, it can penetrate into substrates more deeply which can make it more problematic to remove. In some cases, natural degradation of oil may be enhanced by mechanical disturbance of shoreline substrates to increase the availability of oxygen (Mearns 1996). Oil percolated into the coarse sediments of some beaches in Prince William Sound following the 1989 *Exxon Valdez* oil spill, where some of it became trapped in an anoxic layer and persisted for decades (Short et al. 2007). Mechanical disturbance was impractical there and would likely have caused as much or more damage to the resident biota as the oil. Both fresh and weathered oil that gets into coastal vegetation, especially into salt marshes can be nearly impossible to remove without resorting to extreme measures, such as cutting the vegetation to just above the root mass to expose and collect oil on the seabed and disposing of the oiled vegetation. This reduces the contact hazard posed by the oil to wildlife, but at the cost of eliminating nesting and rearing habitat for at least a season and perhaps permanently if the vegetation fails to grow back.

The benefits of shoreline cleanup and remediation techniques must be carefully weighed against their risks. Aggressive methods such as high-pressure, hot- or cold-water washing may sterilize biologically productive shorelines and remove fine particulate material that is an essential habitat characteristic for some organisms (Mearns 1996), leading to habitat alteration that may take decades to recover from. Such methods may also endanger cleanup workers if oil is converted into an aerosol that might be inhaled. Use of beach cleaning agents may be helpful in some circumstances, although these chemicals may be mildly toxic to biota. Application of bioremediation methods, usually consisting of oil-degrading microbes combined with nutrients to support their growth can be very effective at removing oil from shorelines provided adequate oxygen is available and nutrients can be efficiently re-supplied (Mearns 1996). Bioremediation materials are usually sprayed onto beaches, and exposure to the solvents used may be a concern for cleanup workers.

C. Ecosystem Effects

The animals and plants killed by the direct effects of oil spills, or by response, mitigation and remediation efforts may lead to changes in the structure and func-

tioning of marine ecosystems (Peterson et al. 2003). Such changes are often difficult to detect, especially when species and habitats at risk are inadequately characterized during the planning phases of offshore oil and gas exploration and development. Nonetheless, irreversible changes to marine ecosystems are among the most long lasting impacts that accidental oil discharges can have. Species extinctions are one kind of irreversible ecosystem change, but others are possible as well.

Predators near or at the top of marine food webs often exert strong structuring effects by controlling the populations of their prey. These structuring effects may form a "trophic cascade", wherein populations of prey species that support relatively large populations of top predators are themselves limited, and their low numbers allow their own prey species to flourish, and so forth down the food chain. If an oil spill and consequent cleanup activities reduce large numbers of top predators such as marine mammals or seabirds, these relationships may shift, causing sometimes dramatic changes in the abundances of various species, perhaps including commercially important species. Such shifts may require decades for recovery, and in extreme cases an ecosystem may shift to a new metastable equilibrium state irreversibly.

Social Effects of Spills and Cleanup Techniques

Large scale oil spills can have devastating economic and other social impacts. Fishery closures far in excess of what is needed to keep oil-tainted seafood out of the marketplace may be ordered because of the need to be cautious in the face of uncertainty regarding the extent and duration of oil pollution, with commensurate economic losses for the industry. In extreme cases, such closures may lead to permanent loss of market share, if products are displaced by competitors that gain better market acceptance, such as happened the once-lucrative pink salmon fishery in Prince William Sound, Alaska following the 1989 *Exxon Valdez* spill.

Exaggerated fears of oil-contaminated shorelines and seas may cause profound economic losses to tourism industries. Most of the public will avoid exposure to any perceived risk posed by an uncertain or poorly-understood threat such as is typically associated with oil pollution, and these reactions are exacerbated by the typical selection bias imposed by news media covering such events. The most extreme examples of contamination get the most coverage, creating the impression of much more extensive contamination than is actually the case.

Fisheries and aquaculture involving suspension feeding organisms such as oysters and clams are especially vulnerable to oil contamination, particularly if dispersants are used nearby. These organisms may easily become tainted by oil because they are so efficient at accumulating oil microdroplets.

Oil spill cleanup efforts may provide a temporary boon to local economies by providing a source of additional income, which may be especially welcome by those livelihoods are jeopardized by fishery closures, product contamination or oil-related declines in tourism. However, these benefits are typically short-lived, and may create additional adverse social impacts. Selective participation in cleanup efforts may create winners and losers within the same communities, engendering resentments that can seriously damage the character and social fabric of these communities. Protracted lawsuits typically add to individual and community stress. In extreme cases, where some members of a community are financially ruined while others are enriched, the result may be considerably increased incidences of domestic violence, substance abuse, violent crime and suicide, as was documented in communities affected by the 1989 *Exxon Valdez* spill (Russell et al. 1996).

III. Scientific Research and Monitoring Needs

Scientific research and monitoring needs fall into four categories: elucidation of toxic agents and mechanisms; monitoring the short- and long-term effects of spills; identification of vulnerable habitats, species and life-stages; and development of better cleanup and response technologies.

The funding made available to the oil pollution research community in the aftermath of the 1989 *Exxon Valdez* oil spill led to fundamental advances in our understanding of the toxic components and mechanisms of oil pollution. As a result of this work, it is now more realistically appreciated that oil pollution can affect fish and wildlife populations, and probably humans as well, in subtle but serious ways, and that much more remains to be discovered. Because this line of research has little potential for direct commercial benefit but is likely to bolster the case for greater regulation of petroleum products and the petroleum industry, there are almost no sources of funding available apart from governments. Yet even relatively modest investments in such research may yield substantial dividends. By elucidating what biological resources are at risk, policy makers will be able to avoid impacts that are

presently unsuspected to biological resources, while also avoiding overly strict regulation and resource closures that invariably lead to economic losses.

Better monitoring of short- and long-term oil spill effects interacts synergistically with research on toxic agents and mechanisms by providing opportunities to verify the relevance of the toxicity research, and by providing evidence for impacts that have not been considered heretofore. Again, the 1989 *Exxon Valdez* spill provides an example of this positive dynamic linking these efforts. The embryotoxicity research conducted in the aftermath of this spill (and supported by the funding made available by it) was inspired by field observations of relatively poorer survivals of pink salmon embryos rearing in streams on oiled beaches compared with those on un-oiled beaches. As a result of the embryotoxicity research, we now have a better idea of where, when, how and what to look for to determine whether a particular spill causes more subtle damage to exposed populations. We now realize, for example, that oil need not kill exposed biota directly; merely weakening biota even slightly very often results in their eventual premature mortality from increased vulnerability to predation or disease.

Once a spill begins, there is an immediate need to quickly determine the biological resources most at risk. In addition to identifying the most vulnerable species and lifestages, the most vulnerable, productive and otherwise important habitats should be afforded priority for allocation of spill response resources to mitigate impacts. Currently such habitats are identified using an environmental sensitivity index that is based on shoreline geomorphology. This index does not account for variation in biological productivity, reproductive habitat, ecosystem complexity, biodiversity, or habitat that supports rare, threatened or endangered species. Coastal zone maps that identify such important ecological areas in advance would be an invaluable asset to spill response officials to reduce the impacts of spills on the affected ecosystems.

Finally, research on better methods for collecting and remediating the effects of spilled oil are urgently needed. Recent research, again funded in the aftermath of the 1989 *Exxon Valdez* spill, has led to promising methods for delivering nutrients to oil buried within beaches, and it is likely that better designs for the oil collection devices used with surface skimmers would lead to significant increases in their effectiveness. Improved dispersant formulations that are less toxic to humans and to wildlife, along with better methods for delivering would be welcome additions to the limited array of tools available for mitigating spills. Along these lines, the Environmental Protection Agency (EPA) could helpfully waive prohibitions against oil discharges at sea and on shorelines to allow for experimental spills wherein new dispersant and other oil mitigation measures could be realistically tested. However, a requirement for such waivers should be adherence to rigorous standards of scientific practice. All too often field tests that fail to meet basic criteria for scientific experiments, such as positive and negative control treatments, replication, quantitative evaluation of test results, etc. are promoted as "scientific" when in fact they barely meet reasonable criteria for pre-experiment feasibility studies. At minimum, the EPA, NOAA, the Minerals Management Services and the U.S. Coast Guard should insist that rigorous scientific standards be met before relying on results claimed for new approaches to oil spill response and mitigation.

IV. Concluding Remarks

The science of oil spills is an especially complex branch of environmental science. As is hopefully clear from the above sections, oil affects species and ecosystems in ways that are often subtle and in any case are far from well understood. Once spilled, oil affects the environment in myriad ways, including many that are currently unknown, and response and cleanup actions add to the complexity. Every spill of any size presents unique impacts and response challenges.

When a spill is very large, factors related to scale seriously constrain our ability to contain them. For every spill situation there is some size threshold beyond which the efficacy of response, mitigation and restoration are primarily limited not by the available techniques or stockpiles of materiel, but by the ability to apply them effectively to where the oil is. By definition, very large spills expand quickly to impact large areas, and as slicks fragment and respond to the vagaries of winds and currents, keeping track of the oil becomes nearly impossible, especially with loss of visual contact at night (which may be prolonged in the Arctic), or when storms preclude surveillance flights while moving the oil rapidly. The fundamental problem becomes one of keeping track of all the oil parcels moving ever farther away from each other in a big ocean, and having the resources to identify and deliver the right combination of response options in a timely manner before loosing track of the oil again. At some point this challenge becomes hopeless beyond some size threshold. It is for these and related reasons that a scientific panel recently convened to review dis-

persant use for the Deepwater Horizon blowout concluded that "No combination of response actions can fully contain oil or mitigate impacts from a spill the size and complexity of the DWH incident" (Coastal Response Research Center 2010).

Fixing our ability to track and apply appropriate response measures to spills the size of the Exxon Valdez or the Deepwater Horizon blowout would require orders of magnitude greater investments in obtaining and maintaining the delivery infrastructure required. In the case of the Deepwater Horizon blowout, concerns regarding whether the current Administration acted quickly enough or made the right decisions, or whether they should have "taken over" the spill are largely beside the point. Neither the United States government nor the oil industry have the resources to fully contain a discharge the size of the Deepwater Horizon, and only the oil industry has the resources to be able to eventually stop the flow.

Recognizing the truth of the panel's conclusion has important implications for oil spill response policy and for how we go forward with regulating offshore oil and gas development. Regulatory policy has heretofore subscribed to the fiction that adequate spill response plans are a reasonable requirement for offshore oil and gas exploration and development. Spill scenarios that could not be contained by the resources and approaches described in these plans were conveniently dismissed as too improbable to warrant consideration, despite their recurrences over the last two decades. Given that continued oil production from U.S. territorial waters will increasingly require drilling in ever more challenging environments such as deeper ocean waters or in the Arctic, where we have little engineering experience in either, we must face a stark choice: Either we must accept that risks of uncontrollable releases will continue to escalate, leading to more frequent accidents akin to the Deepwater Horizon, or we must tighten our regulation of offshore oil and gas exploration and production considerably.

More generally, the United States government has a responsibility to manage the nation's natural resources wisely. The desire for smaller government implies a commensurately constrained ability to meet this responsibility. The effect of this is to cede these responsibilities to the industries that profit most from natural resource exploitation, and operate under a fiduciary responsibility that requires them to place their narrow economic interests above the wider interests of the public. To the extent that this effort succeeds, we should expect more and even bigger environmental disasters like the Deepwater Horizon blowout. Simply put, the Congress is faced with the question, "does America hold the long term health and biodiversity of our ocean resources in commensurate value as the short term demand for oil?" And if so, is the Congress willing to pay for their protection?

The United States is fortunate to have a substantial number of talented, dedicated environmental scientists in the employ of our resource agencies, whose primary motivation is to ensure that development of natural resources is done in a manner that does not inflict unacceptable damage on the capacity of our natural environment to sustain us. Recent years have seen increasing marginalization of their contributions, yet their understanding of and appreciation for the complexity of environmental interactions is unparalleled. Their advice should not be casually dismissed in favor of short-term economic arguments, and the steady erosion of their base budgets that has occurred over the last two decades should be reversed.

To cite one especially relevant example here, NOAA's Office of Response and Restoration, which is responsible for providing scientific advice to guide oil spill response efforts and to evaluate the environmental damages caused by oil spills, has lost about 30% of its staff over the last eight years, seriously straining their capacity to do their job when faced with a event on the scale of the Deepwater Horizon blowout. Other natural resource agencies in the Federal Government have faced similar budget reductions. Just as it costs money to maintain a fire department, it costs money if the Federal Government is going to recover its ability to independently assess the environmental risks of oil and other economic development, and to respond effectively to accidents when they occur.

As oil exploration pushes into these more challenging environments, the oil industry is positioned to reap most of the benefits while the public is saddled with nearly all of the risk. As I noted initially, this risk extends to loss of livelihoods and of life itself. It is for these reasons that my organization, Oceana, recommends a ban on new offshore drilling and a reinstatement of the moratoria previously in effect before 2008.

With these sober facts in mind, I recommend the Congress take the following actions:

1. I commend Chairman Baird and Representative Woolsey for introducing HR 2693 to amend the research provisions of the Oil Pollution Act of 1990, and I urge the Congress to pass it.

2. Immediately, include the expertise of scientists (including people with local and traditional knowledge) in a comprehensive review of the health and biodiversity of the ecosystems within the range of offshore drilling. (I would be privileged to participate in further discussion of the framework of such a review).
3. Stop offshore drilling until the President's Commission on the Deepwater Horizon blowout has completed their report and you can determine from the comprehensive science review in point number 2 above if we should go forward, how, when and where. It is Oceana's belief that the only appropriate conclusion for the panel is that new offshore drilling is not worth the risks and should not be allowed.
4. Conduct a thorough review of the Outer Continental Shelf Lands Act and other related Federal laws to ensure inclusion of the necessary oversight and protections of America's living marine resources.
5. Provide NOAA, EPA and the United States Coast Guard with the authority and the resources necessary for understanding, regulating and protecting America's oceans.
6. Initiate a process that will lead to a National energy plan that includes adequate protection for our oceans.

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BIOGRAPHY FOR JEFFREY SHORT

Jeffrey Short recently retired from a 31-year career as a research chemist at NOAA, where he worked primarily on oil pollution and other contaminant issues. He was the leading chemist for the governments of Alaska and the United States for the Exxon Valdez oil spill, and guided numerous studies on the distribution, persistence and effects of the oil on the ecosystem. During his last two years at NOAA, Dr. Short launched a research effort aimed at determining the effects of ocean acidification on commercially important shellfish in Alaska. Dr. Short is the author of more than 60 scientific publications and has contributed to 3 books on oil pollution. Dr. Short is now Pacific Science Director with Oceana, an international marine conservation organization.

Chairman BAIRD. Thank you, Dr. Short.

Dr. Joye.

STATEMENTS OF SAMANTHA JOYE, PROFESSOR OF MARINE SCIENCES, UNIVERSITY OF GEORGIA

Dr. JOYE. Thank you, Mr. Chairman and Members of the Committee for inviting me to testify. I am an oceanographer, and I have studied natural oil and gas seepage in the Gulf of Mexico for over 15 years. I am here today to discuss with you the environmental assault on the Gulf of Mexico that has resulted from the Deepwater Horizon oil spill.

At day 51 of this disaster there is still far too many unknowns regarding the ocean graphic impacts of this spill. I want to highlight some of those unknowns here for you.

First and foremost, we do not yet have robust independent estimates of the rate of leakage from this well, nor do we know the fraction of oil versus gas coming out of the riser pipe. Independent estimates of these numbers are needed immediately and continuously until the pipe has been sealed.

The second thing that we really have a lack of information and knowledge of is how the oceanic system is being altered and how the biological components of the system are reacting to this alteration. I recently returned from a two-week research cruise to the Gulf of Mexico. We found sub-sea plumes enriched in oil and gas that are derived from the Deepwater Horizon leaking well. These are some of the highest concentrations of methane gas that I have ever measured in the waters of the Gulf of Mexico, and I have no doubt that they are rising from this well.

We also found up to 10 miles away from the well at 1,100 meters detectable amounts of oil and PHs in the water. There are substantial increases in biological activity and consumption of oil and gas throughout the water column, not limited to these deepwater plumes. The entire water column is being impacted by the oil and gases being introduced to the system from this well.

We only made snapshot assessments of what is happening out on the water in the Gulf of Mexico. Continuous monitoring and assessments are thus urgently needed.

We simply do not know at this point how the oceanic system is being impacted by this bottom-to-top infusion of oil and gas, and when you add to that the unknown effects of dispersants onto the oceanic ecosystem, we really can't even begin to understand the impacts of this disaster.

For example, what are the physiological affects of dispersants on phytoplankton, on microorganisms, on larvae of important fishery species? We simply don't know the answers to these questions. Now, these are not questions that we need to be answering at this point. We should have known the answers to these questions before these dispersants were ever used.

What will be the long-term oceanic impacts of this spill? Are we going to see oxygen depletion in the water columns of the Gulf of Mexico? What will be the food web impacts of the spill? What will be the impacts long term of the dispersants and the toxic impacts of oil itself?

In terms of what is needed to respond to this disaster in terms of the oceanography and the ecology of the Gulf of Mexico ecosystem, I supplied information in my written testimony regarding the instrumentation and infrastructure that the oceanographic research community needs. I want to say here, though, that oceanographers are not used to sampling oil-laden water. None of our instrumentation, very little of our instrumentation and none of our collection devices are really made for this kind of sampling. This is an immediate need that needs to be addressed because if we are going to properly evaluate and assess the impact of this spill, we need to properly obtain samples.

Finally, I feel it is critical to coordinate the assessment and impact of this—of the oceanographic community of this disaster. This could easily be done by organizing a National Academy of Sciences workshop with oceanographers familiar with the Gulf of Mexico and others who are interested in working on the deepwater impacts of the spill.

Thank you.

[The prepared statement of Dr. Joye follows:]

PREPARED STATEMENT OF SAMANTHA JOYE

Background

I am an Oceanographer in the Department of Marine Sciences at the University of Georgia (Athens, GA). My research aims to understand how microbially mediated processes influence elemental cycling in the environment. Over my career, a good deal of my research effort has focused on naturally occurring gas and oil seeps, commonly referred to as 'cold seeps', in the Gulf of Mexico. I am an internationally recognized expert on cold seeps and have published a number of high-profile papers describing the microbiology and biogeochemistry of these ecosystems. My testimony will describe the role of hydrocarbons in the Gulf of Mexico ecosystem, both in the natural context and with respect to the potential impacts of focused large inputs

such as those resulting from the current Deepwater Horizon spill (hereafter referred to as the BP blowout). I will discuss the ecology of the Gulf of Mexico system, the ecological importance of oil recovery, the nature and potential ecological role of the observed subsurface plume features and highlight needs, current gaps, key features and required support for a successful coordinated Federal research program in response to the oil spill.

Ecological role of oil and gas seepage in the Gulf of Mexico

Broader Context: In most pelagic oceanic systems, ecosystem energy flow begins with phytoplankton, who through photosynthesis oxygenate surface waters and provide organic matter to fuel heterotrophic processes and secondary production at higher trophic levels. Heterotrophic organisms consume phytoplankton (e.g. zooplankton) and recycle released dissolved organic matter (e.g. heterotrophic bacteria). Zooplankton are consumed by larger zooplankton and fish and, in the Gulf, this trophic energy cascade is topped by consumers such as sperm whales and predatory fish such as blackfin tuna (who both eat squid and fish). In the Gulf of Mexico, primary production and microbial dynamics have been studies extensively in coastal waters such as those around the mouth of the Mississippi River, but blue water (i.e. open ocean) data on these processes are limited. Studies of benthic processes and benthic communities in deep water are also limited relative to the Gulf's coastal waters but benthic data are more abundant than water column data.

A unique characteristic of the Gulf of Mexico is that its subseafloor sediments contain vast reserves of hydrocarbons. Some of this oil and gas (methane and higher alkanes) fluxes naturally from deep reservoirs through complex fault-networks to reach surficial sediments. In sediments, these reduced substrates fuel extremely high rates of microbial metabolism. Some oil and gas escapes from the sediments and reaches the water column, where it is subject to additional oxidation. A fraction of this water column gas flux ultimately reaches the atmosphere, but these fluxes are not well constrained (1). Natural oil seepage from the seafloor creates slicks that can be quantified and mapped using satellite imagery (2).

Naturally occurring oil and gas seepage plays a key role in shaping the ecology, microbiology, and biogeochemistry of the Gulf of Mexico system, particularly its deep sediments and waters. Under most circumstances, natural seeps are the most important source of petroleum to the marine environment (3). In the Gulf of Mexico, about 95% of offshore oil inputs are from natural seeps under normal conditions. Systems like the Gulf of Mexico are thus accustomed to slow, somewhat diffuse inputs of oil and gas, and the biological communities have adapted to endure and in some cases metabolize these materials such that negative impacts of such inputs are localized as opposed to widespread (3).

Sediment processes: Seepage of oil and gas at the seafloor supports the establishment and proliferation of diverse chemosynthetic ecosystems that includes seep endemic sessile fauna (e.g. tubeworms and mussels), mobile fauna that tend to stay around seeps (e.g. clams, urchins, eels, fish, shrimps) as well as foraging species, such as demersal fish that likely migrate between seeps (e.g. six gill sharks) (5). Some endemic seep fauna harbor chemosynthetic symbionts (e.g. tubeworms, mussels, clams) while others are heterotrophic (5).

While the macro-ecology of cold seeps in the Gulf of Mexico has been well described (5), the microbiology of these habitats is not (6–9), even though the microbial processes serve as the geobiological engine of cold seeps. Free-living microorganisms degrade oil and gas; under the anoxic conditions typical of seep sediments, oil and gas degradation are largely performed by sulfate reducing bacteria and the product of their metabolism (hydrogen sulfide) provides an inorganic energy source (hydrogen sulfide) to the chemosynthetic macrofauna. The microbial degradation of oil and gas also generates carbonate ions, which subsequently drives precipitation of authigenic carbonates. These carbonate hardgrounds are colonized by deepwater corals (e.g. *Lophelia*), generating another unique seafloor ecosystem that is ultimately driven by natural seepage.

Water column processes: The impact(s) of natural oil and gas seepage on water column microbial communities has received little attention even though it is well known that both oil and gas are introduced into the water column at cold seeps in the Gulf of Mexico and elsewhere. Microbial oxidation of oil is carried out by microorganisms like the gammaproteobacterium *Alcanivorax*. Microbial oxidation of methane is carried out by a diverse assemblage of methane-eating, or methanotrophic, microorganisms (10). Other low molecular weight alkane gases are similarly oxidized. Because the Gulf of Mexico experiences natural seepage, the natural microbial community here is poised to consume oil and gas. At least 1000 naturally occurring seeps along the Gulf of Mexico shelf and slope deliver from 1000–2000 barrels of oil per day into the Gulf's waters (4). The fact that this naturally derived

oil does not accumulate on beaches underscores the ability of natural microbial and physical processes to consume it relatively quickly. However, as will become clear later in my testimony, the magnitude of this spill may saturate the microbial community's ability to consume the introduced oil and gas.

The need document the rate of leakage

In contrast to the naturally occurring hydrocarbon seepage, the BP blowout is injecting from 19,000 barrels (low-end estimate) to 70,000 barrels (high-end estimate) of oil per day into the water column via a focused, intense jet at a water depth of 5,000m. The amount of gas being injected into the system has not been constrained though BP has noted that the total flow could be as much as 40% gas. While natural seepage varies extensively in space and time, the BP blowout is an intense, localized input of labile organic matter to the deep ocean environment. Thus, the BP blowout is an unprecedented perturbation to the Gulf of Mexico system that has no natural equivalent.

It is virtually impossible to understand or quantify the ecological consequences of the BP blowout on the Gulf of Mexico ecosystem *without knowing how much oil and gas has leaked from the wellhead*. These numbers need to be estimated and corroborated independently based on available observational data. Unfortunately, the leak rate was not quantified robustly during the first month of the spill (at least that information has not been made publicly available). Unless we know how much oil is leaking from the wellhead, we cannot gauge the full extent of the ecological consequences in deepwater or surface water environments. For example, how much deepwater water column oxygen consumption will be fueled by this influx of oil and gas? Which water column microbial communities will be stimulated by oil and gas? What is the time scale of this response? How will surface water microbial communities respond to surface oil and gas inputs? Potential fishery, marine mammal, and wildlife consequences of the BP blowout cannot be properly predicted until we know the magnitude of the disaster. To put it bluntly, the scientific community is hamstrung until we know precisely how much oil and gas has leaked and is leaking from the wellhead.

It is even more important to quantify the inputs from the wellhead since dispersants are being added to the fluid stream at the seafloor. The aim of deepwater dispersant addition is to break up the oil and reduce formation of surface slicks. The application of dispersants at the riser makes it impossible to estimate the size of the leak solely from surface observations (e.g. using satellite imagery). Given the importance of the estimating the magnitude of the spill, the challenge of monitoring hydrocarbons not only on the surface but also within mid- and deep waters, and of quantifying the hydrocarbon's impact on ecosystem services in benthic, pelagic and littoral zones, it is critical that leak rates are quantified at least every other day by independent scientists until the well is capped and the leakage stopped. There are many scientists who can make these measurements and I know they are willing and eager to help.

Ecological Importance of Oil Recovery

The Gulf of Mexico ecosystem provides a number of ecosystem services to the public, including, fisheries production, recreation and tourism, carbon sequestration and water purification in coastal marshes and mangroves, to name a few. The potential coastal impacts of the BP blowout have received the most attention because this is where the direct human impacts are perceived to be the greatest. Certainly tourism, fisheries yield and production, and wetland and submerged aquatic vegetation (e.g. seagrass) habitats will be impacted. But, the food web of coastal and offshore habitats is likely to be impacted significantly. Everything from the base of the food web—microorganisms—to the higher order consumers—invertebrates, zooplankton, jellyfish, fish, birds, sea turtles, marine mammals—will suffer direct consequences of the BP blowout as long as there is oil in the system due the inherent toxicity of crude oil components. This is why it is essential to recover as much of the spilled oil as possible and to remove it from the environment. While removing oil can be accomplished via skimming or burn offs on the surface ocean or clean up and removal from beaches and marshes, removing methane and other alkane gases is not possible; other than evasion to the atmosphere, the fate of methane dissolved in water lies in the hands of microorganisms that can utilize methane as an energy source.

A secondary effect of the input of oil and gas on the oceanic system arises from the perturbation of the carbon and oxygen budgets in the system. Before the spill, oxygen concentrations in the water column reflected a "steady state" balance between sources (photosynthesis) and sinks (respiration). [Note that while atmospheric

exchange can also be important in some cases, for the present discussion, this term will be neglected.]

The direct injection of large quantities of oil and gas into the system has upset the delicate balance of oxygen in the offshore system. Basically, the oxidation of the oil and gas has stimulated respiration such that oxygen is being consumed more rapidly than it is being supplied. We do not know what the end result of this infusion of oil and gas will be on the Gulf's oxygen budget. But, we can use well-studied coastal ecosystems to inform us of the possible consequences of extremely high organic matter loading. In coastal ecosystems, excessive inputs of inorganic nutrients and hyper-production of labile organic carbon has driven increased respiration and heterotrophic oxygen consumption leading to the formation of coastal "dead zones". Low oxygen (hypoxic) or zero oxygen (anoxic) waters have been documented in coastal systems across the globe in recent years. These dead zones are a direct result of perturbation of the carbon and oxygen budgets of these systems. Scientists have previously defined an oxygen concentration of 2 mg/L as the threshold for "hypoxia"; this concentration is where many oxygen-requiring organisms begin to display symptoms of oxygen stress. Under anoxic conditions (0 mg/L oxygen), oxygen-requiring organisms are excluded from the system.

It is well known that methane and oil consumption proceed most effectively under aerobic conditions. This imbalance between oxygen inputs and outputs, if sustained over an ample period of time, could lead to hypoxia or anoxia in the water column, which would have substantial and potentially widespread negative impacts on any oxygen-requiring animal populations and on the food web of the system.

Dispersants. Initial concerns regarding the BP blowout focused on coastal impacts and the need to keep oil from damaging critical coastal ecosystems and the coastal economy, which depends heavily on tourism and fisheries (in addition to the oil industry). Certainly such concerns are valid and widespread efforts to protect the coastal zone from the oil are essential. It appears that the widespread use of dispersants in response to the BP blowout is due largely to the desire to keep the beaches clean and minimize the impact of the spill on coastal environments.

However, oil on the surface of the ocean and even on beaches can be cleaned up. Dispersed oil cannot be cleaned up, rather it moves with the water and the oil and dispersants are likely to influence oceanic ecosystems for years to come. Because dispersed oil cannot be effectively recovered, its fate is largely tied to the activity of microorganisms that degrade it, assuming the dispersants have no negative impact on their metabolism. The implication of this is that dispersed oil may stimulate the oxygen demand of the system and potentially promote subsurface hypoxia.

Oil and gas suspended in the mid-waters and deepwaters of the Gulf of Mexico

Little attention has been given to the offshore oceanic impacts of the BP blowout and initial reports of subsurface oil were received with skepticism. The BP blowout is introducing both oil and methane gas into the deepwater. The oil and gas mixture emitted from the pipe is derived from a very deep subsurface reservoir and the pressure/temperature field of the fluid is dramatically altered as it exists the riser pipe and enters the deep water. Previous studies of deepwater blowout events predicted (3) and illustrated (11) that a substantial fraction of the released oil and gas would become suspended in diffuse pelagic plumes (figure 1, taken from reference 3). Suspension of oil in the deepwater is predicted (and was documented, see ref. 11) to occur *even in the absence of added dispersant agents*. Mid-water oil may derive from coagulation and settling of oil from surface waters or from slowly rising deepwater plumes.

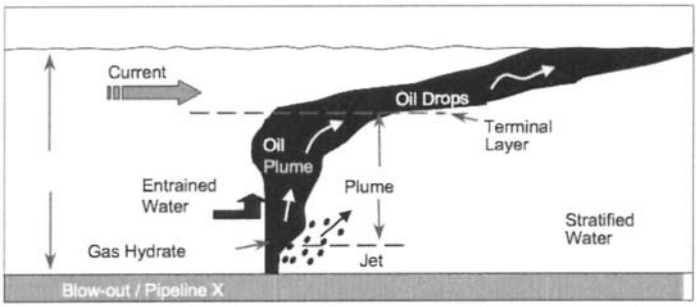

FIGURE 4-6 Schematic diagram depicting the basic physical processes involved in a deepwater subsurface oil and gas release.

Mid- and deep- water oil and gas will flow along the path of the prevailing ocean currents and along bathymetric anomalies. Satellite sea surface imaging has clearly illustrated how difficult it is to understand the movement of oil is in a two-dimensional setting. Mapping and modeling movement of deep and mid-water plumes will be even more challenging.

The fate of oil in the deepwater is likely to be very different from that of surface oil because some processes that occur on the surface do not occur at depth. Most importantly, photooxidation and evaporative loss are important terms of oil breakdown (former) and removal (latter) in surface slicks. Photooxidative processes transform crude oil into compounds that may, or may not, be susceptible to subsequent microbial oxidation.

Neither of these processes is important in deepwater, leaving microbially mediated oxidation and perhaps sedimentation along the seabed as the primary fates of the oil. For deepwater methane, the primary fate is likely microbial oxidation whereas both microbial oxidation and evasion to the atmosphere occur close to the surface.

In the water column, oil and methane oxidation are often coupled to aerobic (oxygen) respiration, meaning that microbially mediated consumption of oil and methane may generate oxygen depletion. Oxygen depletion in deepwater is a significant concern because deepwater oxygen is not replenished *in situ* by photosynthesis (as is the case for surface waters) rather it is replenished by physical processes (12). While surface water hypoxia/anoxia might be short-lived, deepwater hypoxia/anoxia could persist for years if (likely decades). Hypoxia or anoxia would have multiple impacts on the deepwater system, including changes in microbial community composition and the associated processes they mediate, exclusion of oxygen-requiring fauna (e.g. zooplankton, gelatinous zooplankton, fish, squid, whales, etc.) and altered nutrient cycles. For example, if the deepwater becomes anoxic, microbial respiration could switch to sulfate reduction, raising the possibility for generation of substantial volumes of anoxic, sulfidic water deep in the Gulf of Mexico. Furthermore, if such anoxic waters were to intersect with sediments or be pushed into the coastal zone, the impacts could be severe and widespread.

Coupled to the deepwater pelagic system is the benthic ecosystem. The seafloor in the vicinity of natural oil and gas seeps is home to diverse chemosynthetic ecosystems and colonies of cold water corals. Although these organisms can tolerate reduced oxygen concentrations and hydrocarbons, the impacts of the BP blowout will challenge the tolerance of sessile communities beyond any previous insult (12).

Research needs

To properly assess and monitor the oceanic impacts of the BP blowout requires a long term, coordinated research program. It is essential to quantify the mass of oil and gas entering the system, to determine their breakdown rates and fate in the environment, and to constrain their incorporation into the marine food web. Such monitoring must be done immediately and then we must track coupled biogeochemical dynamics of the system closely in the coming weeks, months, and years.

Little monitoring data for offshore sediments or pelagic waters is available in the immediate vicinity of BP blowout (lease block MC252), thus we have no robust baseline against which to compare post-spill conditions and responses. Through NOAA and DOE funding, a long-term research program was established at MC118, a site about 9 miles upslope from MC252, but that program is young and a long term monitoring data set of the benthic and pelagic system is not yet available. The BP blow-

out thus underscores the need for baseline monitoring in the offshore systems where deepwater drilling is occurring now and where it is planned for the future.

Current deepwater monitoring efforts have focused to a large extent on the area within about 20–30 miles of the leaking wellhead. Basin-wide measurements are needed as soon as possible because the dispersed oil, and the dispersants that generated it, may travel great distances from the site of the spill. It is therefore imperative to obtain background information from sites that may be potentially impacted as soon as possible.

Multiple types of data are needed and these data should be collected throughout the water column at as many places as possible. Detailed hydrographic and physical oceanographic characterization of the water column is essential. Such studies in surface waters (upper 200m), mid-waters (200–800m) and deep waters (800m to the bottom) should address at least the following specific objectives:

1. Quantifying the concentration of oil and the composition of the crude oil (PAH, BTEX, etc.) and fingerprinting the oil to trace it to its origin;
2. Quantifying rates of primary production and evaluating the potential impacts of dispersants on phytoplankton populations and activity (surface waters only);
3. Quantifying concentrations of dissolved oxygen, dissolved inorganic carbon, methane, dispersants, and nutrients and key trace elements (like iron);
4. Quantifying rates of heterotrophic respiration and methane oxidation;
5. Evaluating whether, and if so how, microbial activity is impacted by dispersants;
6. Conduct toxicity studies to evaluate the impact of dispersants on larvae, phytoplankton, zooplankton, and microorganisms;
7. Determine how the microbial community composition is altered by both dispersants and the presence of oil and gas;
8. Determine how microbial degradation alters the composition of the complex oil mixture present in the waters;
9. Quantify incorporation of oil and methane into higher trophic levels in the Gulf's food web;
10. Quantify bioaccumulation of oil-derived toxins (e.g. PAHs) into fishery species;
11. Develop oxygen and carbon budgets for different regions of the Gulf of Mexico that are a function of oil and methane inputs;
12. Quantify the dynamics and movement of oil aggregates from the surface to mid water to deepwater and from deepwater to seafloor sediments;
13. Evaluate benthic impacts of the BP blowout—both in terms of toxicity of the oil, fate of the oil, and potential impacts of water column hypoxia or anoxia—on sensitive benthic communities (chemosynthetic habitats and corals).

Gaps in Federal research and technology for oil spill response

I recently spent about two weeks (May 25th through June 6th, 2010) on a research vessel working in the area of the BP blowout. Most of the instruments oceanographers use to sample water and sediments are not designed for working in oily water. Traditional Niskin water sampling bottles are made of plastic and they adsorb oil; they are difficult to clean and because they are open going down, could be contaminated during descent. The oceanographic community needs multiple sets of Teflon-lined "Go-Flo" bottles for sampling oil-impacted waters. Research ships need to be equipped with state-of-the-art optical sensors for measuring oil, colored dissolved organic matter (CDOM), and transmissometry remotely. Such sensors can be mounted onto standard CTD rosettes. Such sensors could also be mounted onto gliders or ROVs to survey wider areas. Acoustic systems, e.g. 12 kHz chirp sonar systems, could aid in visualizing mid- and deep- water plume features easily and rapidly. For sampling sediments, targeted sampling systems such as video-guided multiple corers are essential. At present, such a deep video-guided, remote sediment sampling system is not available through the UNOLS (University-National Oceanographic Laboratory System) fleet instrumentation pool. Without a remotely targeted sediment sampling system (e.g. a multiple-corer as noted above), use of remotely operated vehicles (ROVs like the JASON) and/or manned-submersibles (like the ALVIN) become essential components of the program.

Any long term monitoring would benefit from a dedicated fleet of ships and a core group of scientists to assure continuity in site access, analytical methods, and ap-

proach. Organizing a National Academy of Sciences sponsored workshop or symposium to organize oil spill related monitoring and assessment activities could help the Oceanographic research community mobilize, focus, and plan such efforts quickly.

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BIOGRAPHY FOR SAMANTHA JOYE

Dr. Samantha Joye is a professor in the department of marine sciences in the University of Georgia's Franklin College of Arts and Sciences. She is an expert in the biogeochemical cycling of nutrients, metals, and organic materials in the environment; in the microbiology and biogeochemistry of methane hydrate and chemosynthetic habitats; and in microbial ecology, metabolism and physiology.

Dr. Joye has been studying the microbiology and geochemistry of Gulf of Mexico deep seafloor and deep pelagic habitats for over 15 years. Her work in the Gulf has included expeditions using a variety of deep submergence vessels, including manned submersibles (e.g. the ALVIN and JOHNSON SEA LINK) and remotely operated vehicles (e.g. the JASON-MEDEA).

Dr. Joye's research has been widely published in leading scientific journals, and she is regularly called upon by national and international scientific and policy agencies for expert commentary and panel service. Her work has been funded by substantial, multi-year grants from the National Science Foundation, the Environmental Protection Agency, and the National Oceanic and Atmospheric Administration, among other funders.

Dr. Joye's previous work in the Gulf of Mexico has examined how natural fluxes of oil and gas influence benthic and water column microbial communities. Her cur-

rent research in the Gulf oil spill zone is documenting the distribution of deepwater plumes of oil, measuring the activities of microbes breaking down the oil, and assessing other variables such as dissolved oxygen concentration and other environmental impacts of the spill.

Dr. Joye earned her Ph.D. in Marine Sciences at the University of North Carolina-Chapel Hill in 1993 and joined the faculty of the University of Georgia in 1997, having serving briefly as a research associate at San Francisco State University and an assistant professor of oceanography at Texas A&M. She was awarded a sabbatical fellowship at the Hanse Institute for Advanced Study in Delmenhorst, Germany, where she served as a visiting professor at the Max Planck Institute for Marine Microbiology in Bremen, in 2002–03. In 1997 and again in 1999, she served as a research fellow in the Marine Biological Laboratory in Woods Hole, MA.

Chairman BAIRD. Thank you, Dr. Joye.

Dr. Haut.

STATEMENTS OF RICHARD HAUT, SENIOR RESEARCH SCIENTIST, HOUSTON ADVANCED RESEARCH CENTER

Dr. HAUT. Thank you, Chairman and Members of the Subcommittee. I work at the Houston Advanced Research Center known as HARC. We provide unbiased science for policies and push technologies to commercialization in the areas of clean energy, air quality, and a complex balance between natural and human systems.

I am also on the board for the Research Partnership to Secure Energy for America or RPSEA, where I chair the Environmental Advisory Group. RPSEA has over 160 members, including 26 research universities, as well as various companies and organizations. It manages the $37.5 million per year of research funding created by Section 999 of the Energy Policy Act of 2005. RPSEA's program is complementary to the research sponsored by the MMS, NOAA, Coast Guard, and others.

The Deepwater Horizon incident has identified specific areas requiring research, research that is in the public interest related to national security, the economy, and the environment. RPSEA in collaboration with HARC, has the experience, the expertise, and the systems in place to manage comprehensive programs aimed at preventing future well control incidents, responding rapidly if an incident occurs, and determining the value of the ecosystems at risk.

Various needs are stated in the Department of Interior's 30-day report, as well as in a white paper developed by RPSEA. One of over 90 programs that RPSEA supports is a collaboration of universities, national laboratories, industry, and environmental organizations to progress technologies for development of onshore resources.

An example element of our program is an environmental scorecard that is based on the U.S. Green Building Council's methodology. The first objective of a comprehensive research program should focus on preventing incidents. Our program started a European chapter, and in September we will meet to discuss technologies, best practices, standards, and regulatory frameworks. Our program could be expanded to engage all stakeholders to research offshore technologies and regulations.

Norway, for example, has moved from a prescriptive-base to a performance-base framework. In a prescriptive system regulations state the requirements, and companies are monitored to ensure that they comply. Performance-based regulations specify the safety

standards. Authorities check that industry has the necessary management systems and companies must select the solutions that fulfill the requirements. The new research program could compare the effectiveness of these frameworks.

The second objective of a public interest program would address the research needed to minimize response time to environmental impact. Our program is investigating the handling of produced water and could be expanded to research systems that handle oily water associated with offshore skimming. The program may also include early-warning sensors that may identify potential hazards to the environment, as well as to monitor marine life and wildlife at risk.

Gulf Coast universities, several of which are RPSEA members, have the offshore and coastal expertise. Louisiana State University, for example, is evaluating the effects of dispersants at and below the ocean surface, and RPSEA provides the structure to exchange ideas, transfer technologies, and develop the unbiased signs for sound policy. A research program may be established to understand the impact of prescribed burns.

The third objective of a comprehensive program would be to determine the value of ecosystems. Our research team has been working on this for various systems, and we could evaluate deepwater coastal regions and Gulf Coast wetlands. RPSEA manages over $37.5 million of new programs every year, and HARC is engaging all stakeholders in reducing environmental tradeoffs, and this collaboration provides that structure for managing any new public interest programs.

In conclusion, as we remember the 11 workers that perished and the thousands of current offshore workers, I thank you for this opportunity to discuss the specific research needs to produce an economically-sound and in an environmentally-sensitive manner the offshore resources that provide national security, Federal revenue, and thousands of jobs.

[The prepared statement of Dr. Haut follows:]

PREPARED STATEMENT OF RICHARD HAUT

Good morning Chairman Baird, Ranking Member Hall and Members of the Subcommittee.

My name is Rich Haut. I am currently employed at the Houston Advanced Research Center, a 501(c)3, non-profit organization. (*www.harc.edu*) At the Center, we use the tools of science, policy and technology to provide new knowledge about the complex balance between environmental, social and economic issues. We are funded on a project-to-project basis by local, state and Federal agencies, as well as industry and foundations. The Houston Advanced Research Center is a boundary organization, working with universities, industries, environmental organizations and government entities to take an unbiased, scientific approach to provide scientific based reasoning for policies and to push environmental based technologies to commercialization. Businessman George P. Mitchell, supported by four Texas universities, created the Center in 1982. Today the Center is focused on three areas: 1) clean energy, including the acceleration of alternative energy, 2) air quality research that includes emissions technologies and transportation policies and 3) the interaction between natural and human systems.

I am also on the board for the Research Partnership to Secure Energy for America (RPSEA: *www.rpsea.org*) where I chair the Environmental Advisory Group. The Research Partnership has over 160 universities, companies and organizations nationwide and is the research management organization coordinating 37.5 million dollars of research funding per year that was created by section 999 of the Energy Policy Act. This funding is related to deepwater oil and gas development, unconventional natural gas development and technology requirements for small producers. The En-

vironmental Advisory Group consists of members from universities and industry as well as representatives from prominent environmental organizations.

The recent incident involving the Deepwater Horizon at Mississippi Canyon Block 252 (MC252) is a tragedy. As the investigation continues with the objective to identify the root cause of the accident, the failure of the system and the resulting impact has already identified specific areas requiring research.

The offshore drilling industry had an extraordinary safety record. No one expected the incident to happen. The incident has appropriately caused everyone to reflect, refocus and rethink about the importance of offshore production and the research needed to ensure the safe, environmentally sound production of these reserves.

The Need for Energy

The Energy Information Administration's Annual Outlook 2010 [1] projects that total U.S. consumption of liquid fuels, including both fossil liquids and biofuels, grows from 19.5 million barrels per day in 2008 to 22.1 million barrels per day in 2035. U.S. dependence on imported liquids is expected to decline from the 60 percent share attained in 2005–06 to 45 percent in 2035. Domestic crude oil production increases from 5 million barrels per day in 2008 to 6.3 million barrels per day in 2027 and remains at just over 6 million barrels per day through 2035.

Production increases are relied on from the deepwater areas of the Gulf of Mexico and from onshore enhanced oil recovery (EOR) projects. Efforts to increase the share of domestically produced oil in the Nation's liquid fuel supply are generally seen to be serving a beneficial purpose from both economic and energy security perspectives, provided they are done in an environmentally safe manner. The future of the U.S. energy supply is dependent upon the reserves located in the deepwater areas of the Gulf of Mexico.

The recent incident involving the Deepwater Horizon underscores the need for research to address critical aspects of deepwater developments. An objective, science based program may be undertaken with three main objectives:

- Enhance Technologies to Minimize Incidents
- Identify, Develop and Improve Proactive and Reactive Response Procedures and Processes
- Develop Understanding of the Value of Ecosystem Services and Identify Locations of High Value in a Seasonally Dynamic Ecosystem

Enhance Technologies to Minimize Incidents

The first objective of a comprehensive research program is aimed at preventing incidents from occurring. A review of the state-of-the art of technologies that may be used to improve safety, wellbore integrity and environmental protection of deepwater operations could identify priorities, technology gaps and further research needs. The review may consist of an evaluation of existing safeguards and international offshore procedures, standards and practices as well as identifying promising technologies that can address safety and environmental concerns associated with deepwater, harsh environments.

One of the programs that I direct is the Environmentally Friendly Drilling Systems Program (*www.efdsystems.org*). Our research team consists of several universities and national laboratories as well as industry. Our advisory committee has members from all stakeholder groups, including prominent environmental organizations, industry and concerned citizens. We focus on identifying and developing new technologies for environmentally sensitive development of unconventional onshore energy resources. The objective is to identify, develop and transfer critical, cost effective, new technologies so that onshore reserves may be developed in a safe and environmentally friendly manner. One of the elements of the program is an environmental tradeoffs scorecard that is based on the U.S. Green Building Council's methodology and has been supported by all of our program stakeholders. Another element is the handling of produced water.

The Environmentally Friendly Drilling Systems Program can serve as a model for an analogous offshore program that enables all stakeholders to identify needed research, to provide direction and to follow progress. Our Program recently started up a European chapter, partnering with a university in Austria. In September we will be having our first exchange, discussing new technologies, best practices, standards and regulatory frameworks related to onshore unconventional natural gas operations.

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[1] EIA, 2010, Annual Energy Outlook 2010, DOE/EIA–0383(2010): *http://www.eia.doe.gov/oiaf/aeo/overview.html*

An offshore program could be developed using the same organizational structure as the Environmentally Friendly Drilling Systems Program. This new research program may, in addition to identifying and developing new technologies, explore the various approaches for regulating safe activity in the offshore sector.

Norway, for example, has moved over time from a prescriptive-based framework to a performance based framework. A prescriptive system is based on laws and regulations that set specific demands for structures, technical equipment and operations in order to minimize accidents and hazards. In a prescriptive system, regulations state the necessary requirements of safety and companies are monitored to ensure that they comply.

By contrast, performance-based regulation involves specifying the performance or function that is to be attained or maintained by the industry. The regulations define the safety standards that industry must meet. Authorities check that industry has the management systems that permit such compliance. Companies must select the solutions that fulfill the official requirements.

A trend has existed among safety regulators worldwide over the past 20–30 years to move towards a greater degree of performance-based regulation. This is because the prescriptive approach has often turned out to encourage a passive attitude among the companies. They wait for the regulator to inspect, identify errors or deficiencies and explain how these are to be corrected. As a result, the authorities become in some sense a guarantor that safety in the industry is adequate and take on a responsibility that should rest with the companies.

The research program may also address recommendations contained in the Secretary of Interior's May 27, 2010 report: "Increased Safety Measures for Energy Development on the Outer Continental Shelf," in particular, recommendations concerning well control systems and safety equipment. Other research needs related to wellbore integrity includes cement evaluation technologies, how to maintain communication and power between the surface and subsea safety systems and increasing the intervention capability of remotely operated vehicles.

Identify, Develop and Improve Proactive and Reactive Response Procedures and Processes

The second main objective of a comprehensive research program would address the research needed to minimize the time to respond to an incident as well as to minimize the environmental impact. In open-water marine spills, there are four primary response objectives:

1. Prevent the spill from moving onto shore
2. Reduce the environmental impact
3. Speed the degradation of any unrecovered oil while minimizing the harm on the ecosystems
4. Mobilize rapid well intervention/containment standby equipment

The industry has various vessels and equipment on standby used to contain spills, to skim, and to deploy dispersants. A research program may be established to identify the state-of-the-art technologies and methodologies and identify what else could be necessary in order to respond to an emergency situation. The Secretary of Interior's report, previously mentioned, also recommends a comprehensive study of methods for more rapid and effective response to deepwater blowouts.

This program may also include early warning sensors that may identify potential hazards to the environment as well as to understand the movement of marine life and wildlife that may be affected by an incident.

In addition, I previously mentioned that through our Environmentally Friendly Drilling Systems program we are evaluating equipment for produced water handling. Equipment and systems that handle onshore produced water could be possibly modified for handling oily water that is associated with offshore skimming technology. The research program may include the research and development required to progress technologies that can optimize offshore skimmers.

We know that BP has been requested to employ less toxic dispersants than the two chemicals that were being used. Louisiana State University, a member of the Research Partnership to Secure Energy for America, will be evaluating the effects of using hundreds of thousands of gallons of toxic dispersants on oil at and below the surface of the ocean. They will investigate where the dispersants are going, whether there is a good mix of water, oil and dispersant, and the effects of the dispersants on oil and then they will follow the dispersant through the recovery phase. The robust research program will investigate the impacts of dispersed oil and the dispersants.

The expertise to study the effects on the coastal wetlands may be found at Louisiana State University, along with other Gulf Coast universities. The Research Partnership to Secure Energy for America provides the structure for these researchers to exchange ideas, transfer technologies to industry and provide the unbiased science to develop sound policy.

The Houston Advanced Research Center has managed an innovative and unique air quality research program for the state of Texas. This research program is a collaboration of civic, industry, environmental, and local and State government entities. Over the last six years the program has administered over $10 million of research funds aimed at improving emissions inventories, air quality modeling and monitoring, and air regulations and policy. Among other accomplishments, this program has enhanced meteorological and air quality model performance.

Controlled burns have been used to augment skimming activities associated with the Deepwater Horizon incident. When sea conditions allow (when seas are below 3 feet) fire booms towed behind two boats are used to pull oil away from the main spill for safe burning. A research program may be established to understand the environmental impact of controlled burns. For example, satellite data can now be used along with so-called "inverse" atmospheric models to keep track of emissions from controlled burns. The Houston Advanced Research Center has also developed new combination remote sensing and fast point sampling technology that can measure air emissions from controlled burns from ship platforms or from onshore. An important new area that can be develop is full multi-media modeling, that is modeling of air/water/soil compartments, of the local and distant impacts of controlled burns and other off-shore operations.

Develop Understanding of the Value of Ecosystem Services and Identify Locations of High Value in a Seasonally Dynamic Ecosystem

The third main objective of a comprehensive research program would develop an understanding of the value that various ecosystems supply. The marine and coastal areas of the Gulf of Mexico are home to highly productive and valuable ecosystems. These ecosystems provide a wide range of benefits known as ecosystem services including fishing, primary production, nutrient cycling, tourism, storm surge mitigation, climate regulation, wildlife habitat, water quality and aesthetic and cultural benefits. Ecosystem service benefits arise from the functioning of a healthy ecosystem and provide significant value to people—monetarily, environmentally, socially and culturally. A research program may be established to investigate how these benefits vary with spatial or temporal changes in the ecosystem, developing a clear understanding for the Gulf's many stakeholders. Areas that supply high-valued ecosystem services may then be identified in order to prioritize where to place appropriate monitoring and early warning devices.

With over 95,000 miles of coastline and the largest exclusive economic zone in the world, the U.S. benefits significantly from goods and services derived from the ocean and coasts—food, minerals, energy and other natural resources and ecological benefits. Economic activity in U.S. coastal regions and waters account for a large portion of the national economy, totaling trillions of dollars each year. Nearly half of the U.S. population is located in coastal counties. The oceans also play a primary role in the Earth's environment and natural operations, shaping and sustaining life.

Currently, marine ecosystem health and the benefits humans receive from these ecosystem services are threatened by a range of challenges. The challenges include increased levels of exposure to toxins and pollutants from harmful algal blooms, industrial emissions and accidents, agricultural runoff, and other sources. Overfishing and certain fishing techniques remain a serious concern with significant consequences for the health of marine ecosystems. These challenges are increasing stressors and impacts on the marine environment, people and communities, and are presenting management issues that need to be confronted. Energy development, shipping, aquaculture and emerging security requirements are examples of uses that place increasing demands on the oceans' ecosystems.

A research program may be designed to develop ecosystem management tools and metrics applicable to coastal and offshore regions. The program can identify, assess, and recommend remote sensing technologies and ecosystem services models and methodologies appropriate for marine ecosystems. The basic components of the program's conceptual framework would be remote sensing technologies that can gather *data* on ecosystem attributes, ecosystem function models that can approximate the *response* of the ecosystem attribute to stimuli (such as presence of an oil spill, change in water temperature, shifts in population, or installation of new infrastructure), and the ecosystem services models that can *evaluate* the changes in benefits received by humans from the working environment. The program would improve the understanding of how changes in the physical, biological, ecological and chemical

marine processes are connected with social and economic consequences of management decisions on the long-term health and well-being of the oceans.

Remote Sensing—Measuring the complexity of species and their natural environments may be time consuming and expensive. However, remote sensing techniques used for mapping and monitoring of terrestrial and ocean conditions via the reflective or absorptive properties at particular energy spectra may effectively monitor specific resources across large scales. It is, for example, possible to estimate the species richness of terrestrial ecosystems across regional scales using Normalized Difference Vegetation Indices (NDVIs) derived from National Oceanic and Atmospheric Administration (NOAA) satellite imagery. Indicators of ecosystem health and productivity, such as chlorophyll concentration and biomass production, can also be assessed using satellite imagery. For marine ecosystems, several datasets useful for assessing ecosystem attributes are routinely collected including Chlorophyll-a measurements, sea surface temperature, and surface reflectance. Advanced Very High Resolution Radiometer (AVHRR) and Moderate Resolution Imaging Spectroradiometer (MODIS) satellite data are routinely used to monitor the density of phytoplankton in the surface waters of the oceans.

In addition to satellite imagery, aerial sensors can be used across smaller scales to provide finer resolution imagery, which is often used as a ground-truth when studying satellite imagery. Light Detection and Ranging (LiDAR) data is also obtained via aerial platforms and can be used to measure ecosystem complexity or suitability as habitat for a particular species.

A research program could explore the use of satellite and aerial measurement technologies for measuring and monitoring marine and coastal ecosystems, and the subsequent linking of these data into spatially-cognizant ecosystem function and service models.

Ecosystem Function and Service Modeling—The valuation of ecosystem services is done to 1) to estimate a value of ecosystems services both as they exist now and relative to other economic activities and 2) to conduct scenario analysis to better understand changes in the value of ecosystem services due to impacts on the quality or quantity of these service flows and stocks. Typically, these studies have been one-off, location-specific studies with the set of economic tools remaining fairly constant, but with advances over time in the methodology for implementing these tools.

Methodologies to value ecosystem services have and continue to be developed to improve inclusion of environmental services and resources in policy making regarding resource and development management. The value that these services have for society, businesses and individuals remains largely unknown in any measureable sense and often in a conceptual sense. Without measurable values, it is difficult to evaluate tradeoffs resulting from different management or development options or changes from other impacts. Ecosystem service values give a clearer idea of human benefit that is consistent with improving welfare.

Identification or development of an ecosystem response function is necessary for modeling marginal changes in ecosystem services. An ecosystem response function will allow both 1) a quantitative link between ecosystem attributes and ecosystem services and 2) an ability to model scenarios or marginal changes in the ecosystem. The program will also identify or develop a computer based evaluation process that will aid replication of analysis.

Studies in ecosystem services valuations must carefully consider the trade-offs between costs and accuracy. Original research provides more reliable and credible results, but it is more expensive and time consuming. Alternatively, the lower cost Benefit Transfer approach is only as reliable as the original studies and errors in the existing reports are likely to be passed through and possibly amplified. Decision makers need results which indicate how marginal or incremental changes in ecosystem attributes or functions will impact ecosystem service valuations. Finally, the most frequent knowledge gap in the analysis of ecosystem services pertains to the ecosystem response function, which is often ignored due to the inherent complexities involved with ecosystem functioning.

Through the Environmentally Friendly Drilling Systems Program, the research team has been developing a comprehensive framework with a proven valuation model. The comprehensive framework is provided by the Economic Valuation of Ecosystem Services (EVES) framework. Valuation is provided by the Multi-scale Integrated Models of Ecosystem Services (MIMES) model. Explicit in this approach is the consideration of the linkages between ecosystem attributes and the delivery of ecosystem services. This is achieved by making use of remote sensing technologies and data sets and inclusion of ecological experts in the research process. This technology possesses a demonstrated capability to combine social, economic and environmental perspectives (i.e. a triple bottom line approach) in order to assess the status

and to indentify optimal and balanced outcomes from different management options for ecosystem services.

A research program may be designed to conduct an evaluation of key ecosystem services of Gulf of Mexico deepwater, coastal regions and Gulf Coast wetlands that dynamically links ecosystem attributes with ecosystem service valuations. The objective would be to identify the areas of high value in order to ensure that appropriate and adequate monitoring and early warning devices may be placed. Valuation of ecosystem services can be used to prioritize spending on ecosystem protection.

In conclusion, our quality of life has an unquenchable thirst for energy. Offshore drilling and production helps to satisfy this thirst. Offshore resources provide national security, Federal revenue and jobs for thousands of workers. As we remember the 11 workers that perished and the thousands of current offshore workers, I thank you for this opportunity to discuss the specific research needs to exploit offshore resources in an economically sound, safe and environmentally sensitive manner.

BIOGRAPHY FOR RICHARD HAUT

Dr. Richard Haut is currently a Senior Research Scientist at the Houston Advanced Research Center (HARC). He serves as the Principal Investigator (P.I.) for various projects associated with securing energy for the future. A major effort is serving as P.I. for the Environmentally Friendly Drilling (EFD) program in partnership with Texas A&M University, other universities, industries and environmental organizations with the objective of integrating advanced technologies into systems that significantly reduce the environmental tradeoffs of petroleum drilling and production. He also serves as the P.I. for various projects concerning the built environment, working with the City of Houston. Dr. Haut also serves as the P.I. for the Marine Retrofit Program sponsored by the U.S. Environmental Protection Agency.

Dr. Haut's technical background includes a Masters degree and a Ph.D. in Engineering. He has over 25 years of industry technical and management experience prior to joining HARC in June 2002, having been responsible for analyzing offerings for key technologies or niche capabilities and developing synergistic, strategic relationships in the energy industry. He also was instrumental in establishing joint ventures and other joint industry programs, including the start-up of Enventure Global Technology where he was the Chief Operating Officer. Over a two year time period, Dr. Haut was involved in the successful development of Enventure, taking it from conception to profitability during this time period. In 1999 he received Hart Publication's Meritorious Award for Engineering Innovation and in 2002 received the Natural Gas Innovator of the Year Award from the Department of Energy. In 2009, the EFD Program, under Dr. Haut's direction, was honored by the Interstate Oil and Gas Compact Commission with their Chairman's Stewardship Award for Environmental Partnership.

Dr. Haut has been invited to speak at various conferences, has authored numerous papers, has been awarded various patents and has several patents pending. He was featured in the *Wall Street Journal*, February 11, 2008 as well as the Summer 2008 edition of *Echoes*, the alumni magazine of Rose-Hulman Institute of Technology and has been interviewed on multiple occasions by the media. He has frequently been asked to speak about sustainable development, the built environment and the offshore/energy industry. He is a board member of the Research Partnership to Secure Energy for America (RPSEA) where he also chairs the Environmental Advisory Group. Dr. Haut chaired the Society of Petroleum Engineers' Health, Safety and Environment subcommittee for the 2009 Annual Technical Conference and continues to serve on the subcommittee throughout 2010.

Dr. Haut has made over 25 invited presentations, has over 20 publications and more than 80 patents/published patent applications along with numerous media interviews directly related to the environmental stewardship of the energy industry.

Chairman BAIRD. Thank you, Dr. Haut.

Dr. Kinner.

STATEMENTS OF NANCY KINNER, UNIVERSITY OF NEW HAMPSHIRE, CO-DIRECTOR, COASTAL RESPONSE RESEARCH CENTER

Dr. KINNER. Chairman Baird, Ranking Member Biggert, and distinguished Members of the Subcommittee on Energy and Environment, thank you for inviting me to appear before you today to give you my perspective on what is needed to support a coordinated

Federal program on oil spill R&D. My name is Nancy Kinner, and I am a Professor of Civil and Environmental Engineering at the University of New Hampshire, and the Co-Director of the Coastal Response Research Center.

The Center, started in 2002, is a partnership between NOAA's Office of Response and Restoration and the University of New Hampshire. It acts as an independent, honest broker to oversee research on response and restoration, and serves as a hub for the oil spill response community. The Center has run a competitive grants program, funding 30 R&D projects on the fate, behavior, and effects of oil spills on natural resources and their associated human activities.

Several of the products created by Center-funded research are being used at the Deepwater Horizon spill, including the Environmental Response Management Application or ERMA, which manages and displays information about the spill to responders and now to the public.

Since the Deepwater Horizon blowout occurred, I am frequently asked why, with all of our nation's technology and research capabilities, we have seemed unable to cope with this major spill, 21 years after the Exxon Valdez disaster. Appendix B in my written testimony contains information on the amount of Federal, state, and industry-supported oil spill R&D since the landmark OPA 90. It can be summarized by saying that the road to funding oil spill R&D has been paved with good intentions, but relatively few dollars.

For example, of the $30 million authorized in OPA 90 for competitive grants, only one-sixth of that amount was actually appropriated to fund projects.

But other fundamental problems also hinder advancement. Notably, the lack of robust peer review requirements for oil spill research, the lack of coordination between stakeholders in the oil spill response community, and the lack of emphasis on translating the results into practice. The list of issues requiring R&D is too long to review today. For example, since 2003, our Center has hosted 20 workshops with stakeholders from the oil spill response community to identify gaps in knowledge and technology and the research needed to address them.

The topics have ranged from dispersed and submerged oil to integrated spill modeling and the human dimensions of spills, including the workshop that Dr. Short referred to just a few minutes ago that we held a couple of weeks ago on dispersants. Many of the issues are part of the Deepwater Horizon response, and indeed, the spill in the Gulf has brought to light new R&D questions regarding the fate and behavior of oil released at great depth, as well as the need for specialized containment, detection, recovery, and restoration strategies, and better programs to test and validate new response technologies.

The question I believe is how to coordinate a Federal research program on oil spill response and restoration. Federal oversight of spill R&D is essential. I recommend the following model going forward: an interagency committee co-chaired by Coast Guard and NOAA whose members are those of the Federal agencies directly involved in spill response and restoration, as well as the states di-

rectly involved in oil spill response and restoration, and independent, federally-funded programs that are doing spill R&D.

In addition, I believe that researchers from industry and international spill R&D programs should be included in the discussions. The committee would benefit by having an executive agent respected by all entities to serve as de facto staff to foster coordination among members and to oversee the external research program that addresses priority national needs defined by the committee.

Finally, I suggest a new paradigm for conducting some controversial R&D projects, such as ones involving toxicity. Scientists representing all stakeholders should be brought to the table to design the research protocols for the project that would then be funded through competitive grants. With this approach all parties agree in advance to accept the results derived from a robust experimental design.

In recent years, many people have been disheartened that oil spill R&D programs have been under-funded despite the magnitude and complexity of questions that remain to be answered. It seemed, they said, that we did not learn the lessons of the Exxon Valdez, and as we all know too well, those who do not learn from history are doomed to repeat it.

Thank you for giving me this opportunity to speak before you today. I would be happy to answer any questions.

[The prepared statement of Dr. Kinner follows:]

PREPARED STATEMENT OF NANCY KINNER[2]

Chairman Baird, Ranking Member Inglis, and distinguished members of the Committee on Science and Technology's Subcommittee on Energy and Environment, thank you for the opportunity to appear before you today on behalf of the University of New Hampshire and the Coastal Response Research Center. My perspective on the question of oil spill research and technology needs is highly influenced by my work with the Coastal Response Research Center (CRRC) since its inception in 2002. In order to make that perspective clear, I will give you an overview of the Center's history, mission and activities and its approach to oil spill research & development (R&D).

I. Overview of Coastal Response Research Center

NOAA's Office of Response and Restoration (ORR) became increasingly aware of the lack of oil spill R&D in its areas of primary responsibility: fate and behavior of spills and their impacts on natural resources and human activities. ORR recognized the role that a research university could play in addressing the R&D needs as well as the approach it would use to do so. Hence, in 2002 ORR started working within the University of New Hampshire to address this problem. The CRRC (*http://www.crrc.unh.edu*), a partnership between NOAA ORR and the University of New Hampshire, was created to address the need for improved spill response and restoration. The Center oversees and conducts independent research, hosts workshops, and leads working groups that address gaps in oil spill research in order to improve response, speed environmental recovery, and reduce the societal consequences of spills. In 2004, the partnership was codified by a memorandum of agreement between the University of New Hampshire and NOAA. CRRC acts as an independent, non-partisan entity to bring together members of the oil spill community, as well as those in relevant fields outside the spill community, including local stakeholders, and state, Federal and international agencies to address the many technical, economic, social, and environmental issues associated with oil spills in marine environments. Funding for the Center has been largely by Congressional appropriation (Table 1) with some allocations from ORR's base budget.

[2] Appendix A contains information on Dr. Kinner's research on bioremediation of contaminated subsurface environments.

Table 1
CRRC Funding History

Fiscal Year	Appropriation	Grant to UNH	*[Other funding: specify]*
2002	$750,000	$701,997	
2003	$750,000	$714,580	
2004	$2,000,000	$1,978,955	
2005	$2,000,000	$1,694,312	
2006	$3,000,000	$2,481,900	$75,000 (Marine Debris/NOAA, ORR)[1]
2007	$1,800,000	$1,435,249	
2008	0	0	$49,000 (eSCAT/NOAA, ORR)[1] $60,000 (ERMA®/NOAA, ORR)[1] $36,000 (In-situ/API)[2] **$145,000 (2008 Subtotal)**
2009	0	0	$25,000 (Workshop/ExxonMobil)[2] $63,000 (Workshop/NOAA OCRM)[3] $162,000 (ERMA®/NOAA, ORR)[1] **$250,000 (2009 Subtotal)**
2010	0	$200,000	$220,000 (ERMA®/ for Gulf/NOAA)[1] $30,000 (eSCAT for Gulf/NOAA)[1] $65,000 (NOAA, OCRM)[3] $139,000 (NOAA, ORR)
TOTAL 02-10	**$10,300,000**	**$9,206,993**	**$924,000** **($139,000 for CRRC's Direct Oil Spill R&D Use)**

[1] eSCAT and ERMA® funding is primarily for the UNH Research Computing Center to work on computer programming. Marine Debris funding was for an Environmental Research Group project.
[2] $61k to the Center for Spills in the Environment from API ($36k for In Situ Burning) and $25k from Exxon Mobil for partial support of the 2009 R&D Workshop)
[3] Funding for workshop on Ocean Thermal Energy Conversion (OTEC) - not oil spill related.

The Center is served by a multi-agency Advisory Board, comprised of members from U.S. EPA, NOAA, USCG, state-based R&D programs and industry that provide guidance on program direction. The board, in conjunction with the UNH and NOAA co-directors, developed five objectives for CRRC: (1) funding and oversight of relevant, peer-reviewed research that is able to be developed into practical improvements in oil spill response; (2) hosting topical workshops and working groups that include representatives of all spill community stakeholders to focus research efforts, and ensure that crucial real-world experience from oil spill practitioners is considered; (3) educating the next generation of spill responders through outreach and support of undergraduate and graduate student projects; (4) involving members of the international oil spill community to tap into expertise from around the world; and (5) developing response tools to aid responders.

Funding of relevant, peer-reviewed research is accomplished through a periodic request for proposal (RFP) process. Proposals are reviewed by three to four experts in the area of the proposed research. They are ranked by their scientific validity and how well they address key research needs related to the fate, behavior and effects of oil in the environment, and are likely to lead to practical improvements in oil spill response and restoration. A panel of leading scientists and practitioners then review the peer-reviewed and ranked proposals and recommend which should be funded. Each funded research project is assigned a NOAA liaison to ensure the research can be transformed into practice, and in addition, the CRRC's Science Advisory Panel meets annually to review progress of the research and provide feedback to improve the quality and efficacy of the research.

II. Oil Spill Response R&D Prior to the Deepwater Horizon Incident

The 1989 *Exxon Valdez* spill in Alaska directly resulted in the landmark Oil Pollution Act of 1990 (OPA 90), part of which addressed the need for R&D to improve prevention, preparedness, response and restoration. Specifically, an Interagency Co-

ordination Committee on Oil Pollution Research (ICCOPR) was formed, headed by the U.S. Coast Guard (USCG), and included the Mineral Management Service (MMS), Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), National Institute of Standards, Department of Energy, Department of Defense, NASA, FEMA, U.S. Fire Administration, and U.S. Fish & Wildlife Service. ICCOPR's role, as set forth in OPA 90, is to: (1) to prepare a comprehensive, coordinated Federal oil pollution research and development (R&D) plan; 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. Funding for R&D for states and universities was authorized, but after an initial infusion of money in the immediate aftermath of the *Exxon Valdez*, was never appropriated. In fact, the Federal and private sector money spent on oil spill R&D has decreased significantly since 1990 (Appendix B). OPA 90 also authorized some R&D funding for USCG, MMS and EPA for oil spill response. NOAA was not given any R&D funding as part of OPA 90. [N.B., I do not know why this happened, but find it ironic as NOAA is one of the Federal agencies most closely aligned with research, particularly in the marine environment.] The decrease in funding was related to the belief that through a focus on prevention and preparedness, we would not face a major spill event again of the scope and magnitude of the *Exxon Valdez*. Unfortunately, the Deepwater Horizon Gulf oil spill has proved that assumption to be horribly wrong. It is important to note that the amount of oil spilled from maritime shipping accidents, particularly from tankers, has fallen dramatically with the advent of better navigational aids, inspections and, in the case of tankers, the double hulled requirements. Likewise, there has been a specific response structure established with USCG in charge of a well defined incident command system (ICS), a network of Regional Response Teams (RRTs), and Area Committees. This command and control hierarchy is tested frequently in mandated drills and exercises at the local, regional, national and international level (e.g., Canada).

III. Problems with the Current R&D Model

The question is: how do we improve oil spill R&D going forward, based on what we have learned from the past, including the Deepwater Horizon incident?

One problem facing oil spill R&D was the lack of robust peer review requirements for any research performed. This resulted in skepticism regarding findings from industry or NGO financed projects and even some projects funded by Federal agencies. Many of the reports generated from these R&D projects were never published in scientific or engineering peer-reviewed journals. This does not mean the results are invalid, but it does mean that they are often questioned by key stakeholders in the "opposing camp". There are also cases where the experimental design/methods underlying the research were flawed and the data could not be used. For example, the CRRC, in conjunction with NOAA ORR and U.S. EPA, reviewed over 700 data points on acute toxicity of individual polycyclic aromatic hydrocarbons (PAHs) to aquatic organisms for an oil spill response field guide. The Center used a set of criteria (Table 2) to review each data point, including whether the PAH concentration to which the organism was exposed was actually measured, or just inferred from the initial mass added to the test chamber. After this standard quality assurance and quality control (QA/QC) process was completed, over 200 data points had to be eliminated because they did not meet QA/QC criteria.

Table 2: Screening Criteria for PAH Data Used to Create the Acute Toxicity Field Guide

Data for Naphthalene, Acenaphthalene, Anthracene, Fluoranthrene, Phenanthrene and/or Pyrene
LC50 measured at 24, 48, 72, 96 or 128 hours
LC50 method used
Concentration of contaminant measured at least once
>3 datapoints available

A second problem is the lack of coordination between Federal, state, and international governmental agencies; and other stakeholders (e.g., NGOs and industry) regarding oil spill R&D. ICCOPR only consists of Federal agencies and was therefore, not able to be a hub for the entire oil spill R&D community. Any proposal to move forward with oil spill R&D must include all stakeholders because the results must be "accepted" by all parties to minimize duplication and avoid overlap of the limited amount of funding that will ever be allotted to this topic due to the realities of budget constraints.

Since its inception in 2004, CRRC has hosted over 20 workshops on a wide variety of topics across the spectrum of oil spill R&D needs, and leads working groups on: oil dispersants; modeling of oil in the environment; submerged oil; toxicity of oil; and ephemeral data needs. The workshops (Table 3) have identified deficiencies in response and restoration, while the working groups (Table 4) help coordinate which agency funds specific R&D projects to avoid duplication of effort.

Table 3: CRRC-led R&D Needs Workshops.

U.S. Coast Guard Arctic Response - April 23, 2010
NRDA in Arctic Waters: The Dialogue Begins - April 20-22, 2010
Sea Grant & NOAA ORR Collaboration - January 25, 2010
Ocean Uses Atlas - January 12-14, 2010
Response to Liquid Asphalt Releases in Aquatic Environments - October 21, 2009
2009 Research & Development Needs - March 17-19, 2009
Oil Spill Modeling Working Group Meeting - September 16-17, 2008
Opening the Arctic Seas: Envisioning Disaster & Framing Solutions - March 18-20, 2008
HEA Metrics Workshop - December 4-6, 2007
Environmental Response Data Collection Standards - September 25-27, 2007
Modelers' Summit - June 26, 2007
Submerged Oil Workshop - December 12-13, 2006
Innovative Coastal Modeling for Decision Support: Integrating Physical, Biological, and Toxicological Models - September 26-28, 2006
Toxicology Working Group Summit - August 15 & 16, 2006
Workshop on Research Needs: Human Dimensions of Oil Spill Response - June 13-15, 2006
Research & Development Needs for Making Decisions Regarding Dispersing Oil - September 20-21, 2005

Table 4: CRRC-led Working Groups

Dispersants Working Group
Modeling Working Group
Submerged Oil Working Group
Toxicity Working Group
Ephemeral Data Working Group

A third problem is the need of translation of the results of oil spill R&D into practice. While some of the needed oil spill R&D involves fundamental work, much of it must be very focused on how the knowledge gained can actually be used in the field by responders and those charged with compensatory restoration of natural resources and their associated human activities. Hence, models for R&D, such as the National Science Foundation (NSF) prototype, are not completely satisfactory because of the lack of emphasis on transferring research into practice.

In keeping with its mission to ensure that research is transformed into practice, CRRC has created several spill response tools that are currently being used in the response to the Deepwater Horizon incident in the Gulf of Mexico, including the Environmental Response Management Application (ERMA®), the Oil Spill Toxicity

Field Guide, and the link between the Clarkson Deepwater Oil and Gas Blowout Model (CDOG) and NOAA's GNOME surface slick model. These response tools were created to address deficiencies identified at CRRC workshops.

Another issue that is beginning to plague the oil spill community is the wave of retirements of experienced practitioners and researchers. One of the Centers missions is to educate the next generation of scientists and engineers who will pursue careers in oil spill response and restoration. CRRC has provided funding for four masters students and two Ph.D. students who have conducted research topics as diverse as movement of submerged oil, human dimensions of oil spills, and biodegradation potential of oil in Arctic environments. CRRC has also helped to educate numerous undergraduate students who participated in workshops as recorders and assisted with graduate student research projects.

Since its inception, CRRC has funded 27 research projects through its peer review process for a total of $4.3M. The research foci, as mandated by the Center's Advisory Board, are oil-in-ice, dispersed oil and submerged oil. Within these foci, the topics funded center around: injury and recovery of natural resources, socio-economic issues, and transport and weathering of oil. All of these are areas that specifically address NOAA ORR's role as a natural resource trustee and as the principal scientific advisor to the Federal On-Scene Coordinator during an oil spill. The research projects have resulted in 51 publications in peer reviewed journals.

Relevant to the Deepwater Horizon spill, the Center leads a Dispersants Working Group (DWG) consisting of 26 stakeholders, agencies and organizations that fund dispersant-related research. The goal of the DWG is to pursue an integrated approach to dispersants research by participating in a coordinated research plan where requests for proposals (RFPs) or the equivalent are shared among the members and duplication of effort is avoided. Each member funds research in its own area of responsibility. For example, USCG, MMS and NOAA fund research on: the SMART dispersant monitoring protocols, the efficacy and effects of dispersants respectively. The CRRC coordinates the group's activities by including: (1) holding annual DWG meetings (typically at oil spill conferences such as Clean Gulf every November); (2) postings of reports, RFPs and other elements of interest on its website; (3) hosting public forums where the latest research is discussed; and (4) updating/revising the dispersants use R&D needs as DWG member funded projects are completed and when/if new R&D questions are identified. Appendix C contains a list of all the $8.2.M of dispersants research that DWG members have funded since 2005 as well as the topics remaining to be funded. CRRC has funded $2.4M of the dispersants research. Other funders include: MMS, USEPA, USCG, Non-US government agencies/organizations (e.g., CEDRE, SINTEF, JIP, Environment Canada, Canada's Fisheries and Ocean and industry. The total R&D needs in the area of dispersants research was estimated at <$30M without any questions associated with the Deepwater Horizon Incident. Unfortunately, the reason that more of the R&D needs, identified by the NRC 2005 dispersants report and the needs identified by the CRRC hosted dispersant/dispersed oil meeting sessions (2005, 2007, 2009) have not been funded is simply a lack of funding by Federal agencies, states and the lack of commitment to R&D by the oil industry. State R&D programs in Louisiana and California have undergone major budget cuts recently. Texas continues to have a strong financial commitment to R&D. API and the major oil companies have reduced R&D spending markedly and decreased the personnel they have committed to oil spill response research.

In all of these cases, the common element is the widely held belief prior to April 20, 2010 that we no longer have major oil spills, as witnessed by the 20+ years that have elapsed since the *Exxon Valdez* incident. Deepwater Horizon has reminded us that this belief is inaccurate; that as we have continued to drill for oil and gas in more extreme coastal and offshore environments, we have assumed greater risks (e.g., drilling in very deep water; in potentially harsh environments as in the Arctic) without preparing for the consequences should a spill occur.

IV. Future Oil Spill R&D

If the Deepwater Horizon incident results in more funding appropriated for oil spill R&D, the question becomes how to best design the vehicles to: (1) determine the research needed, (2) coordinate financial support among the possible funding entities, (3) solicit proposals, (4) select the ones to fund, (5) insure the results are useful to the oil spill response and restoration community, (6) transformed into practices, and (7) determine when the R&D is sufficient or if new funded projects are needed to resolve the problem.

A. Determining the R&D Needs

In 2003 and again in 2009, the CRRC convened workshops of -30–50 representatives of the oil spill community, to develop a host of research priorities for oil spill response and restoration. The topics for which R&D needs were developed included: spill response during disasters; spill response technologies; acquisition, synthesis and management of information for spills; human dimensions of spills; ecological monitoring and recovery following spills; biofuels; ecological effects of spills; and environmental forensics. [N.B., The organizing committee for the 2009 workshop decided not to include breakout groups on dispersed and submerged oil, liquid asphalt, spill modeling, or oil-in-ice because recent workshops hosted by CRRC which delineated those R&D needs.]

The goal of the 2009 workshop, and all CRRC workshops, is to bring stakeholders from Federal and state spill-related agencies, industry, NGOs and researchers from academia and other research organization together to discuss knowledge gaps and their associated R&D needs and potential RFP (request for proposal) topics. For each proposed project the workshop participants provide objectives, guidelines, potential issue/problems that could be encountered, and an explanation of the application to the decision-making process. These become the basis for RFPs that each member writes in its area of responsibility or focus. Hence, when they create their agency's/group's oil spill RFPs, they will likely use some part of the R&D workshop needs. [N.B., the agencies/groups may also have RFPs on other topics, related to their specific mission.] Though the working groups coordinate who covers which R&D needs, they do not dictate the RFP topics funded by each member. This has been a reality since the concept of working groups in 2005. It is also a reality that any future coordinating effort would face (e.g., ICCOPR) because members want to maintain autonomy to control who and what proposals get funded. Even if this could be overcome by forcing U.S. Federal agencies to fund projects by a common mechanism, it would be difficult to get cooperation from states, NGOs, other countries, and industry. Therefore, the working group model may be the best option to insure R&D is coordinated among the stakeholders. Further, it is key to have participation in the R&D needs workshops by representatives of all stakeholders (e.g., Federal and state agencies, industry, NGOs, national and international) and a mix of researchers (e.g., academics) and practitioners (e.g., responders). Researchers can offer an infusion of ideas based on fundamental principles and cutting-edge science and engineering, while practitioners can insure that the realities of response are injected into the discussion.

B. Solicitation and Selection of Proposals

Almost all funding entities have some form of public solicitation, though the extent is limited in some cases. The biggest differences are in selection of the proposals/researchers to fund. As noted earlier, RFP processes that require proposals to undergo rigorous peer review (i.e., similar to that used by the U.S. National Science Foundation) are usually viewed as having the most credibility. However, the type and extent of peer review varies widely among oil spill funding entities. Some RFPs are funded primarily on a research team's qualifications with little review on the experimental design proposed to address the R&D need. This oftentimes results in research whose results may not be accepted by all (e.g., industry funded research selected by this process may not be accepted by NGOs or governmental agencies).

Even when peer review is used to review the entire proposal, the extent of review can be varied. Some agencies conduct primarily an internal review using their own scientists/engineers, whereas others use a combination of external scientists /engineers and practitioners. This is a fundamental difference in the use of peer review to produce research that addresses a funding entity's needs.

C. Utility of Results in Response and Restoration

When the research is conducted to produce a detection or response device, it is usually not a problem to generate practical results. These are typically engineering types of projects, often conducted by consultants. For example, one problem faced when oil sinks (i.e., becomes submerged) to the bottom and collects on a muddy sediment in nearshore coastal waters, is that it becomes very difficult to detect. This R&D needs was identified in a CRRC and USCG hosted workshop in December 2006. Subsequently, the USCG R&D Center (New London, CT) issued a Broad Agency Announcement (BAA) to solicit proposals on this topic. In the first funding allocation, USCG funded several groups with promising technologies to perform preliminary demonstrations of their capabilities. Subsequent funding was focused on the technologies able to detect the submerged oil at the large-scale MMS-operated OHMSETT test tank in New Jersey. Results are pending, but should establish

which technology to pursue for further funding to meet the overall goal of submerged oil detection.

This type of research contrasts with the more fundamental R&D that must be conducted to answer questions of the fate, behavior and effects of oil. These are often the questions that must be addressed by NOAA and USEPA. For these questions, a broader scientific community must be involved (e.g., academicians). When that happens, there is often the possibility that the results may be less directly used by the responders. There are two primary reasons for this. (1) The researchers often have little experience with oil spills or the constraints imposed by working in field where there is often only a short window in which to respond. (2) Researchers who study fate, behavior and effects issues are not usually as focused on producing a product as those who are working on technology development. CRRC has developed two solutions to address this problem. Each RFP topic is assigned a NOAA practitioner to serve as a Point of Contact (POC) during the proposal development stage. Researchers interested in submitting a proposal on the RFP topic are strongly encouraged to talk with the POC not only about the topic, but also about the operational, logistical, and field conditions that constrain application of the project results. [N.B., The POC has *no* role in the peer review process.] Since CRRC instituted this approach the majority of the proposals received have been much more focused on addressing the R&D specific needs, indicating the researchers have a much better grasp of the constraints of a spill response.

Once a project is funded, a NOAA liaison is assigned to the team. The liaison is a NOAA employee who will use the research to address R&D issues s/he will face during a spill response (e.g., a NOAA spill modeler was the NOAA liaison on a research project aimed at applying a probability model to predict where submerged oil might move in shallow nearshore waters). Again, since using this approach, CRRC has found that the research results are more easily transferred to practitioners.

D. Updating R&D Needs

The working group members meet annually, if at all possible (though sometimes participation is limited by budget constraints of some of the partners) to review progress towards meeting the R&D needs identified during the workshops. Public forums are held when the members determine sufficient progress has been made towards addressing needs. In addition, they allow for discussion of whether an R&D need has been fully addressed so it can be removed from the "list". They also foster discussion of new R&D needs in the interim between workshops.

E. Oil Spill Research and Technology Needs

The topics of workshops hosted by the CRRC with representatives of the members of oil spill community have focused on the areas of greatest need in the field: dispersed oil, submerged oil, integrated 3D spill modeling, Arctic oil spill needs, including Natural Resources Damage Assessment, toxicity, fate and behavior of liquid asphalt, along with topics identified on the 2009 Research & Development Priorities: Oil Spill Workshop.

The Deepwater Horizon response has faced several of these issues (e.g., dispersed oil fate and behavior, acute and chronic toxicity, submerged oil detection, 3D modeling), but has also brought to light some new issues associated with understanding the fate and behavior of oil released from wells at great depth (e.g., fate and behavior, propensity for natural dispersion in the water column, emulsification, containment).

There has also been an issue with the use of new technologies for response (e.g., products designed to absorb floating oil without uptake of water, a variety of dispersants) and for stopping the uncontrolled flow of the oil from the riser. There must be a method to test these new technologies before they are applied in an actual event. The risks of doing that are very high and not likely to be taken by the Unified Command or the Federal On-Scene Coordinator. Perhaps a model for this kind of testing can be adopted from the water treatment industry. USEPA funds the National Sanitation Foundation to run a technology testing program where manufacturers pay to have independent research laboratories evaluate their devices by using pre-established protocols and standard analytical methods. This subjects all technologies designed to treat a certain contaminant to the same standards and testing. It is important to note that the cost of the evaluation is borne by the manufacturer, but that USEPA provides base funding to the National Sanitation Foundation to administer the program and establishes the protocols and standards.

V. A Model for a Coordinated Federal Research Program

The question of how to coordinate a Federal research program on oil spill response and restoration is one that is complex and must be carefully considered. The ICCOPR model of OPA 90 is not satisfactory, in part because much of the funding authorized was not appropriated. At least three other factors contribute: (1) the expectation that all of the Federal agencies on ICCOPR would actively participate when they were only tangentially associated with oil spill response, (2) the expectation that the Federal agencies would have the capacity to oversee a multi-faceted R&D program when little of their normal agency focus was on R&D, and (3) the assumption that Federal oversight would bring about the integration, coordination, and acceptance of the results of the R&D. The concept of Federal oversight is not fundamentally flawed, because the government should insure that the needed R&D is conducted, especially on the issues associated with drilling operations and transport in extreme and unexplored environments (e.g., deep ocean drilling, Arctic environment).

I recommend that Congress consider the following model going forward: an interagency committee co-chaired by NOAA and USCG that is comprised of those agencies actually funding oil spill response and restoration R&D (e.g., MMS, USEPA, USFWS) as well as the various states that have active oil spill R&D programs (e.g., TX, CA, and LA) and well established oil spill R&D programs (e.g., OSRI, CRRC, PWSRCAC, CIRCAC). However, such a Federal and state focused committee, even with the inclusion of federally funded programs that have R&D, is missing two major players in oil spill R&D: industry R&D programs and international oil spill R&D entities (e.g., those of Canada, France, Norway). Researchers from these two groups need to be included in the discussions.

The committee needs an outside Executive Agent—respected by all the Federal agencies and states—to serve as de-facto staff, to foster coordination among members, and to manage an external research program addressing priority national needs as defined by the committee, but not being addressed by specific existing Federal or state efforts.

Selection of the Executive Agent, via a competitive process, should be merit based, with continuation based on periodic performance reviews. The Executive Agent should have well-recognized and respected capabilities that warrant its selection for such a role including the demonstrated ability to:

- Work with the spill community to prioritize important issues needing attention,
- Administer a nationally competitive research,
- Facilitate coordination of Federal, State, private sector, and as possible, international spill response research,
- Produce independent, third-party peer reviews of its work, and
- Serve as a neutral party in fostering cooperation among national and international members of the oil spill community.

Finally, I suggest we also consider a new paradigm for conducting some controversial R&D projects (e.g., ones to establish toxicity thresholds of key species). Scientists representing all stakeholders should be brought to the table by the Executive Agent to identify the R&D need (e.g., objectives, guidelines, potential issues, application to decision-making) and then to develop the experimental design and materials and methods as well as the data analysis techniques to be used. By agreeing to these essential components of the project in advance, the results obtained will be much more likely to be accepted, so that progress towards better spill response and restoration can be made more rapidly.

VI. Conclusions

- The CRRC, a partnership between NOAA ORR and the University of New Hampshire, was created to address the need for improved spill response and restoration. The Center oversees and conducts independent research, hosts workshops, and leads working groups that address gaps in oil spill research in order to improve response, speed environmental recovery, and reduce the societal consequences of spills. CRRC acts as an independent, non-partisan entity to bring together members of the oil spill community, as well as those in relevant fields outside the spill community, including local stakeholders, and state, Federal and international agencies to address the many technical, economic, social, and environmental issues associated with oil spills in marine environments. Funding for the Center has been largely by Congressional appropriation with some allocations from ORR's base budget.

- There are four major impediments to oil spill R&D:
  - the inadequate funding available for R&D on a sustained basis (See Appendix B).
  - the lack of robust peer review requirements for research performed has resulted in skepticism regarding findings.
  - the lack of coordination between Federal, state and international government agencies; and other stakeholders (e.g., NGOs and industry) regarding oil spill R&D. ICCOPR only consists of Federal agencies and is therefore, not able to serve as a hub for the entire oil spill R&D community.
  - the need to translate results of oil spill R&D into practice. While some of the needed oil spill R&D involves fundamental work, much of it must be very focused on how the knowledge gained can actually be used in the field by responders and those charged with compensatory restoration of natural resources and their associated human activities.
- Future R&D needs should be identified using a working group model to insure R&D is coordinated among all stakeholders. Further, it is key that participation in the workshops that focus on identifying R&D needs include representatives of all stakeholders (e.g., Federal and state agencies, industry, NGOs, national and international) and a mix of researchers (e.g., academics) and practitioners (e.g., responders).
- Solicitation and selection of R&D proposals should be based on a rigorous external peer review process including scientists, engineers and practitioners.
- Efforts, such as assigning responders as points of contact during the RFP process and practitioners to serve as liaisons for funded R&D projects, are essential to producing research results that are readily transferred to use during response and restoration.
- It is important to update oil spill R&D needs regularly (e.g., at least every five years or after a major incident) as questions are resolved and new problems arise that need to be addressed.
- Oil spill response and restoration areas that have significant R&D needs include: dispersants and dispersed oil; submerged oil; integrated 3D spill modeling; Arctic oil spill needs, including Natural Resources Damage Assessment; toxicity, fate and behavior of liquid asphalt; spill response during disasters; spill response technologies; acquisition, synthesis and management of information for spills; human dimensions of spills; ecological monitoring and recovery following spills; biofuels; ecological effects of spills; and environmental forensics; as well as issues brought to light by the Deepwater Horizon incident: the fate and behavior of oil released from wells at great depth (e.g., propensity for natural dispersion in the water column, emulsification, containment).
- The ICCOPR model of OPA 90 is not satisfactory, not only because much of the funding authorized was not appropriated, but because of: (l) the expectation that all of the Federal agencies on ICCOPR would actively participate when they were only tangentially associated with oil spill response; (2) the expectation that the Federal agencies would have the capacity to oversee a multi-faceted R&D program when little of their normal agency focus was on R&D; and (3) the assumption that Federal oversight would bring about the integration, coordination, and acceptance of R&D needed for oil spill response. The concept of Federal oversight is not fundamentally flawed, because the government has responsibility to insure that the needed R&D is done, especially on the issues associated with drilling operations and transport in extreme and unexplored environments (e.g., deep ocean drilling, Arctic environment).
- Congress should consider the following model going forward: an interagency committee co-chaired by NOAA and USCG that is comprised of these agencies actually funding oil spill response and restoration R&D (e.g., MMS, USEPA, USFWS) as well as the various states that have active oil spill R&D programs (e.g., TX, CA, and LA) and well established oil spill R&D programs (e.g., OSRI, CRRC, PWSRCAC, CIRCAC). Oil spill researchers from industry and international R&D programs should be included in the discussions. The committee needs an outside Executive Agent—respected by, all the Federal agencies and states on the committee—to serve as de-facto staff, to foster coordination among members, and to manage an external research program addressing priority national needs as defined by the committee, but not being addressed by specific existing Federal or state efforts.

Appendix A

Information on Dr. Kinner's research of bioremediation and contaminated subsurface environments

Prior to the formation of the CRRC, Dr. Kinner worked in the field of bioremediation. In the late 1980s, she lead an examination of the potential for *in situ* enhanced biodegradation of gasoline in New Hampshire groundwater through the introduction of nutrients and electron donors and found that complete *in situ* bioremediation is possible under optimal conditions. In the early 1990s, it became apparent that ecological interactions within the groundwater microbial community may be playing a role in bioremediation, she had NSF funding for research at the Massachusetts Military Reservation (MMR) in Sandwich, MA with partners at the United States Geological Survey (USGS) to investigate the role protistan predation on bioremediation of a subsurface wastewater plume. This research formed a cornerstone for future predation-linked bioremediation studies, and determined that groundwater protists can have a potentially rapid and major impact on bacteria associated with groundwater bioremediation. In the late 1990s, a spill of #2 fuel oil in a salt marsh in Portland, ME spurred CICEET-funded research on enhanced biodegradation of petroleum in salt marshes through the addition of nutrients and terminal electron acceptors such as oxygen and nitrate. This research found that bioremediation of petroleum contaminated salt marshes is possible through the addition of nutrients, oxygen and nitrate, with significantly less disturbance than typical mechanical remediation methods. Shortly thereafter, the Bedrock Bioremediation Center was formed with a grant from USEPA and examined bioremediation of chlorinated solvents in a fractured bedrock aquifer, a poorly understood environment with respect to bioremediation. The work focused on bioremediation of trichloroethene (TCE), one of the most common groundwater contaminants, and led to a better understanding of the important role nanoflagellates have in biodegradation of TCE, and confirmed the presence of nanoflagellates in anaerobic fractured-bedrock aquifers, something previously thought impossible. More recently, CRRC has partnered with SINTEF, the University of Rhode Island, and the University of Alaska in a Joint Industry Project (JIP) to examine the role of predation on biodegradation of crude oil in Arctic sea ice. This research is ongoing.

Appendix B

Oil Pollution Research and Development Funding

Prepared for NOAA ORR by CRRC

R&D Needs

Title VII of the Oil Pollution Act of 1990 (OPA–90) addresses research. It mandated that an interagency committee, chaired by U.S. Coast Guard, develop a multidisciplinary plan to identify "significant oil pollution research gaps" and "establish research priorities and goals for technology development related to prevention, response, mitigation and environmental effects". The first plan was released in 1993 and reviewed by the National Academy of Sciences. That plan was last revised in 1997, after which the Interagency Committee was less active. The broadly representative Advisory Committee to the Coastal Response Research Center (a partnership between NOAA and the University of New Hampshire managing a national peer-reviewed competitive program) urged the Center to focus on this as one of its early activities. In 2003 and 2009, the Center hosted workshops which included participants from a broad spectrum of the oil spill community that resulted in reports on research needs for five year horizons. Each plan built upon the preceding ones and incorporated knowledge gained from research conducted over the intervening years.

R&D Funding

At the Federal level, OPA–90 authorized $30M from 1991–1995 to fund a regional research competitive grants program to universities and research institutions. This program only funded 20 R&D projects totaling $5.2M in 1994–1995. EPA (~$0.9M/yr), MMS (~$0.9M/yr) and USCG (~$0.7–$2M/yr) have used a fairly constant portion of the monies they receive from the Oil Spill Liability Trust Fund (OSLTF) to support specific R&D projects. A Congressional earmark, from 2002 to 2007, provided $0.5 to $3M/yr to NOAA to support its R&D partnership with the Coastal Response Research Center.

At the State level, there has been modest, but consistent funding for oil pollution R&D: Texas ($1.2M/yr since 1991), California ($0.3M–$0.6M/yr since 1993), and Louisiana ($0.5M to $0.8M/yr since 1993). Each State's program funds research projects primarily through competitive intrastate grants. OPA–90 provided ~$0.8 M/yr for the Prince William Sound Oil Spill Recovery Institute (OSRI) in Alaska (generated from interest from a ~$22M trust within the OSLTF). While focused on regional research needs, these programs have provided important information to improve overall oil spill response.

Industry support for R&D, primarily through the American Petroleum Institute (API), the Marine Spill Response Corporation (MSRC) and a few joint industry/government programs, peaked from the mid 1970s to mid 1990s (~$50M expended by API over the years 1975–1996; MSRC conducted a $30M research effort that was terminated in the mid-1990s). Since then, the private sector has drastically decreased its oil pollution R&D funding (API spent ~$40K/yr for research since the year 2000).

Appendix C

Dispersant Research

Updated: 5/11/2010

Dispersed Oil Research Data

Topics from CRRC Workshop Report on "Research & Development Needs For Making Decisions Regarding Dispersing Oil"		Project/PI	Project's Coverage of Research Topic	Expected Completion Date	Funding $	Report/Abstract Available? If so, when & where	Funding Agency
Table 1. EFFICACY TOPIC 1: Chemical Parameters that Influence Overall Effectiveness.							
1A. Research Topic	***Literature synthesis on physical and chemical properties of oils that determine the overall effectiveness of dispersant***	"Dispersants: An Electronic Bibliography on Effectiveness, Technological Advances, and Toxicological Effects." Conover (LUMCON Library, LSU)		Complete		http://www.lumcon.edu/library/dispersants/	Louisiana OSRADP
		"Stability and the Resurfacing of Dispersed Oil." Fingas (Environment Canada)	Partial	Complete		http://www.pwsrcac.org/docs/d0026200.pdf	PWS RCAC
		"A Review of the Emulsification Tendencies and Long Term Petroleum Trends of Alaska North Slope Oils and the White Paper on Emulsification of ANS Crude Oil Spilled in Valdez." Fingas (Environment Canada)	Partial	Complete		http://www.pwsrcac.org/docs/d0024800.pdf	PWS RCAC
		"Technology Assessment of the Use of Dispersants on Spills from MMS-Regulated OCS Facilities" SL Ross Envrionmental Research Ltd.	Partial	Complete		http://www.mms.gov/tarprojects/349.htm	MMS
		"Assessment of the Use of Dispersants on Marine Oil Spills in California" SL Ross Envrionmental Research Ltd.	Partial	Complete		http://www.mms.gov/tarprojects/413.htm	MMS
		"Chemical Characteristics of an Oil and the Relationship to Dispersant Effectiveness" Emergencies Science Division, Environment Canada	Partial	Complete		http://www.mms.gov/tarprojects/436.htm	MMS
		"Identification of Window of Opportunity for Chemical Dispersants on Gulf of Mexico Crude Oils" SL Ross Environmental Research Ltd.	Partial	Complete		http://ww.mms.gov/tarprojects/595.htm	MMS
1B. Research Topic	***Refining existing datasets to correlate physical and chemical properties of different types of***	"Effectiveness by use of dispersant on various oils at relevant weathering degree and ice concentrations." Task leader - SINTEF (Norway)	Partial	June, 2008		TBA	Shell

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Topics from CRRC Workshop Report on "Research & Development Needs For Making Decisions Regarding Dispersing Oil"		Project/PI	Project's Coverage of Research Topic	Expected Completion Date	Funding $	Report/Abstract Available? If so, when & where	Funding Agency
		"Wave Tank Studies on Dispersant Effectiveness as a Function of Energy Dissipation Rate and Particle Size Distribution." Lee, Venosa (Bedford Institute of Oceanography, Canada)	Partial	2009	$199,999	www.crrc.unh.edu/center_projects.htm/center_projects.htm	CRRC
		"Effects of Dispersants on Oil-SPM Aggregation and Fate in US Coastal Waters." Khelifa, Fingas (Environment Canada)	Partial	2008	$126,378	www.crrc.unh.edu/center_projects.htm	CRRC
		"Development of a Numerical Algorithm to Compute the Effects of Breaking Waves on Surface Oil Spilled at Sea: Dispersion and Submergence/Over-Washing as Extremes of a Theoretical Continuum." Reed, Daling, Johansen (SINTEF Materials and Chemistry, Norway)	Partial	Complete	$278,750	www.crrc.unh.edu/center_projects.htm	CRRC
		"Measurements and Modeling of Size Distributions, Settling and Dispersions (turbulent diffusion) Rates of Oil Droplets in Turbulent Flows." Katz, Gopalan (The Johns Hopkins University, Department of Mechanical Engineering)	Partial	January, 2009	$240,158	www.crrc.unh.edu/center_projects.htm	CRRC
		EMSA - Project: "Decision Support Tool for Dispersant Use." (SINTEF, CEDRE, Alun Lewis Ltd)	Partial	Completed 2006	$100,000	EMSA-Report + Model tool available: Contact: Lito.Xirotyri@emsa.eu.int	SINTEF/ EMSA/ CEDRE/ Lewis
		"Correlating Results of Dispersants Effectiveness at Ohmsett with Identical At-Sea trial: Effects of Oil Viscosity and Dispersant to Oil Ratios" SL Ross Envrionmental Research Ltd.	Partial	Complete		http://www.mms.gov/tarprojects/477.htm	MMS
		(above)				http://www.mms.gov/tarprojects/526.htm	
		"Analysis of IFO-180 and IFO-380 Oil Properties for Dispersant Windo of Opportunity" SL Ross Envrionmental Research Ltd.	Partial	Complete		http://www.mms.gov/tarprojects/506.htm	MMS

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Topics from CRRC Workshop Report on "Research & Development Needs For Making Decisions Regarding Dispersing Oil"		Project/PI	Project's Coverage of Research Topic	Expected Completion Date	Funding S	Report/Abstract Available? If so, when & where	Funding Agency
		"Correlating Reults of Ohmsett Dispersant Test with At-Sea Trials: Workshop to Coordinate Publications and Prioritize Follow-up Research" SL Ross Envrionmental Research Ltd.	Partial	Complete		http://www.mms.gov/tarprojects/507.htm	MMS
		Mitigating Oil Spills from Offshore and Gas Activities by Enhancement of Oil-Mineral Aggregate Formation (DFO Canada - Center for Offshore Oil & Gass Environmetnal Research)				http://www.mms.gov/tarprojects/585.htm	MMS
1C. Research Topic	*Protocols for creating weathered oil/emulsions*	"Harmonization of SINTEF / CEDRE Methodologies."		complete		SINTEF- reports: Contact: per.daling@sintef.no / Francois.Merlin@cedre.fr	SINTEF/ CEDRE
		"Development of a Method to Produce Large Quantities of Realistic Water-In-Oil Emulsions for Use in Evaluating Oil Spill Response Equipment and Methods." Belore (SL Ross Environmental Research Ltd.)		Complete		http://www.mms.gov/tarprojects/516.htm	MMS
1D. Research Topic	*Development of standard oils with known dispersibility over a range of variables, for use in comparison with*	"Wave Tank Studies on Dispersant Effectiveness as a Function of Energy Dissipation Rate and Particle Size Distribution." Lee, Venosa (Bedford Institute of Oceanography, Canada)	Partial	see previous		www.crrc.unh.edu/center_projects.htm	CRRC
		"Development of a Numerical Algorithm to Compute the Effects of Breaking Waves on Surface Oil Spilled at Sea: Dispersion and Submergence/Over-Washing as Extremes of a Theoretical Continuum." Reed, Daling, Johansen (SINTEF Materials and Chemistry, Norway)	Partial	see previous		www.crrc.unh.edu/center_projects.htm	CRRC
		"Measurements and Modeling of Size Distributions, Settling and Dispersions (turbulent diffusion) Rates of Oil Droplets in Turbulent Flows." Katz, Gopalan (The Johns Hopkins University, Department of Mechanical Engineering)	Partial	see previous		www.crrc.unh.edu/center_projects.htm	CRRC
		"Harmonization of SINTEF / CEDRE Methodologies"		see previous			SINTEF/ CEDRE

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1E. Research Topic	*Development and intercomparison studies of methods for measuring droplet size distributions and energy dissipation rate in different*	"Wave Tank Studies on Dispersant Effectiveness as a Function of Energy Dissipation Rate and Particle Size Distribution." Lee, Venosa (Bedford Institute of Oceanography, Canada)	Complete	see previous		www.crrc.unh.edu/center_projects.htm	CRRC
		"Development of a Numerical Algorithm to Compute the Effects of Breaking Waves on Surface Oil Spilled at Sea: Dispersion and Submergence/Over-Washing as Extremes of a Theoretical Continuum." Reed, Daling, Johansen (SINTEF Materials and Chemistry, Norway)	Complete	see previous		www.crrc.unh.edu/center_projects.htm	CRRC
		"Measurements and Modeling of Size Distributions, Settling and Dispersions (turbulent diffusion) Rates of Oil Droplets in Turbulent Flows." Katz, Gopalan (The Johns Hopkins University, Department of Mechanical Engineering)	Complete	see previous		www.crrc.unh.edu/center_projects.htm	CRRC
		"JIP-Coastal Spill Contingency-Lifetime of Weathered Oils Using Flume Basin."		2008	$300,000	Contact: merete.moldestad@sintef.no	SINTEF/ JIP
		"Laboratory Testing to Determine Dispersion Predictability of the Baffled Flask Test (BFT) and Swirling Flask Test (SWT)" US EPA and University of Cincinnati	Partial	Complete		http://www.mms.gov/tarprojects/513.htm	MMS
		"Chemical Dispersant Research at Ohmsett: Phase 2 - Validation of Small-Scale Laboratory Test Dispersant Effectiveness Ranking " (Mr. Randy Belore/Dr. Ken Trudel, S.L. Ross Environmental Research, Ltd)				http://www.mms.gov/tarprojects/638.htm	MMS
		"Analysis of Dispersant Effectiveness of Heavy Fuel Oils and Weathered Crude Oils at Two Different Temperatures Using the Baffled Flask Test" US EPA and University of Cincinnati	Partial	Complete		http://www.mms.gov/tarprojects/529.htm	MMS
1F. Research Topic	*Design and implement a research program to fill identified*	"2005 Research & Development Needs For Making Decisions Regarding Dispersing Oil"	Partial	Complete		www.crrc.unh.edu/dwg/dispersant_workshop_report_complete.pdf	CRRC

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		"JIP: Oil in Ice-Project4: Dispersant Effectiveness in Ice"		2009	$350,000	Draft report . 2009 Contact: per.daling@sintef.no	Norwegian reseach Counsil/ JIP
		"Using Dispersants to Test and Evaluate the Effectiveness of Dispersants in Cold Water and Broken Ice." Belore (SL Ross Environmental Research Ltd)		Complete		http://www.mms.gov/tarprojects/450.htm	MMS
		"Ohmsett 2003 Cold Water Dispersant Effectiveness Experiments." Belore (SL Ross Environmental Research Ltd.)		Complete		http://www.mms.gov/tarprojects/476.htm	MMS
		"Dispersant Effectiveness Testing on Heavy OCS Crude Oils at Ohmsett." Belore (SL Ross Environmental Research Ltd.)		Complete		http://www.mms.gov/tarprojects/514.htm	MMS
		"The Effect of Warming Viscous Oils Prior to Discharge on Dispersant Performance." Belore (SL Ross Environmental Research Ltd.)		Complete		http://www.mms.gov/tarprojects/527.htm	MMS
		"Dispersant Effectiveness Testing on Realistic Emulsions at Ohmsett." Belore (SL Ross Environmental Research Ltd.)		Complete		http://www.mms.gov/tarprojects/542.htm	MMS
		"Calm Sea Application of Dispersants." Trudel, Belore (SL Ross Environmental Research Ltd.)		Complete		http://www.mms.gov/tarprojects/545.htm	MMS
		"Chemical Dispersibility of OCS Crude Oils in Non-Breaking Waves; Part 1 Determining the Limiting Oil Viscosity for Dispersion in Non-Breaking Waves." Trudel, Belore (SL Ross Environmental Research Ltd) Lewis (Alun Lewis Oil Spill Consultancy)		Complete		http://www.mms.gov/tarprojects/546.htm	MMS
		"Research at Ohmsett on the Effectiveness of Chemical Dispersants on Alaskan Oils in Cold Water." Trudel, Belore (SL Ross Environmental Research Ltd.)		Complete		http://www.mms.gov/tarprojects/568.htm	MMS

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		"Laboratory Study to Compare the Effectiveness of Chemical Dispersants When Applied Dilute versus Neat" SL Ross Environmental Research Ltd	Partial	Complete		http://www.mms.gov/tarprojects/350.htm	MMS
		"Changes with Dispersant Effectiveness with Extended Exposure in Calm Seas" S.L. Ross Environmental Research Ltd and Alun Lewis Oil Spill Consultancy	Partial	Complete		http://www.mms.gov/tarprojects/590.htm	MMS
		"Development of a Training Package on the Use of Chemical Dispersants for Ohmsett - The National Oil Spill Response Test Facility" S.L. Ross Environmental Research Ltd.	Partial	Complete		http://www.mms.gov/tarprojects/613.htm	MMS
		"Chemical Dispersant Research at Ohmsett" S.L. Ross Environmental Research Ltd.	Partial	Complete		http://www.mms.gov/tarprojects/615.htm	MMS
		"Chemical Dispersant Research at Ohmsett" S.L. Ross Environmental Research Ltd.Literature Review on Chemical Treating Agents in Fresh and Brackish Water" (Randy Belore, S.L. Ross Environmental Research, Ltd.)				http://www.mms.gov/tarprojects/635.htm	MMS
		"Chemical Dispersant Research at Ohmsett: Phase 2 - Evaluation of Dispersant Effectiveness in Low-Dose, Repeat Applications" (Mr. Randy Belore/Dr. Ken Trudel, S.L. Ross Environmental Research, Ltd)				http://www.mms.gov/tarprojects/638.htm	MMS
		"Chemical Dispersant Research at Ohmsett: Phase 2 - Validation of Small-Scale Laboratory Test Dispersant Effectiveness Ranking " (Mr. Randy Belore/Dr. Ken Trudel, S.L. Ross Environmental Research, Ltd)				http://www.mms.gov/tarprojects/638.htm	MMS
		"Review of Ohmsett Cold Water Testing." Fingas, DeCola (Environment Canada)		February 2006		http://www.pwsrcac.org/docs/d0030200.pdf	PWS RCAC

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Table 2. EFFICACY TOPIC 2: Operational and Hydrodynamic Parameters that Influence Overall Effectiveness.							
2A. Research Topics	***Determination of the factors that represent realistic operational conditions for wave tank test systems***	"JIP-Coastal Spill Contingency-Lifetime of Weathered Oils." And the CRRC-project (see below)		2008	$150,000 + $120,000	Both projects just initiated. Contact: Merete.moldestad@sintef.no or oistein.johansen@sintef.no	SINTEF
2B. Research Topics	***Improving models of dispersed oil transport in the upper mixed layer***	CRRC-project: "Development of Numerical Algorithms to Compute the Effects of Breaking Waves."		see previous		www.crrc.unh.edu/center_projects.htm	CRRC/ SINTEF
		"Field Verification of Oil Spill Fate & Transport Modeling and Linking CODAR Observation System Data with SIMAP Predictions" Payne, French-McCay, Terrill, Nordhaussen (Payne Environmental Consultants, Inc.)	Complete	2007	$196,041	www.crrc.unh.edu/center_projects.htm	CRRC
2C. Research Topics	***Update SMART monitoring protocols***	"Field Verification of Oil Spill Fate & Transport Modeling and Linking CODAR Observation System Data with SIMAP Predictions." Payne, French-McCay, Terrill, Nordhaussen (Payne Environmental Consultants, Inc.)	Partial	see previous		www.crrc.unh.edu/center_projects.htm	CRRC
		"The NEBAJEX (MUMM /SINTEF /CEDRE)"	Complete	2003	EU-funded project	Reports available: MUMM (Belgium) Contact: R.Schallier@mumm.ac.be	SINTEF/ MUMM/ CEDRE
		"Upgrade of SMART Dispersant Effectiveness Monitoring Protocol" S.L. Ross Environmental Research Ltd.	Partial	Complete		http://www.mms.gov/tarprojects/598.htm	MMS/USCG

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2D. Research Topics	*Assessment of the effects of dispersant application on subsequent mechanical recovery of*	"Mechanical Recovery of Oil Treated with Dispersant."		2002	$50,000	SINTEF Report available (in Norwegian)	SINTEF/ Norwegian Authorities
		"Investigation of the Ability to Effectively Recover Oil Following Dispersant Application" S.L. Ross Environmental Research Ltd.		Complete		http://www.mms.gov/tarprojects/589.htm	MMS
2E. Research Topics	*Optimizing the operational effectiveness of dispersant*	"Improve and Adapt Existing Dispersant Application Technology for Oil in Ice and Low Temperatures." Task leader Sintef	Partial	August 2009		TBA	Shell
		"Development of New Application System for Large Response Vessels."	Complete	2006	$60,000	Report in Norwegian - Norsk Hydro Contact: Fredrik.Schlanbusch@hydro.com or per.daling@sintef.no	SINTEF
		"JIP-Oil in Ice: Development of Boat Application Systems Use in Ice-Covered Areas."	Partial	2009	$550,000	Just initiated, project plans exists. Contact: per.daling@sintef.no	SINTEF/ JIP
		"Chemical Dispersant Research at Ohmsett: Phase 2 - Evaluation of Dispersant Effectiveness in Low-Dose, Repeat Applications" (Mr. Randy Belore/Dr. Ken Trudel, S.L. Ross Environmental Research, Ltd)				http://www.mms.gov/tarprojects/638.htm	MMS
2F. Research Topics	*Evaluation of new technologies for monitoring dispersant effectiveness in the*	"Upgrading of Instrumentation at SINTEF and Testing During Field Trials."		2006	$150,000	Report to NOFO: from 2006 field trial (in Norwegian) Contact: per.daling@sintef.no	SINTEF/ Statoil/ NOFO

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Table 3. TOPIC 3: Modeling Integration of Chemical, Operational and Hydrodynamic Parameters.							
3A. Research Topics	*Workshop on requirements for integrating oil toxicity and*	"Innovative Coastal Modeling for Decision Support: Integrating Physical, Biological, and Toxicological Models"	Complete	Sept, 2006		http://www.crrc.unh.edu/fall_institute/	CRRC
		"EIF Acute Project." (Statoil, Hydro, SINTEF, DnV)		2007	$150,000	Contact: Hanne Greiff Johnsen (HANJO@statoil.com) or oistein.johansen@sintef.no	SINTEF/ Statoil/ Hydro
3B. Research Topics	*Improved models to predict dispersant effectiveness and oil fate*	"Development of a Numerical Algorithm to Compute the Effects of Breaking Waves on Surface Oil Spilled at Sea: Dispersion and Submergence/Over-Washing as Extremes of a Theoretical Continuum." Reed, Daling, Johansen (SINTEF Materials and Chemistry, Norway)	Partial	see previous		www.crrc.unh.edu/center_projects.htm	CRRC
		"AMOS (JIP): Development of OSCAR-3DPlume."		1999-2004	$500,000	Contact: Mark.reed@sintef.no	SINTEF/ JIP
		"Validation of the Two Models Developed to Predict the Window of Opportunity for Dispersant Use in the Gulf of Mexico" (Khelifa, Environment Canada)				http://www.mms.gov/tarprojects/637.htm	MMS
		"Development of OSCAR-3D Plume: For Use of Dispersant in Shallow Water."		1999-2004	$500,000	Contact: Mark.reed@sintef.no or jim.r.clark@exxonmobil.com	SINTEF/ ExxonMobil

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Table 4. EFFECTS TOPIC 1: Fate of Oil and Dispersed Oil in the Water Column and Other Habitats.							
1A. Research Topics	*Understanding the interactions of chemically dispersed oil droplets with suspended*	"Effects of Dispersants on Oil-SPM Aggregation and Fate in US Coastal Waters." Khelifa, Fingas (Environment Canada)	Partial	see previous		www.crrc.unh.edu/center_projects.htm	CRRC
		"Fate and Effects of Dispersed Oil in Shallow Water."	Plan to initiate in 2010	2009	$250,000	Contact: Alf.g.melbye@sintef.no	SINTEF/ JIP
1B. Research Topics	*Assessment of the degree, rate, and consequences of surfactant leaching from surface slicks and chemically dispersed oil droplets*	"Petroleum Environmental Research Forum (PERF) Project--Dispersant Effectiveness after Extended Contact." Resby (SINTEF), Nedwed (ExxonMobil)	Focus is assessment of degree, rate, and consequences of surfactant leaching from surface slicks--no study of dispersed oil droplets	May, 2007	$350,000	http://www.mms.gov/tarprojects/563.htm	ExxonMobil, Total, Statoil, US MMS, OSRL, Alaska Clean Seas, Sakhalin Energy Investment Company (Shell operated), Dept of Fisheries and Oceans Canada, TX General Land Office
		"SERF-JIP: Effectiveness of Dispersants after Extended Contact Time with Oil." (SINTEF /CEDRE cooperation)		2007	$300,000	Contact: tim.j.nedwed@exxonmobil.com or janne.resby@sintef.no	SINTEF/ CEDRE
1C. Research Topics	*Reconciliation of the differences between the empirical evaporation approach and traditional pseudo-*	"Field Validations of Model Predictions."		1996-2000		Contact: Mark.reed@sintef.no	SINTEF

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1D. Research Topics	*Quantification of the biodegradation kinetics of dispersed oil*	"Several Recent Research Projects at SINTEF." within biodegradation of WAF and dispersed oil	Partial	2000-2006	$400,000	Contact: Odd.G.Brakstad@sintef.no	SINTEF/ JIP/ Norwegian Research Council
		"Biodegradation of Chemically Dispersed Oil: an Ecosystem Approach" (AEA Technology)	Partial	Complete		http://www.mms.gov/tarprojects/338.htm	MMS
		"Effects of Chemically Dispersed and Biodegraded Oils" (Plymouth Laboratories, Inc)	Partial	Complete		http://www.mms.gov/tarprojects/449.htm	MMS
1E. Research Topics	*Improve, verify, and validate oil spill trajectory and fate models*	"Field Verification of Oil Spill Fate & Transport Modeling and Linking CODAR Observation System Data with SIMAP Predictions." Payne, French-McCay, Terrill, Nordhaussen (Payne Environmental Consultants, Inc.)	Partial	July, 2007	Complete	www.crrc.unh.edu/center_projects.htm	CRRC
		"Delivery and Quality Assurance of Short-Term Trajectory Forecasts from HF Radar Observations." Garfield (San Francisco State University), Paduan (U.S. Naval Postgraduate School), Ohlmann (UC Santa Barbara)	Partial	Dec, 2008	$229,904	www.crrc.unh.edu/center_projects.htm	CRRC
		"A Continuous Ongoing Process."			$100,000/ year	Contact: Mark.reed@sintef.no	SINTEF

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Table 5. EFFECTS TOPIC 2:		**Realistic Exposure Regimes/Toxicity Testing.**					
2A. Research Topics	***Develop methods for collection and analysis of samples of dissolved phase and particulate/oil-droplet phase PAH in environmental***	"Acute and Chronic Effects of Oil, Dispersant and Dispersed Oil to Sensitive Symbiotic Cnidarian Species, Including Corals." Mitchelmore, Baker, Hatch (University of Maryland Chesapeake Biological Laboratory)	Partial	July, 2008	$199,247	www.crrc.unh.edu/center_projects.htm	CRRC
		"Studies Using Aquatic Turtles (the Diamondback Terrapin and Snapping Turtle) to Assess the Potential Long-Term Effects of Oiling of Nests During Early Embryonic Development." Rowe (University of Maryland Chesapeake Biological Laboratory)	Partial	2008	$205,421	www.crrc.unh.edu/center_projects.htm	CRRC
		"Long-term Effects - Exposure Methodology Development."	partial	2007	$100,000	Contact: Trond.Nordtug@sintef.no	SINTEF/ Norwegian Research Council
2B. Research Topics	***Monitoring dispersed oil concentrations at spills of opportunity***	SINTEF is responsible for all monitoring of dispersed oil during field testing by NOFO of dispersant on experimental oil spills	Partial		$150,000/ year	NOFO-reports (in Norwegian); Contact: per.daling@sintef.no	SINTEF
		Effects of Dispersed Oil on Arctic Marine Environments				Contact: victoria.broje@shell.com	JIP/Shell
2C. Research Topics	***Literature synthesis of dispersed oil toxicity studies***	"Effect of Dispersed Oil."	partial	2007	$100,000	Report pending. Contact: Tone Frost, Statoil (TKF@statoil.no) or Trond.Nordtug@sintef.no	SINTEF/ Statoil

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2D. Research Topics	*Standard methods for toxicity testing of dispersed oil appropriate for*	"Method Development for Testing Effects of Dispersed Oil Droplets on Fish Larvae and Calanus."	Partial	2007	$100,000	Contact: Trond.Nordtug@sintef.no	SINTEF/ Norwegian Research Council
		"Chemical Response to Oil Spill: Ecological Effects Research Forum (CROSERF)" (Ecosystem Management and Associates, Inc)	Partial	Complete		http://www.mms.gov/tarprojects/296.htm	API, Exxon, Chevron, Marine Spill Response Corporation, state government agencies (AK, CA, FL, LA, TX, WA), federal government agencies (MMS, NOAA, EPA) and Environment Canada

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Table 6. EFFECTS TOPIC 3: Integration to Make Short and Long Term Prediction of Effects.							
3A. Research Topics	*Synthesis of existing dispersed oil toxicity data to support risk-based decision making for use of dispersants at spills*	"Environmental Impact Factor (EIF Acute)." SINTEF /Veritas	Partial		$100,000	Reports: Contact: Hanne Greiff Johnsen (HANJO@statoil.com) or oistein.johansen@sintef.no	SINTEF/ Hydro/ Statoil
3B. Research Topics	*Effects of dispersed oil on wildlife*						
3C. Research Topics	*Effects of short-term exposure to dispersed oil*	"Acute and Chronic Effects of Oil, Dispersant and Dispersed Oil to Sensitive Symbiotic Cnidarian Species, Including Corals." Mitchelmore, Baker, Hatch (University of Maryland Chesapeake Biological Laboratory)	Complete	see previous		www.crrc.unh.edu/center_projects.htm	CRRC
		"Acute and Chronic Effects of Crude and Dispersed Oil on Chinook Salmon Smolts (*Oncorrhynchus tshawytscha*)." Tjeerdema (University of California, Davis)	Complete	2006	$150,000	www.crrc.unh.edu/center_projects.htm	CRRC
		"Influence of Dispersants on Oil Toxicity in Fish Embryos." Incardona, Scholz, Collier, Blanchard (NOAA Fisheries, Northwest Fisheries Science Center)	Complete	Ongoing			NOAA/ NWFSC
		"The Relationship Between Acute and Population Level Effects of Exposure to Dispersed Oil, and the Influence of Exposure Conditions Using Multiple Life History Stages of an Estuarine Copepod, *Eurytemora affinis*, as a Model Planktonic Organism." Aurand, Coelho (Ecosystem Management & Assoc)	Complete	July, 2008	$232,062	www.crrc.unh.edu/center_projects.htm	CRRC

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		"Effects of Dispersed Oil on Cod-Larvae."	Partial	2007-2009	$600,000	Contact: Trond.Nordtug@sintef.no	SINTEF/ JIP
		"Understanding fitness-related effects of dispersed oil on Calanus finmarchicus"	Partial	2010-2012	$1,406,432	Contact: Bjørn Henrik Hansen (BjornHenrik.Hansen@sintef.no)	SINTEF/RCN
3C. Research Topics	*Effects of short-term exposure to dispersed oil*	"Acute and Chronic Effects of Crude and Dispersed Oil on Chinook Salmon Smolts (*Oncorrhynchus tshawytscha*)." Tjeerdema (University of California, Davis)	Effects of short term-exposure to dispersed oil	2006			CA OSPR
3D. Research Topics	*Long-term effects of short-term exposures to dispersed oil*		Long-term effects of short-term exposure to dispersed oil	Initiate Summer 2007; Complete Summer 2008	$451,110	Report of short-term studies provided to CRRC 9/1/06. Publications in draft.	CA OSPR
		"Acute and Chronic Effects of Crude and Dispersed Oil on Chinook Salmon Smolts (*Oncorrhynchus tshawytscha*)." Tjeerdema (University of California, Davis)	Effects of short term-exposure to dispersed oil	Initiate Spring 2007; Completion Summer 2007			CA OSPR
			Long-term effects of short term exposure to dispersed oil	Initiate Summer 2007; Complete Fall 2008	$174,098	Winter 2008	CA OSPR
		"Effect of Oil and Dispersant and Dispersed Oil on Feathers"					CA OSPR
		"Physical Fate and Biological Effects of Dispersed Oil in Shallow Water." Preproject	Complete	2008		State of the art reports (restricted). Contact: Alf.g.melbye@sintef.no	JIP: Statoil, Eni

Updated: 5/11/2010

Topics from CRRC Workshop Report on "Research & Development Needs For Making Decisions Regarding Dispersing Oil"		Project/PI	Project's Coverage of Research Topic	Expected Completion Date	Funding $	Report/Abstract Available? If so, when & where	Funding Agency
		"Dispersants as Oil Spill Countermeasures for the Remediation and Restoration of Sensitive Coastal Habitats" Lin (Louisiana State University)	Complete		$188,472	www.crrc.unh.edu/center_projects.htm	CRRC
3E. Research Topics	***Integration of fate and toxicity models with population models to predict short- and long-***	"Innovative Coastal Modeling for Decision Support: Integrating Physical, Biological, and Toxicological Models."	Complete	2006		http://www.crrc.unh.edu/fall_institute/	CRRC
		"NRDAM for the 1991 Gulf War, Arabian Gulf"		2003	$300,000	Report restricted: Contact: Mark.reed@sintef.no	SINTEF
		Coastal and shoreline oil spill response: Fate of oil spill in coastal waters	Covers processes involved in the fate of dispersed oil, with emphasis on the effect of presence of dispersant on these processes	Initiate Primo 2010. Complete primo 2012	$150,000	Contact: Alf.g.melbye@sintef.no	JIP: Statoil / Shell / Eni

BIOGRAPHY FOR NANCY KINNER

Nancy Kinner is a professor of civil and environmental engineering at UNH. She has been co-director of the Coastal Response Research Center, a partnership between UNH and the National Oceanic and Atmospheric Administration (NOAA), since 2004. The center (*www.crrc.unh.edu*) brings together the resources of a research-oriented university and the field expertise of NOAA's Office of Response and Restoration to conduct and oversee basic and applied research, conduct outreach, and encourage strategic partnerships in spill response, assessment and restoration.

Kinner's research explores the role of bacteria and protists in the biodegradation of petroleum compounds and chlorinated solvents. She teaches courses on environmental microbiology, marine pollution and control, the fundamentals of environmental engineering, and environmental sampling and analysis.

Kinner received an A.B. from Cornell University in biology (ecology and systematics) in 1976 and an M.S. and Ph.D. in civil engineering from the University of New Hampshire, where she joined the faculty in 1983. She has conducted funded research projects for agencies and research organizations including USEPA, NSF, AWWARF, CICEET and the NH Department of Environmental Services.

Chairman BAIRD. Thank you, Dr. Kinner.

Mr. Costner.

STATEMENTS OF KEVIN COSTNER, PARTNER, OCEAN THERAPY SOLUTIONS, WESTPAC RESOURCES

Mr. COSTNER. Thank you, Mr. Chairman and Members of the Committee for inviting me. I am the only one up here that doesn't have a doctor in front of its name. That is pretty common for me.

I know there must be a question as to why I am here. I would like to share with everyone in the room that it is not because I heard a voice in a cornfield. I am here because the images that haunt us all today are the same as they were 20 years ago: the Exxon Valdez. Who could forget the birds and animals covered in oil, men and women standing in rubber boots on the beach, armed with pitchforks and hay waiting for the oil to wash ashore? It was both sad and heroic.

The international community, again, is watching in awe as the most powerful country in the world is fumbling its way through the biggest environmental disaster in history. The Exxon Valdez became one of the moments in time that we mark as Americans, a moment where we as a nation collectively stopped and lived the same nightmare; 9/11, Katrina. It was hard for me to fathom how we could engineer nuclear power and put a man on the moon but

somehow not muster the technology to clean up an oil disaster of our own making.

For the past 15 years I have been an entrepreneur in the environmental technologies world. In 1993, I bought a patent from the Department of Energy for a centrifuge oil/water separator technology, a technology that I believe had the potential to fight catastrophic oil spills. I founded Costner Industries and brought together a group of scientists and engineers to develop a robust and portable device that would replace these reoccurring images and serve as the first line of defense in the oil spill cleanup and recovery.

In two years the dream moved from research and development to a commercially-viable product ready to be deployed anywhere in the world. This was done without help from outside investors or government grants. The price tag would be over $20 million, and I paid it.

Those with a science background will find our machines easy to understand. They are designed to separate oil and water at high speeds up to 200 gallons per minute, resulting in a 99 percent purity of water and oil. Five different sizes were designed, with the largest machine having a 5 by 5 footprint. They would have the ability to be deployed on all manner of boats. The biggest plus would be that it would be easy to operate. That was always good news to me considering I might have to be the one to operate it some day.

Let me paint a picture for you. Assuming 20 V–20s were deployed to the Exxon Valdez in the first hours of this spill, 90 percent of that oil could have been recovered in less than one week. The cost of recovering a spill on the ocean is a fraction of the cost of cleaning it on the shore.

So what happened? Not to the $20 million but what happened? My enthusiasm for what the machine could do was met with apathy, a refusal to move off the status quo. The list of government agencies, oil companies, and foreign companies we contacted reads like a "Who's Who" of those who needed it, those who should have been looking for it, and probably more to the point those who should have been developing it themselves.

I was told that it was too expensive, that there was no need, that the spills were becoming less frequent, at least the ones we could see. Many times we offered to send our machines around the world to aid in the cleanup where spills were happening. In 1997, we went so far as to donate our largest machine to Japan during a spill. While this move may not be viewed in the business community as a smart one, I hope it reads in the light of day as to the level of commitment my company had and the people working there had for this reoccurring problem.

The same offer was repeated and refused many times on our own shores, an ugly catch-22 that you can read more about in my written testimony. As the Gulf Coast is under siege, I would ask the Committee to now consider the valuable role that this machine built over 12 years ago can now play. Men and women in the oil industry are out of work through no fault of their own. Our fishermen have been sidelined because of this catastrophic disaster.

Their families are now in that awful, uncertain place of not knowing the quality of life that awaits them.

Our President finds himself in the middle of balancing an industry that hasn't considered the what if scenarios of working on the high seas. He is faced with this weak response of an oil industry that is sadly not ahead of the curve. I know the President, and I know this body want the American people to go back to work, but I also know that you want them to be safe.

So how do we do this in good conscience? I believe this machine made over 12 years ago with all the care and science and money that I could throw at it is one major solve in this giant puzzle that will get people back to work. The American people deserve the comfort of knowing that there is a proactive solution to this everyday occurrence on our oceans, rivers, and lakes. It may seem an unlikely scenario that I am the one delivering this technology at this moment in time, but from where I am sitting it is equally inconceivable that these machines are not already in place.

I realize protection is not a profit center, and safety is never thought to be sexy. Who wants to wear the ugly orange life preserver? I want you all to picture something now. I am a storyteller so bear with me.

You have got a boat. It is a big, fancy yacht. Who doesn't want one? With all the fancy gadgets and security devices to make it run right. It has got a 38-foot fishing boat along with it. It has got a helicopter pad, everything you could want, everything to make your trip go right, but there is an explosion and now your boat is sinking. It is going down. Fishing boat, sunk. Helicopter, sunk. Jet skis, gone. And now the lifeboats are gone, too. Everything around you is sinking beneath the ocean, and the one thing you have left, the one thing keeping your wife alive, your kids, is this ugly little orange life preserver that was hidden away, that was stowed out of sight.

We have legislated life preservers. We have legislated fire extinguishers. We have legislated lifeboats and first aid kits. It seems logical that as long as the oil industry profits from the sea they have the legal obligation to protect it, except when they would find themselves fighting for life and limb.

A single machine can separate 210,000 gallons per day. What that means is the American people now have a rapid response, that they have insurance, a tool in the box, if you will, against another catastrophic spill. The American people can begin to put away their rubber boots.

Florida Congressman Diaz-Balart asked us, where are the fire trucks? I left a meeting yesterday with Edison Chouest, the largest oil servicer in the Gulf. With our machine in mind they proposed designing a vessel that would fundamentally change the world's approach to oil recovery. Together we envision a world-class first responder vessel that could be strategically deployed around the world. Initial orders have also been placed by BP for individual machines.

Right now we are in a fight to protect our jobs, our way of life, and an ecosystem that cannot protect itself. Our machine is the right machine to take on this challenge at this moment. It doesn't require dispersants or chemicals to operate it. In short, we do not

have to further pollute the ocean. The time is right for technology to take center stage in our country's prevention and defense against catastrophic spills. We can put Americans back to work and bring an entire industry into the 21st century of oil spill response.

Thank you.

[The prepared statement of Mr. Costner follows:]

PREPARED STATEMENT OF KEVIN COSTNER

Link to video demonstration of CINC technology: *http://rcpt.yousendit.com/886302095/156538534818ed0c3b1d910c32ec33d2*

Mr. Chairman, Members of the Subcommittee, thank you for the opportunity to speak here today and for raising this important discussion. I come before you as a discouraged U.S. citizen, and an entrepreneur with a partial solution to the tragedy unfolding in the Gulf. Seventeen years ago I purchased a licensed patent for a centrifugal force oil-water separator from the Department of Energy's Idaho National Laboratory. Today that technology, CINC, is the most effective and efficient tool for cleaning up oil spills that you've probably never heard of. Despite CINC's proven demonstrations in front of oil industry and government leaders, the technology sat passively on shelves for more than ten years, powerless to make right the oil spills that continued and will continue to occur. It is incumbent on us to do everything possible to clean up the massive spill in the Gulf. CINC has an important role to play in that legacy, as I will explain.

Introduction

The Exxon Valdez oil spill was a devastating and humbling moment for our country. The entire world community watched in awe as the U.S., the most powerful country in the world, thrashed and capitulated, helpless to save itself from the worst environmental disaster in history. We engineered nuclear power and put a man on the moon, but could not save ourselves from oil, the most basic resource involved in almost every aspect of our daily lives. U.S. citizens stood heroically on the beach, prepared to clean up a mess that they had no part in creating. Such epic failure was hard for me to fathom, and yet the images of rubber boots, straw and soup ladles against an endless black tide confirmed this utterly demoralizing display of incompetence that would continue to repeat itself.

While it's not wrong to focus so much attention on large spills, we cannot diminish the smaller spills that happen around the world every day. Estimates are between 5,000 and 13,000 gallons in a typical year. For every 1 million gallons pumped from wells, it is estimated that 20 gallons will end up in the oceans. At our current rate of oil production that means the equivalent of the Exxon Valdez spill every 7 months.

Partly in response to the Exxon Valdez, I resolved to commit personal resources to engineer a product that would be effective in cleaning up oil spills. Like fire extinguishers, oil-water separators could be stationed on every boat, harbor and port where oil was present. I envisioned the machine as a safety device, compact and portable enough that it could be a deployed on a small craft, and rugged enough to operate reliably in rough seas. The CINC oil-water separator can do all this.

I. Early development and patent history

Taxpayers paid for the early development of a liquid-liquid separator technology, licensed and patented from the Department of Energy (DOE) and Idaho National Laboratories (INL), a government owned, private contractor operated facility, in 1993. Originally developed to assist in nuclear fuel reprocessing, the machine was then made available to the private sector to improve upon the licensed patent. Today the technology represents one of the laboratory's highly successful transfers of technology, which makes the patent unique and of particular interest for the government and U.S. citizens.

In operation since 1949, Idaho National Laboratories (INL) is a science-based, applied engineering laboratory dedicated to supporting the U.S. Department of Energy's missions in nuclear and energy research, science and national defense. Like all other Federal laboratories, INL has a statutory, technology transfer mission to make its capabilities and technologies available to all Federal agencies, to state and local governments, and to universities and industry. To fulfill this mission, INL encourages its scientific, engineering and technical staff to disclose new inventions and creations

to ensure the resulting intellectual property is captured protected and made available to others who might benefit from it. As part of the mission, intellectual property is licensed to industrial partners for commercialization, creating jobs and delivering the benefits of federally funded technology to consumers. In other cases, unique capabilities are made available to other Federal agencies or to regional small businesses to solve specific technical challenges. INL uses a variety of flexible partnership mechanisms to advance technology development and to establish industrial partnerships that in turn benefit INL, DOE and the partner. Some of these benefits include: Increased technical breadth and depth of laboratory staff available to national missions; Leveraged Federal research, development and demonstration; Reduced costs to taxpayers by using funding from other sources; and enhanced competitiveness for U.S. companies.[1]

The foundation of our CINC technology was created over 30 years ago and has been used by the Department of Energy (DOE) to recover valuable metal resources through a process of solvent extraction. In 1993 I was awarded a Technology Transfer from the U.S. Department of Energy (DOE) for a liquid-liquid solvent extraction technology, which we believed had the potential to be scaled up and commercialized in the fight against oil spills.

Dave Meikrantz, a scientist working for DOE, and the original inventor of the technology, came on board as the Director of Technology at Costner Industries (CINC), my newly formed private company.

Private acquisition and investment

Since 1989 and the Exxon Valdez, I had been thinking about investing in environmental solutions that could prevent the severity of similar disasters which were sure to follow. In Newbury Park, CA I was already funding research and development on flywheel technology that used magnets, but it was not until I took possession of the DOE technology that Costner Industries was officially formed. My brother, Dan Costner, would go on to run the company.

We moved quickly to bring on a team of scientists and engineers for rapid research and development. The first two years were spent scaling up a prototype machine that processed only milliliters per minute. After that initial period of research and development we moved into production and manufacturing in Carson City, Nevada. Over time we created five commercial units with processing speeds that range from 1/2 gallon to 200 gallons per minute.

The fact that the machine was capable of separating numerous liquid elements meant that it could be applied in diverse industries including pharmaceuticals, chemicals, metals mining and recovery, food and nutrition, biodiesel, biotech and environmental clean up. As useful as it was in so many ways, and as profitable as it could have become through diversification, I zeroed in on one singular process with immense potential.

Over the next 17 years I would devote more than $20 million dollars of my own toward developing a rugged, compact, portable machine that could separate oil from water. At the height of our business CINC employed roughly 20 people in manufacturing and 15 sales representatives around the world.

As a citizen I recognized I recognized the need for this kind of technology. As an entrepreneur I seized an opportunity to fill a gaping hole where these solutions are concerned. CINC's potential lay in the ability to become the first line defense in oil spill cleanup with the added benefit of valuable oil recovery.

II. How it works

Our separator was designed for use in oil and chemical spill clean up, oil production, remediation, nuclear waste and environmental clean up, or any application that requires the separation of two liquids with a variety of viscosities. Our technique is not hard to understand. The design is compact, portable and simple enough be operated with minimal expertise. CINC does not use chemical or biologic agents in its clean up process. And separation is excellent: both oil and water outputs are greater than 99% pure, as opposed to skimming, which at best is 20% oil, 80% water and has additional storage and onshore treatment concerns.

CINC comes in five unit sizes. The largest, a V–20, has a footprint of five square feet and weighs around 4,500 lbs. The unit fits easily onto a fishing boat, dock or other vessel where it can process oil and water, separating 200 gallons per minute.

If response is quick, the lighter components of crude oil have not evaporated and the oil still retains its product quality. Crude oil, when left to weather, will become thicker and thicker, eventually becoming the tar that washes up on beaches. For

[1] INL website: *https://inlportal.inl.gov/portal/server.pt?open=512&objID=255&mode=2*

this reason, CINC units can be most efficient as a first line of defense in oil spill and recovery if they are stationed at key harbors, bays, ports, oil transport and shipping boats, and on oil rigs—in other terms, anywhere where oil can come into contact with water.

Assuming 20 V–20s had been deployed to the Exxon Valdez in the first few hours of the spill on local fishing boats, 90% of the spill could have been recovered in less than 1 week. CINC is at its best working as a first line of defense, gathering oil before it has a chance to stray far from the initial spill point. The cost of recovering a spill on the ocean is a fraction of the cost of cleaning up tar once it's made its way to the shore (roughly $5 million for 20 V–20s versus $4 billion for the Exxon Valdez spill).

Approximately 0.1% of the water discharged back into a spill area contains oil.

Technological obstacles

CINC centrifuges have been installed worldwide for applications in the petroleum, chemical, mining, pharmaceutical, food, fragrances, printing, and environmental industries. The centrifuge performs a wide range of separation, extraction, washing and reaction operations. Unfortunately, CINC was never fully utilized in the way I intended because of a technical obstacle, but also, and perhaps more importantly because of a lack of support from industry and the Federal Government.

Fifteen parts per million became the elusive bar for CINC. To prevent pollution in oceans and freshwater, EPA rules became a factor. However, we would learn, some rules do not apply in emergency situations where clean up is occurring. Obviously you cannot compare the 0.1% oil being discharged from a CINC machine to any other amount of pollution being dumped off a boat. It's a common sense calculation. And yet, this technology was not embraced by industry.

There are also examples where CINC confronted obstacles and was both flexible enough and proactive enough to overcome them. Following a demonstration in Japan we were advised that their main concerns with the centrifuge were: its reliance on a dual power source, which was an inconvenience in certain situations; and the specific brand of skimmer used. Over the course of the next year, CINC attacked these problems. The Japanese response was positive, and yet frustratingly, immovable.

With all the modifications over the past year, such as the conversion to a single power source, and combining it with the more efficient Desmy skimmer, the Oil Spill Recovery System seems as if it would currently satisfy all the concerns that held it back from its prior approval.—Tadabumi Takasu, President of United HiTech in 1998.

Despite our ability in this instance to meet the client where they stood, these efforts were not enough to promote further action by the Japanese. It was suggested that CINC continue with testing.

CINC continued to raise the bar with advancements in its design. A polyurethane casing was designed specifically for oil spill response models. This outer housing reduced the machine's overall weight by 1,000 lbs making it even more mobile and efficient for deployment in an emergency situation.

III. Advocacy and outreach

Beginning in 1993 CINC's sales staff, management and ownership began aggressive marketing and sales efforts targeting private sector industry as well as government entities to demonstrate our capabilities and to solicit support for the use of our technology. The results of such efforts were less than successful in the oil spill response and recovery markets.

Within the community of private sector oil spill responders responses to our equipment tended to be favorable. Indeed CINC impressed audiences across the board. Notwithstanding these positive reactions and experiences, oil spill response teams were bound by various regulatory policies and rules of testing that effectively stonewalled even the possibility of new technologies entering the market. For the purposes of their own protection, these co-ops and companies were not interested in any technology or method of cleanup that had not received the Federal stamp of approval. In order to receive approval, technologies must be tested on actual spills, but the agencies charged with approval will not deploy untested equipment in a spill scenario. We were dealing with a classic and very unfortunate example of a Catch 22.

In over 45 documented cases, CINC made efforts to obtain the required certifications and grow awareness in the public and private sectors. When we were denied access to testing, CINC took on, at its own expense to demonstrate the effectiveness of our product and gain this critical access. We proved our capabilities in front of

the very agencies charged with protecting and identifying new methods and solutions. The U.S. Coast Guard, Marine Spill Response Corporation (MSRC), Minerals Management Service (MMS), U.S. Navy, and the EPA were all made aware of the this powerful technology that deserved a place within our arsenal of defense against oil spills.

Federal outreach and response

In 1994 CINC made first contact with Ken Bitting, Civil Engineer for the U.S. Coast Guard (USCG). We informed USCG that we were deploying technology and wanted to get the correct certifications and requirements to do so. Dave Meikrantz, CINC's Director of Technology, then visited the Marine Spill Response Corporation (MSRC) to understand what kind of equipment they were currently working with. Over the course of the next two years, CINC and MSRC stayed in contact through various meetings, calls, and hosted demonstrations. We requested to participate in their tests and were repeatedly told that there were not enough available funds.

Buccaneer Marine was an organization with crews that would run stand-by oil recovery duty when drilling was permitted off the California Coast. Although the co-ops were formally contracted for oil spill clean up, they would call on Buccaneer in the event of a large spill. In 1995 we ran sea trials of the V–20 under "rock and roll" conditions and discussed potential joint maneuvers for future oil spills. Jim Johnston, the skipper for Buccaneer Marine, had all the ancillary equipment to support oil recovery operations and a trained crew, but was not allowed to recover oil independently without an invitation from the co-ops and USCG permission.

The range of outreach conducted following our failed involvement with MSRC reads like an 'alphabet soup' of government agencies. Between 1995 and 1997 CINC contacted:

1. The California Department of Fish and Game to obtain their guidelines for Oil Spill Prevention and Response (OSPR).
2. Lloyd Nilsen at U.S. Navy Systems Command, Arlington, VA. *No response*.
3. Kyle Mokelien at the Minerals Management Service. *No response*.
4. The Naval Facilities Engineering Service Center (NCEL) and provided a demonstration at Port Hueneme, CA.
5. Yuone Addasi at California Fish and Game. *No response*.
6. Joseph Vadus, Senior Advisor at NOAA. *No response*.
7. Clean Seas Official List (position sites for spills around the world). *No response*.
8. George Wilson and John Johnston, Senior VP of National Response Corp. (NRC), offering to make available V–20s at no cost in the event of a spill. *No response*.
9. All 75 solicitors entering into Basic Ordering Agreements with the U.S. Coast Guard for containment, oil spill and hazardous clean up. *No response*.
10. J. Foster, General Counsel for the Federal Office Science & Technology Policy. Then Senate Minority Leader, Senator Tom Daschle sent the letter outlining CINC's capabilities, and requested that it be tested and considered as a powerful addition to our clean up arsenal. *No response*.

In March of 2001 I made a personal effort to communicate with the heads of EPA and the Department of Transportation. I sent letters to then agency heads, Christine Todd Whitman and Norman Mineta, respectively, explaining the extent of our centrifuge's capabilities and requesting their review and / or assistance. I emphasized that: "Unfortunately in the United States, we remain poised to respond to the next great manmade environmental disaster from the same crisis mode as we did twelve years ago," adding that, "I am excited to show you [with the CINC machine] that we need not repeat history. The answer exists and it is readily available." EPA's response was noncommittal.

Hosted demonstrations for the benefit of government and industry

In addition to the phone calls, letters and general outreach that went unanswered CINC hosted numerous demonstrations for representatives of government, industry to emphasize and reinforce CINC's power and efficiency. We also presented and participated at various conferences and trade shows to elevate the profile of our product.

CINC hosted and/or presented at the following events:

1. Clean Gulf Conference, FL.

2. U.S. Coast Guard Oil Pollution Act—90, Kings Point, NY.
3. International Oil Spill Show, Long Beach, CA. CINC hosted a private demonstration at our facilities, providing private bus transportation and dinner for guests. In attendance were USCG's Director of Research and Development, Ken Bitting, representatives from MSRC and UNOCAL.
4. International Ocean Conference of the Marine Technical Society.
5. Monterey Harbor demonstration for California Fish and Game and the U.S. Coast Guard.
6. At OHMSETT, a U.S. Navy and U.S. Coast Guard facility in New Jersey, CINC is tested under real life oil spill conditions. Following a successful demonstration CINC hosts a dinner event in New York City.
7. U.S. Representative Lois Capps convened a conference in Santa Barbara to discuss oil spill technology. CINC demonstrates before a variety of stakeholders in the oil industry, research institutions, and other Federal agencies. "As TV cameras rolled Friday morning, the Costners and their team successfully demonstrated how the separators work. A temporary water tank was installed in the harbor's parking lot and the water was fouled with diesel fuel, which the machines then cleaned up." Santa Barbara News-Press, April 21, 2001. Government representatives in attendance were: Lt. Graves, USCG; J. Lisle Reid, Regional Director, Mineral Management Service; and Heather Parker-Hall, NOAA representative.
8. Terminal Island, CA, test performed for U.S. Coast Guard Task Force for Contingency Planning. EPA, MMS, FEMA, Fish and Game, and the California Coastal Commission were all in attendance.

In not one single instance did we receive a follow up response to these successful demonstrations. It was frustrating to know how to move forward. We were told the machine had to be proven and tested. When we were denied the opportunity to participate in those tests, we did demonstrations of our own, in an effort to claim the attention we felt we rightly deserved. We earned the respect and of our audiences wherever we went, and yet still were denied any real support. It was extremely difficult for us to know how to move forward doing business in the US.

International use and response

For ten years CINC went about targeting international governments and private entities involved in oil or hazardous spill clean up, in much the same way as we did in the U.S. In many instances we offered use of our machines at no cost wherever oil spills were happening around the world. Despite these efforts we were mostly denied a response from the following entities:

1. Canadian Marine Response Management Corp. responsible for oil spill services and equipment and Larry Wilson of the Canadian Government. *No response*.
2. Oil spill offices in: United Kingdom, Netherlands, Sweden, Italy, France, Germany, India, Australia, Denmark, USSR, Japan.
3. Autralian Emergency Services (AES) and Hartec Systems Anchorage were contacted and offered our equipment and assistance in cleaning up the Komi spill. *No response*.
4. Offered clean up assistance to Marius Mes of Phillips Petroleum of Norway. *No response*.
5. Offered equipment for a spill in Wales, to the Oil Spill Response Lim. And Joint Response Center. *No response*.
6. Peter Oosterling, General Manager of Shell International, The Hague. *No response*.
7. Test performed in Kuala Lampur, Malaysia for the Deputy Prime Minister. CINC transported a V–10 unit and had a successful demonstration. *No response*.

In 1997 we airlifted a V–20 CINC unit to Japan to aid the oil spill clean up caused by a cracked Russian tanker. Although severe weather kept us off the sea, the effort did demonstrate our unit's mobility. The $700,000 price tag for transporting our machine further confirmed our commitment to providing real world solutions to protect our environment and resources.

Business repositioning

We jumped through every hoop that we encountered, but without key institutional support or regulatory action, we didn't have any buyers, and thus, the market was nonexistent. I had to suspend my intentions for the oil-water separator and the company went on to diversify into other markets, including pharmaceutical and chemical centrifuges.

My passion and desire to succeed with CINC never waned. Roughly nine months ago I formed WestPac Resources LLC with my partner Pat Smith, with the intention of attacking the 15 ppm problem that had been a sticking point for government and industry alike. We took a step back and reevaluated the process with a Federal lab focusing on systems engineering. We found an engineer at UCLA, Dr. Eric Hoek, who believed that he could create a backend nanotechnology filter membrane to reduce oil-water output to below 15 ppm—the key to CINC's commercial viability in certain sectors. Again with private resources and no institutional support, I found myself pushing this technology uphill because I believed in its potential.

Ocean Therapy Solutions was born to provide global solutions for oil recovery. OTS utilizes the CINC centrifuge and will incorporate nanotechnology developed by UCLA to produce oil-water output of less than 15 ppm. OTS is currently working in concert with the Parishes of Louisiana and BP to deploy the CINC machines into the Gulf.

IV. Present capabilities and future needs

The fundamentals of the CINC centrifuge are strong. This system model for liquid separation by centrifugal force has proved time and time again to work with diverse elements and under stressed circumstances. For these reasons, scientists and engineers at the Aerospace Corporation are exploring options with us to optimize CINC centrifuges for possible work in the Gulf. If CINC is deployed in the Gulf it will surely encounter new mixtures, emulsifications and viscosities, which will require engineering attention and "fine tuning." These challenges can and will be met. Aerospace is also evaluating satellite and airborne sensor data and Ground Truth Data to help improve situational awareness to aid in the most efficient placement of CINC machines in the Gulf.

Ten V–20s are ready to be deployed in the Gulf at this moment. At our Nevada facility we could begin scaled up manufacturing immediately. This facility, as well as our other strategic manufacturing partners, could provide hundreds of CINC machines in a matter of months.

In addition to separating oil and water, CINC centrifuges have been used extensively in oil production. CCS and ET&T are two mid-stream contractors working for U.S. oil manufacturers that have experience with CINC machines. In fact, ET&T bought the first V–16. We also know that a Dutch oil processing company has been using CINC's for this purpose.

Legislative needs

The government agencies and entities mentioned here should not be singled out for their indifference. Between 1994 and 2004 we contacted every major oil company in the U.S. in an attempt to gain their awareness and support for a technology that could both protect them and the environment in the event of a spill. The most apt word to characterize these interactions was apathy. Simply put, the need for such technology was not recognized at the time we brought this product to market. Now the whole country and the world will recognize the need for preventative spill clean up technology. I am saddened by the disaster that has brought this conversation to bear and also happy to see our technology finally have the chance to take center stage in providing high quality environmental solutions.

Our President has made clear that he does not want to put Americans out of work, but the moratorium on oil drilling is now moving supply rigs overseas to foreign territories. Our President's main concern, as I understand it, is to keep Americans out of harm's way, by not allowing them to work in unsafe environments. CINC machines stand ready to be deployed for immediate clean up, but they also provide the unintended benefit of putting people back to work.

If legislated as a safety standard, CINC machines would be like fire extinguishers for the oil industry, to be kept close at hand wherever oil and water have the opportunity to come into contact. Like any other emergency device, the hope is that you never have to use it, and yet it is reliably there when you need it. CINC machines provide a safety assurance such as the oil industry has never seen. Their effectiveness remains unmatched by any comparable technologies in the past thirty years. In putting CINC to work, we have a situation where regulation can be very good

for business—putting rig safety operators back to work, in a safer environment, with American made machines.

In our experience with the "clean up" industry and government regulatory agencies responsible for protecting our environment and the public, we have learned that interest in any sort of solution is event driven, piecemeal, and reactionary. Following each major disaster there is a frantic search for tools and answers, but it's always too late. This is a great failure of our system because we do not have solutions available when we need them the most. Fortunately, we have a solution that is readily available to set things right in the Gulf beginning tomorrow if we make that decision.

Conclusion

We are all at fault here. It's just too easy to blame BP. It took oil for me to fly here and it will take more oil to solve our problem. What we need to do now is come together. What I can provide it a technology that is available immediately, a technology that will allow rigs to resume operation and to put people back to work. Every day we wait to deploy we lose more wildlife, coral reefs and our way of life.

US Coast Guard has used terms such as "under assault" to describe conditions in the Gulf. He has it right that this is a war to be waged with all the tools, methods, and techniques we have at our disposal. Since the last great debacle (Exxon Valdez spill) there has been too little institutional effort devoted toward defining, identifying and qualifying the best "tool chest."

I heard it stated that throughout the 19th and 20th Centuries, each time America has been compelled into war, we begin fighting it with the methods, tactics, equipment and technologies used in the last war. I believe that statement to be not only poignant but also accurate to events unfolding in the Gulf.

We have the opportunity to provide the American public a solution to the Gulf oil spill and to tell the story that demonstrates the power of combining government resources with private ingenuity. Thank you for this opportunity to speak today. As an entrepreneur, a pragmatist, and a U.S. citizen I am committed to ensuring a positive environmental legacy for the Gulf and all waters around the world.

BIOGRAPHY FOR KEVIN COSTNER

Although best known for his work as an actor, director and producer in the film industry, Kevin Costner has been an entrepreneur in the environmental tech space for more than fifteen years. In 1993 Costner procured a technology transfer from the Department of Energy's Idaho National Laboratory for a centrifugal oil-water separator. He founded Costner Industries (CINC) and committed the next fifteen years, and over $20 million toward research and development, advocacy and outreach on behalf of a rugged, compact portable device that would serve as a first line of defense in oil spill clean up and recovery. Costner's vision and success with CINC technology is its unparalleled efficiency in oil spill clean up.

DISCUSSION

Chairman BAIRD. I thank all of our witnesses.

I will recognize myself for five minutes and then as per the practice we will alternate on both sides.

I am struck by Dr. Short's opening comments and Mr. Costner's concluding comments, and I want to focus on two major areas. One, I want to talk about this issue of adequacy of funding, and then I want to shift to the research on the impacts.

INDUSTRY FUNDING FOR SPILL IMPACTS RESEARCH

It was not that long ago that our major oil companies were recording some of the highest, I think the highest quarterly profits of any corporation in the history of the economy, and yet, as eloquently described by Mr. Costner, the issue of cleaning up if there is damage has been dramatically under-funded, except possibly through private entrepreneurs here. Dr. Short was describing the

shortfall in funding, and then Dr. Kinner talked about the relative authorization level versus actual appropriations.

I am not asking anybody to put—to come up with this off the top of their heads, but if somebody is capable, does anyone know the contrast between the amount of quarterly profits or annual profits of the major oil and gas industries in this country, especially those derived from offshore oil or exploration, versus the amount invested in research and containment and recovery? Anybody even hazard a guess on that? It is multiple orders of magnitude I am sure. I don't want to put you on the spot. I am just struck by that.

Anybody want to take a shot at that?

Dr. SHORT. If I recall right, BP's annual profits are in the order of tens of billions of dollars, and the sum total of research that goes into oil pollution studies is in the order of less than, certainly less than $30 million.

Chairman BAIRD. Anybody—that is multiple orders of magnitude.

Dr. Kinner.

Dr. KINNER. Yes. Mr. Chairman, I don't know, again, oil spill or oil company profits, but I can give you the data that we collected. From the mid '70s to the mid '90s there was $50 million expended by API from '75, to '96. There is a corporation that the oil companies pay into for cleanup called MSRC, and they conducted a $30 million research effort that was terminated in the mid 1990s. And since 2000 API has spent about $40,000 a year for research.

Chairman BAIRD. So relatively small amounts.

Dr. KINNER. Yes, sir.

Chairman BAIRD. Mr. Costner.

Mr. COSTNER. I would just like to say I don't know how much they have spent, but I have spent all my profits on oil spill cleanup.

Chairman BAIRD. I was just going to ask. And without government subsidy, it sounds like.

Mr. COSTNER. That is right. And after taxes.

Chairman BAIRD. Significant. That gap is tremendously instructive and let us then look at the consequences of that gap.

IMPACTS ON CORALS AND ALGAE

Dr. Joye, you have been looking at this. Dr. Joye, I know you come from a research background and been in the region. This committee has actually passed legislation dealing with harmful algal blooms and dead zones in the Gulf. I am particularly interested in coral around the world, both the temperature increase and ocean acidification.

Can you talk to us a little bit about the impact of this spill on both harmful algal blooms, dead zones, and then if you have got some knowledge on deep sea corals in particular.

Dr. JOYE. Sure. The—I think one thing that people need to realize is that there—it is not just a matter of oil on the surface and oil in these deep plumes. The use of dispersants at the surface has resulted in oil being distributed throughout the water column. The whole point of dispersants is to get it off the surface and have it sediment out.

The impacts of that on the offshore system—I will talk to you first and then I will touch a little bit on the deep sea floor and the

coastal systems. The most pronounced, immediate impact is on the oxygen budget of the system.

The ocean anywhere is at a condition that scientists refer to as "steady state." It is in balance. Inputs equal outputs. Right now there has been a tremendous perturbation of that balance, and that input of carbon is resulting in a strong depletion of oxygen and consumption of oxygen by microbial processes.

That—this is not an issue of harmful algal blooms, per se. It is, rather, the opposite. You are putting carbon into the system in the form of gas and consuming oxygen. The signature in the upper water column right now, oxygen is very much depleted compared to what it is normally. In the deep water plumes it is 30 to 50 percent depleted in places. We measured two milligrams per liter of oxygen as the level where organisms like fish, anything that requires oxygen, start to be stressed out. We measured concentrations that were very close to that at two-point-five milligrams per liter already in the upper water column and in the deep plumes, as well.

So oxygen is a serious concern. The repercussions for the system in terms of carbon flow are potentially tremendous. We really don't have them constrained at this point. The system is de facto turning into a heterotrophic system. It is trying its best to consume all the oil and gas that is being put out.

Chairman BAIRD. Tell us what heterotrophic means.

Dr. JOYE. Heterotrophic—sorry.

Chairman BAIRD. I may do that from time to time today.

Dr. JOYE. Probably will need to. A system that produces carbon is an autotrophic system. A tree, a phytoplankton is an autotrophic system. We are heterotrophs. We consume carbon and oxygen in the process. So the organisms in the ocean that are responding to this oil spill are predominantly ones that eat methane and eat oil, so those organisms are all heterotrophic, and in the upper water column they are oxygen-consuming heterotrophs.

So those organisms are being turned on by the—stimulated, if you will, by the input of oil and gas. What that does to the heterotrophic levels in the system is it is an abnormal simulation. How that will cascade up to heterotrophic levels is very unclear, and you always also have to worry about incorporation of oil and gas-derived toxins, particularly in benzene and PAHs and things like that, into organisms and transport of that material up the food web.

In terms of the benthic ecosystems, the Gulf of Mexico——

Chairman BAIRD. I am going to ask you to be very brief. Tell us what benthic organisms are and then—I know this but——

Dr. JOYE. So they are—yeah. So they are organisms that live on the seafloor all around the Gulf of Mexico, and these organisms include deepwater corals, Lophelia-type organisms, as well as kinesthetic communities that are driven basically by the oil and gas. If you take away oxygen from the water, those organisms will not be able to survive.

So the implications and repercussions of the oil and gas imputed into the water column will be immediately felt by any creature that needs oxygen, if oxygen is depleted in the water.

Chairman BAIRD. So the oil doesn't—the oil is consumed by a certain category of organisms. In the process of doing that they also consume oxygen that deoxygenates the water column, and that has adverse repercussions throughout the food chain?

Dr. JOYE. Exactly. So the bottom line is that it is good that they are getting rid of the oil, but you are also getting rid of oxygen.

Chairman BAIRD. At what cost? Thank you.

Ms. Biggert.

EARLY WARNING MECHANISMS

Mrs. BIGGERT. Thank you, Mr. Chairman.

Dr. Haut, in your statement you discuss a potential research program for response procedures and processes that would include early-warning sensors to identify potential hazards. Could you expand a little bit on this concept, and would it be similar to the tsunami warning system that NOAA has set up in the Pacific, or could these sensors be used to—installed on existing infrastructure, or would new infrastructure be needed?

Dr. HAUT. There are currently quite a few sensors already offshore. One of the issues that we would like to look at actually comes from Oakridge National Laboratory. We would like to look at a sensor wiki, where through the internet we could link all these sensors and have all the data available to the public, and we can call up different sensors around the nation and offshore.

So we want to look at incorporation of an entire system of these sensors, and this way we could also identify wildlife, certain time periods certain ecosystems are going to be more valuable than at other times. So what is the value of the ecosystems themselves.

R&D BUDGET PRIORITIES

Mrs. BIGGERT. Okay. Then you also stressed the importance of technology research that would prevent the spills from happening in the first place. If you were given an R&D budget of say $100 million, how much would you spend on preventative technologies and how much would you spend on cleanup technologies?

Dr. HAUT. That is a really good question. And is $100 million even enough? One of the things that we would want to do is to incorporate first a meeting of all different stakeholders, get them engaged to fully understand what the different priorities are and where that money should actually be spent based on the priorities of all stakeholders. Invite environmental organizations, predominant environmental organizations to sit down with industry, to sit down with government agencies and regulators to fully understand where that money should be spent.

Mrs. BIGGERT. So many of you do seem to suggest communication between everyone, which I think is a really very important idea that our agencies don't always talk to each other enough, I think, or to the industry or to the scientists or whatever.

Let me see. Mr. Short or Dr. Short, in your testimony you state that Federal agencies need to insist that scientific standards are met before relying on the results touted for new approaches to oil spill response and mitigation.

EXISTING CLEANUP TECHNOLOGIES

How widespread is the use of technology for oil spill cleanup, whose effectiveness relies on data that does not meet the rigorous scientific standards?

Dr. SHORT. My concern there really was originated from recent experiments that were reported for the in-situ burning of oil in the Arctic, but in general the saga of dispersants—actually to speak more generally to your question—has a very shaky basis as far as evaluating their efficacy in the field.

And in part that is because it is difficult, and mostly it is because of inadequate attention to, you know, normal scientific norms and adequate support to carry out the experiments that need to be done and for long enough to be done.

For example, Environment Canada—Merv Fingas, in particular, ran the Emergency Sciences Technology Division there—made quite a stink about the fact that when you apply these dispersants and dispersion actually occurs, you can have leeching of the dispersant out of the oil and then they resurface somewhere else, and then you have, you know, essentially just recreated the oil spill.

So that is an example of something where people——

Mrs. BIGGERT. Okay. Thank you, and if I have time to ask Mr. Costner then, if—with your machine wouldn't it be better just to have not the dispersants but to really have the oil to absorb that——

Mr. COSTNER. Yes.

Mrs. BIGGERT. —with your machine rather than have it dispersed?

Mr. COSTNER. I think that is ideal, as it serves as a first-response situation wherever you are at, and the dispersants——

Mrs. BIGGERT. Uh-huh.

Mr. COSTNER. —begin to muck things up, but the machine, again, is highly, highly technical, and with the work of aerospace and who works with us, all those things can be overcome, but ideally right at the source we are not only able to collect the spill, but we are able to recover the asset for whomever has lost it. So ideally, yes, that is not what we need to be doing.

Mrs. BIGGERT. Okay. Thank you. I yield back.

Chairman BAIRD. You have asked the very question I was interested in. Thank you very much for that.

Mr. Gordon is next.

Chairman GORDON. Thank you, Mr. Chairman.

TECHNOLOGY TRANSFER

Many thanks to the panel for joining us today. This is not another "who shot John" investigation, but rather an attempt to try to determine what is the research and technology that we need to develop and actually through legislation for the future both to hopefully avoid and, if not, to mitigate these kind of problems.

You know, 50 percent of our U.S. GDP since World War II is the result of either developing technologies or adopting that technology, and much of that resulted out of Federal Government basic research: internet, GPS, we can go on.

So really my interest here is more specifically in the transfer of technologies in oil spill mitigation from basic research either to Federal, universities, on into the marketplace.

Do you see that there are barriers or not, and, if there are barriers, what do we need to do to break those down?

Dr. KINNER. Yes, Representative Gordon, I would like to take a shot at that. One of the real problems, as you pointed out, is technology transfer, and there are a couple of reasons for that.

For instance, if you run a request for proposal process to ask for ideas, oftentimes the researchers respond in the way that they think might be practical, but they have very little experience in the field. So they don't know a lot of those practical constraints that responders actually face.

So there are a couple of things you can do there. First of all, you can have a person who acts kind of as a point of contact, and that individual is a practitioner who understands the needs and then can relate to the scientists that are trying—or engineers who are trying to respond.

Secondly, I think one of the things that has shown to be quite effective is that once a proposal gets funded and it has met all the standards of peer review, you then assign a liaison who is a practitioner to the team to kind of keep that team focused on some of the constraints we face.

Chairman GORDON. Who should be the person or the agency that makes that assignment?

Mr. KINNER. I think that one of the issues is that the agencies haven't. They have R&D programs, but they don't make those assignments, and I think that needs to become part of the process.

Chairman GORDON. We tried to do that in the *America COMPETES Act* where there is the National Science Foundation and the Department of Energy, to help them develop a business model to get them over that Valley of Death. So really it should come from whatever the funding agency would be and not a specific agency somewhere else just to do that.

Dr. KINNER. That is correct.

Dr. HAUT. Mr. Chairman, if I can say, RPSEA, when we put out requests for proposals, we—particular for the deepwater technologies, we demand that we have a company that is a champion for that effort, and so that company then becomes the chairman of a review panel to monitor the progress of that research, and so we have that technology transfer function from the beginning of the initial research.

Chairman GORDON. Mr. Costner, you have been sitting on this for 15 years, so in your experience was there a problem going from the Federal Government, that basic research to you, or was it a problem of the industry accepting it, or you know, what lessons do we have to learn here?

Mr. COSTNER. No. The—we had a successful transfer and that actually came from the Idaho National Laboratory, so they said, go, man, go, and so I did. But the problems that we ran into was when we developed a successful machine that—in going to the government agencies, be it the Coast Guard or—there are so many initials—I have a hard time, the Minerals, MS.

Chairman GORDON. Yeah.

Dr. KINNER. MMS.

Mr. COSTNER. Yes.

Chairman GORDON. We have the same problem.

Mr. COSTNER. All these agencies were very aware of this equipment, saw it work, and many times saw it work successfully. It was what I said in my testimony, there was a general apathy. As far as business industry is concerned, there is a lot of human nature, and that is if—you have to be realistic—when you are in industry, if you have your own private company, you have to be a very evolved person, which is sometimes you look past your profits and you say, we are going to do the right thing. Those people are—they are out there, but they are far and few between.

In a public company when your mandate is profit and loss, a person who is running a public company looks at somebody like myself and all they can see is $500 million or $100 million or $10 million or $100,000 of capital investment to something that would be, in effect, a seatbelt, and I don't want to minimize my equipment. If they are not mandated to take it, the common shareholder will say, where did that $500 million go? You put—you spent $1 billion? Really? Of our money on safety when we really don't have that many oil spills? Because that is what we read.

And so, you know, that person has to be a giant himself, and when I mean a giant, I mean a person that is willing to put their job on the line. It is, I guess it can be found in the political arena, the person who is not willing—who is willing to do the right thing and forego their next term.

Chairman GORDON. Well, they buy fire insurance, they probably buy insurance, you know, on their other types of equipment.

Mr. COSTNER. That is correct.

Chairman GORDON. And so you might say that if you have—$75 million is a lot of money, but if you have a $75 million cap, then you—that is the distance then for you trying to buy your type of insurance.

Mr. COSTNER. It really is.

Chairman GORDON. The cap came off, people knew that they were going to be fully responsible, then just like fire insurance and other types of insurance, this would be an insurance that maybe they would be more interested, not so much out of the good graces but just out of good business sense.

Mr. COSTNER. I think there was a bar that I couldn't get over, and I think there was a bar that industry, and I believe that—and government hid behind. And—but those days are, you know, that is what—that was awhile ago, and but as far as the transfer, no, I did not have a problem. My problem came into being when I exposed the product on a national and international level that it wasn't mandated and it wasn't legislated, and it was easy to just not go there.

Chairman GORDON. Yeah. Well, I think it would be difficult to mandate your product, but we can mandate that you have to have full expense of mitigation, and when you do that, then they need to be out looking for products and ways to mitigate that damage, and you would get that additional insurance.

Thank you, Mr. Chairman.

Chairman BAIRD. Thank you very much.

Mr. Rohrabacher.

CHALLENGES FOR IMPLEMENTING NEW TECHNOLOGIES

Mr. ROHRABACHER. Thank you very much, Mr. Chairman. I apologize that I have missed some of the testimony here today. I had actually another meeting that I am running back and forth from with some—another foreign affairs committee at the same time as this committee.

Mr. Costner, I understand that you have some technology that could—you believe that could be put to use in meeting the current challenge.

Mr. COSTNER. That is right.

Mr. ROHRABACHER. And are you suggesting that there are regulatory roadblocks that are preventing you from—this technology from being utilized?

Mr. COSTNER. Well, I think that if you look at it carefully, I think it has somehow been intertwined between government agencies. When we wanted to originally test the machine, I said that we had volunteered the machine when oil spills would occur, those that we would see on television, not to the extent of the Valdez or what we are experiencing now, we would offer to take our machines out there, and we couldn't get out onto the spots because the Coast Guard would regulate that we couldn't get there. There was—I called it an ugly catch-22.

You know, what we wanted—as a government agency they would like to know if it works. Well, let us go out and show you. We will show you the data. Well, we can't get you officially out on the spill, and there was just this kind of ineptness that kind of really silenced the company.

That is changing now. We have conducted 12 years later which two very successful tests with BP. BP is moving towards and placed an initial order towards these machines and have acknowledged that they do the job, but they are actually doing the job where they were not even originally intended, which is now closer to shore, groundwater, and things like that.

Mr. ROHRABACHER. So we could have, without spending any money on our part, and we are always looking for money here because we spent a trillion and a half dollars more than we took in last year, but actually being a little bit more responsible in terms of regulatory——

Mr. COSTNER. Wow.

Mr. ROHRABACHER. Yeah.

Mr. COSTNER. Really?

Mr. ROHRABACHER. Wait until your currency devalues then you will really go, wow, because that is what people——

Mr. COSTNER. I am at wow now.

Mr. ROHRABACHER. But if—what you are suggesting then is actually without a great expenditure of money, more money from this committee and from doing our job, by simply perhaps making sure that we didn't have regulatory and other type of roadblocks we could have been a lot further along and been able to meet this challenge?

Mr. COSTNER. That is correct.

Mr. ROHRABACHER. Maybe you could let me know—you say the Coast Guard—was there—has any other agency or anything like that that——

Mr. COSTNER. You know, it is in the testimony. You know, I will say this. BP mentioned to me that they would support the oil service suppliers and require them—maybe that is the wrong word, but they would support the idea that these machines are on boats. People are—somehow this wheel is coming around, and it is unfortunate that it is late, but, yeah, that is correct.

Mr. ROHRABACHER. Well, there is an intransigence in the private sector as well as the government sector. What I have personally learned is that some people in business basically know how to do their job based on what exists today, and they resist changing it because then they wouldn't know how to do their job as well, and they are afraid of that.

But on the government side, we just have basically people who don't want to work sometimes, they don't want to change anything because that is their job, and there is a similarity in the intransigence, but I think I find it—on the bureaucratic level maybe there is even a greater intransigence, because at least in the private sector we got guys like you who are using, and congratulations for using your notoriety to try to do good things——

Mr. COSTNER. Well, it was my money actually, and I found the initials. The NOAA, the MSRC, MMS, EPA, and the United States Coast Guard. You know, I think maybe when you talk about the energy transfer, there must be a relationship when you actually test or something where maybe you follow me in industry a little bit and the terms of if the government would have seen that number one, the taxpayer paid for this at first, and then I took it out of the DOE. But if there was an agency that could have like, I guess like a parole officer, I know I am going to use wrong words here. I just know it.

But the ideal thing would be to say, yes, this does work, and bring it back to a body like yourself and find a way for government to be a little more fluid with this situation because these should have been on every ship transferring oil, they should be on every oil derrick, they should be at every port and every harbor, and that is—and they work incredibly efficiently. And, you know, sometimes we are pointing at the larger oil spills, and it is easy to minimize the spills that are occurring every day.

Mr. ROHRABACHER. Yeah.

Mr. COSTNER. And those things can be handled immediately by anybody that is conducting commerce where oil is about to touch water.

Mr. ROHRABACHER. You are an orange—you come from Orange County?

Mr. COSTNER. I was born in Compton, California.

Mr. ROHRABACHER. Right. Well, thank you very much.

Dr. KINNER. Representative Rohrabacher, if I might just add something, I think there are a couple things you have to consider.

One is that Mr. Costner pointed out that they didn't want him to take the technology out during a spill. His technology may be excellent. I don't know his technology, but there are issues of trying

new technologies during a spill where you have to basically be sure that you are not increasing the risk by using those technologies.

So that is one reason why we try sometimes to be a little bit more careful about using new technologies during a spill but——

Mr. ROHRABACHER. As long as there is ample reason to suggest that it might make it worse and I would have to say that I found a lot of intransigence and people with new ideas that there wasn't any type of ample reason to justify that intransigence.

Dr. KINNER. Absolutely, but I would point out, also, that the United States is the only country that does oil spill R&D that has no opportunity to actually have on-water controlled spills to test technology. They do it in Canada, they do it in Norway, and I believe that you heard Ms. Buffington talk about MMS participating in a Norwegian spill. That is because there is no capability to do that in this country, and I think we need to open up that possibly, that we have small releases where we can have on-water testing outside of OHMSETT to test these in real world conditions instead of in a big test tank.

Mr. ROHRABACHER. Thank you very much, Mr. Chairman.

Chairman BAIRD. Thank you, Mr. Rohrabacher.

Ms. Woolsey.

THE COSCO BUSAN SPILL AND THE INTERAGENCY COMMITTEE

Ms. WOOLSEY. Thank you, Mr. Chairman, and thank you very much, panel. I was looking forward to you as the balance to our first panel.

For those of you that may not know this, on November 7, 2007, the container ship, Cosco Busan, collided in the San Francisco Bay with the Bay Bridge, and 58,000 gallons of oil were spilled into the San Francisco Bay, and that is considered a minor spill.

Well, it had huge impacts on my district north of the Golden Gate Bridge, and that was why I introduced H.R. 2693 with the Chairman, and thank you very much, Dr. Short, for mentioning that and giving us a shout out.

But it was then that I realized the question was who is in charge. Who is in charge? And this bill for research and development would put some answers around that and some parameters.

But this whole situation proves once again who is in charge, and panel one proves to me one time over who is in charge. The government panel convinced me more than ever that we have to have one agency in charge because certainly 14 agencies are not acceptable at all, and certainly a group of agencies that were sitting here in front of us who are not—it didn't appear that they were outraged by the BP blowout and the response to it. It seemed to me that they were very willing to defend each other from agency to agency. And I just thought it was unacceptable. We have to have somebody in charge.

Dr. Kinner, you suggest that we have an interagency committee, possibly NOAA and the Coast Guard, you know, and for me that would be the perfect way to go because I love them both, but I don't think so. I think we have to have some agency in charge. Where does the buck stop in an interagency committee? I mean, we have got to a place where the buck stops. The buck stops where?

Dr. KINNER. Well, Representative Woolsey, I think that the reason I suggested that co-chair——

Ms. WOOLSEY. Uh-huh.

Dr. KINNER. —is because there are two different issues as I see them for oil spill R&D going forward. One is the technology questions, the mitigation devices, et cetera, and the other one is the more science-based questions, the fate, the behavior, the effects of the oil. While Coast Guard or MMS or whomever are great on the technology, they are not really able to answer some of those fundamental research issues with respect to fate, behavior, effects, et cetera. And restoration certainly. So that is why I recommended the co-chair.

What I also think is very important about my recommendation was this executive agent, and those might not be the right words. I am not a politician here, but I think——

Ms. WOOLSEY. Parole officer.

Dr. KINNER. Parole officer. Yeah. But, anyway, I think that that is really the very important point about what I said, because I don't think you can expect any of these Federal agencies with their multiple mandates to be bird-dogging what that committee has to do to oversee oil spill R&D, and that is where I think the rubber hits the road.

Ms. WOOLSEY. Well, I agree with you totally, but I—because—but I believe there needs to be something over those two. Certainly we don't need 14. It seems like you agree with me on that.

MORE ON TECHNOLOGY TRANSFER

Mr. Costner, your level of involvement, thank you very much. You brought some good, you know, thank you for bringing this to the whole issue.

But I am curious. In your exploration of bringing your technology to the Federal Government, were you involved in levels where if you were turned down, you could appeal, or were you right at the top from the beginning?

Mr. COSTNER. Well, I sat with the—hosted meetings with the Coast Guard in New York, went to their facility, the Coast Guard facility. Representative Lois Capps, I demonstrated in Santa Barbara where I live and look at out seven oil derricks that sit, you know, out there at the Channel Islands, and those groups attended that meeting. I brought in one of those four-foot high swimming pools.

Ms. WOOLSEY. Uh-huh.

Mr. COSTNER. And I dumped in Alaskan crude oil into there and put a V–10, one of my machines, and drained in about—after having something like this for an hour, people talk, I said, well, let us go out in parking lot, and I dumped in two 50-gallon barrels of crude oil, and I said, there is your oil spill. Oh, my goodness. And I flipped the switch on my machine, and five minutes later the oil was out. It was so quick that it kind of was a little underwhelming because we talked and then people weren't looking, so I said, do you want to do it again? So we dumped the oil back in, and again, it happened.

So that is a reality. I kind of forget what your question was. What was it?

Ms. WOOLSEY. Well, did you have an appeals process?

Mr. COSTNER. Well, it is not called appeals. It is probably called squeal, you know. It is how loud can you be, and I don't know if I am embarrassed about the amount of money that I spent, I don't know if I am proud about it, but at a certain point I knew that I was exhausted. It was a moment where I couldn't go forward. When I hear people talk about $100 billion in an agency, I am sitting over here, my skin is crawling. I would have liked some of that.

But I didn't need it because I am there, and what is interesting is during this talk that pipe is still leaking, and I think we have a unique moment. Am I up here hawking my product? I guess. I don't know. Don't take mine. Take somebody else's, because I have been to all these oil response conventions around the country and around the world, and all I see are booms and the latest helicopter, but I have never seen one machine that deals with getting the oil out.

Ms. WOOLSEY. Uh-huh.

Mr. COSTNER. That is me, and so with the moratorium on there has to be a responsible action at this moment, which is can we effectively take care of a spill that will occur? And that answer is yes, and so we have a long-term problem, a short-term problem, and we have an emergency right now where people aren't going to be able to make their mortgages if they can't go back to work. They can't go back to work if it is not safe, and they can't go back to work if there is not a reasonable application.

That is what this represents, and I know you can't endorse a product. I get that, but I am dying to see anybody that cleans up oil in any kind of response on the scale that I am talking about.

Ms. WOOLSEY. Okay. I know I am overtime.

Mr. Chairman, I just want to say to both Mr. Chairmans and to our Ranking Member, that in our legislation we have to make certain that people who already have good ideas, workable ideas don't have to go back to scratch in order to——

Mr. COSTNER. Thank you.

Ms. WOOLSEY. —compete. Thank you.

Chairman BAIRD. Thanks, Ms. Woolsey, and I have just a few more questions I would like to ask. I don't know if other colleagues will as well, but I would like to just ask just a couple follow-up points.

DISPERSANTS VS. OIL COLLECTION

A fundamental issue seems to me to be this issue of dispersant versus recollection and separation, and the science, the environmental impacts, and the economics of the two, it seems, you know, that it used to be this old adage, the solution to pollution is dilution, but that doesn't really solve it. I mean, if we are just making micro-particles that are consumed by microorganisms that then suck up oxygen and thereby possibly re-release the chemicals, I have been told by coral reef scientists that the dispersants are lethal for a lot of corals. I mean, if you just dump the dispersant on the coral, you have done the coral in right there.

So the received standard operating procedure seems to dump the dispersant on it as quickly as you can. My hunch is that is more

for PR purposes than science. My hunch is that that is so that it looks like there is less oil. I may be wrong on that, but that may be part of it.

To what extent have we really evaluated the science, the economics, the environmental impacts of dispersants versus collection? And whether it is Mr. Costner's device or some other device, the dispersants make it very difficult for a recollection and separation mechanism to work, and they skew the economics in a bad direction for that and maybe for the environment. So this is a core question. What do we know about this?

Dr. KINNER. Mr. Chairman, as I mentioned a few weeks ago, Dr. Short was one of 50 scientists that we had at a meeting down at LSU. We were asked to convene that meeting, the Center was, by the Regional Response Teams in charge of the cleanup, and we were asked that very question. Going forward, if in that case the top kill didn't work, what should be the extent of dispersant use in this spill?

And what we tried to do was bring scientists from Federal agencies, from academia, from other countries, and practitioners together to answer that question, and here is what we concluded, and the report is online. It was released last Friday.

That in the best of all possible worlds you don't want to have to make this decision, but as Dr. Short pointed out, this is a catastrophic spill. So to this point that group of independent scientists felt that the use of dispersants for this spill was less environmentally harmful than allowing that oil to go into the wetlands and the near-shore environments because of the sensitivity of organisms, et cetera.

Was it desirable? No, but you have to make a decision, and mechanical recovery, as Mr. Costner's device is, is the best choice, but you can't always use it because of the weather conditions. This is a nightmare scenario because we have prevailing winds that are onshore that create a lot of wind and waves that prevent mechanical recovery from working, that are driving the oil into the near-shore environments.

The second thing that the scientists said is going forward what should be done continually is a risk assessment, a tradeoff evaluation to make sure whether or not that conclusion still holds going forward as the species in the water change, as the wind conditions change with the season. All of those things really change and potentially, as work like Dr. Joye's shows, that the threshold concentrations in the water column are going up above one part per million or ten parts per million for toxicity concerns.

Chairman BAIRD. I appreciate that. I am going to give Dr. Joye and Dr. Short a chance to respond in a second, but a question that is running through my head here, though, is it seems like—let us oversimplify, but every gallon of un-recovered oil has some level of cost to the environment. Every gallon of added dispersant has some level of cost. To the extent that there is a penalty linked to those two variables, it affects the economics of how we deal with these things. It affects the economics of whether one initiates an initiative like Mr. Costner's or some other entrepreneur.

We need to get that economics straight and we need to really start pricing those kinds of things because—and we can't just say, well, in this catastrophe—I am looking long term.

Dr. KINNER. Yes, sir.

Chairman BAIRD. Okay? Yes, it is—we got to stop this thing, but in the long term we have got to really make some serious question about where our economics and our investments are going to go, and we really need to evaluate the costs of the per gallon dispersant costs, not just in terms of what it costs to make the stuff, but what the environmental impacts are and economic impacts of those environmental impacts.

ENTREPRENEURIAL SOLUTIONS

It just seems we really ought to look at this, and then the other thing I want to just put out there and then I will open it up for response, is you are noticing, Dr. Kinner, that, well, we need to do—and I am mixing things up here, but I am going to just put it out, we need to—we are constrained for our ability to do small scale releases as a test bed. I see it a little differently. I see it if you have got a catastrophic event, unless you are doing something that has likely added affergenic harmful affects by the treatment, you ought to let the entrepreneurs get out there and do it.

Now, we are not saying dump a bunch of chemicals or light the thing on fire, drop a nuke on it or something, but if somebody is saying, I have got a mechanical device that the worst thing that happens is we put the same oil and water back into the system that we started with, that seems to be a fairly low-risk enterprise. And so we ought to find ways of using these tragedies as natural experiments to unleash entrepreneurs on them, again, not with harmful substances, but I think we ought to really take advantage of this and this idea that we deny people access who might have devices that work when we have natural experiments, I would rather do that than dump 100,000, you know, gallons in and say, let us see if we can clean this up. We have already got the gallons. Let us go clean it up.

Anyway, let me open this up.

Dr. KINNER. Representative Baird, with all due respect, we would call that in the field a spill of opportunity.

Chairman BAIRD. Yes.

Dr. KINNER. And we do actually have plans for spill of opportunity testing. In this particular spill we are so undermanned with personnel that to actually go out and do testing would be very, very difficult, sir, but I do think there is opportunity at certain spills of opportunity.

Chairman BAIRD. I am told Ms. Biggert has a question. I am going to ask you to hold onto your answer in response to mine so that Ms. Biggert can ask her question. But then if you leave, I want to stay here and ask my question. All right.

Sometimes in the absence of our colleagues from the other side, they freak out that we will pass legislation or something.

Mrs. BIGGERT. Legislation will come up very quickly.

Chairman BAIRD. In fact, I have written it here.

Mrs. BIGGERT. She wants her bill. Thank you.

MORE ON TECHNOLOGY TRANSFER

Just as a follow up, Mr. Costner, you know, we deal a lot here with what we call the Valley of Death, and the Valley of Death is when there is an industry or a company that develops something, and they get to the demonstration process, and then they want—to get to the commercialization is very difficult, and coming to the Federal Government is one way to do that.

That doesn't—I don't know if that really helps you, but Ms. Buffington in the first panel talked about OHMSETT and that is an acronym that means Oil and Hazardous Materials Simulated Environmental Test Tank. And I wasn't sure whether you said you had been tested by that group or MMS or not.

Mr. COSTNER. I have demonstrated the equipment numerous, numerous times successfully. It is—make no mistake, the equipment is working in other industries. I am separating highly-toxic chemicals in the cosmetic industry and the mining industry.

Mrs. BIGGERT. I just wondered if you had been before that—gone to OHMSETT.

Mr. COSTNER. Who are they?

Mrs. BIGGERT. That—well, I can only——

Mr. COSTNER. I mean, I am sure—okay. Wait a second. Yes. They are with the Navy.

Mrs. BIGGERT. Okay. All right. So——

Chairman BAIRD. If I may, Ms. Biggert, Mr. Costner, it is so refreshing to have a panelist who does exactly what we do up here when we are asked tough questions. Our staff slips us things, and then we get to sound like we really know what we are doing.

Mr. COSTNER. This is the first time you can actually copy and not get in trouble for it.

Mrs. BIGGERT. He is giving away our secrets up here.

Dr. HAUT. Congresswoman, if I may, we have also tested Mr. Costner's technology at Texas A&M, actually in their food laboratory, and I think one of the key things here that we are looking at as Mr. Costner pointed out is the cost effectiveness of it as well.

And as Chairman Baird has mentioned, what is the value of those ecosystem services? We have done a project up in—actually offshore Alaska to look at the value of ecosystem services. Ecosystems provide various benefits, whether it be fishing, climate change, prevention of hurricanes coming onshore, or whatever. But the key thing about the wetlands also is that is where our food source starts. At certain time periods of year as well where we can model this and come up with certain values of those ecosystem services. So we could actually then go in and do a comparison of what is that value versus the comparison of what does it cost to use Mr. Costner's technology or other technologies.

Mrs. BIGGERT. Well, Dr. Haut, would you think then that because of this crisis that either BP or the Federal Government should use this in a crisis like this?

Dr. HAUT. I think there are various things that may be tested. I am extremely interested. I know Mr. Costner has about a half a dozen of his systems offshore right now at ground zero, and I will be very interested to see what those results are in terms of the separation of it.

Mrs. BIGGERT. Okay. Then, Dr. Short, following up, what agencies, Federal agencies are relying on technology that was not tested using the rigorous scientific standards that you talked about earlier, and does this—go ahead. Can you answer that question for me?

Dr. SHORT. Well, the—as far as what agencies——

Mrs. BIGGERT. Uh-huh.

Dr. SHORT. —who—I suppose it would be the Coast Guard and EPA. There is a lot of work that has been done on—to use dispersants as an example—on how well they work in a laboratory setting. There is very little that has been done on how they work in an actual field setting, and the scientific standards that are brought to power when it is is not something that gives one confidence.

And part of the reason for that is, as Dr. Kinner pointed out, we can't do field testing in the United States. If we could go field testing in the United States with, you know, small scale oil spills, it would help a lot.

Mrs. BIGGERT. Okay. So do you think that this contradicts the Federal Government's policy on scientific integrity then?

Dr. SHORT. Well——

Mrs. BIGGERT. By using something like that when they haven't been tested.

Dr. SHORT. Tested adequately you mean?

Mrs. BIGGERT. Uh-huh.

Dr. SHORT. Yes, I do.

Mrs. BIGGERT. Okay. Thank you very much. I yield back.

Chairman BAIRD. Ms. Woolsey has a brief question, but I want to give the opportunity to follow up, and thank you, Ms. Biggert, follow up on the other issues that I approached.

Dr. SHORT. Thank you. I have been squirming in my seat to do so. I want to, I hope, point out to the Subcommittee the—what the actual facts on the ground appear to be when the oil first hits the surface that was described to us at this meeting the first time I heard—that Dr. Kinner convened a couple of weeks ago.

It was a very sobering description from NOAA, ORNR, and what they described was that after the pipeline ruptured and oil began to appear on the surface, it did so in a rising cone of dispersed oil that would show up anywhere within a circle of about 9,000 feet.

Then they said the biggest skimmer we have can sweep 300 feet. Do the math. The mechanical ability to concentrate the oil so that you can use separation technologies effectively just wasn't there.

And so as Charlie Henry said, the first line of defense that we, as a matter of routine, would employ was mechanical recovery, was overwhelmed, and they had to go to dispersants.

And so that kind of put the Agency in a very difficult position right away.

Dr. JOYE. Can I comment on your question?

Chairman BAIRD. Please.

Dr. JOYE. I think one of the biggest issues that I have in thinking about this crisis is that there are two major areas of impact. One is the coastal ecosystems, the wetlands, the fisheries, tourism. The other is the offshore oceanic impacts, and, I think—and this is just my perception and opinion—but it seems to me that the oce-

anic impacts, the open water offshore impacts have received little to no attention while the coastal impacts have—that is where the decisions have been made. They have been targeted for reducing the amount of the oil on the beaches, and the goal, to achieve that goal, what has been done is use of dispersants.

And those dispersants may well be the last line of defense, but I am not convinced that this is the best thing we should be doing, because the entire water column is now—I mean, you have got—it is a huge body of water, and instead of having the oil concentrated on the surface where you at least have a chance of recovering it and removing it, you have now basically diluted it and dispensed it into the entire body of water of the Gulf of Mexico, and how in the world are you ever going to clean that up?

To me that is a serious consideration.

Chairman BAIRD. Dr. Short.

Dr. SHORT. If I may just add to that, you know, we weren't, any of us, real comfortable with that decision. It was—we recognize it was sort of like, well, you are going to lose a big toe or are you going to lose a thumb? Which one?

And on the basis of the information we had before us, which included monitoring results that was conducted by EPA, what we knew about hydrocarbon degradation rates in the Gulf, and about how oil might affect the coastal ecosystems should it get there. It seemed, on balance, that the wisest course was to apply dispersants, provided that we continue to monitor what goes on subsurface as a result of that application to make sure that we are not getting into a situation where we actually made a mistake and the impacts are actually greater.

Chairman BAIRD. But, my concern is, you said do the math. The math changes if you—based on your assumptions.

Dr. SHORT. Uh-huh.

Chairman BAIRD. And so if we get away from the dispersant approach or we fully cost the dispersant approach versus a recollection approach, then maybe the financial incentive, then maybe when people do the math, especially, I think, Mr. Gordon may have—I don't know if he meant to allude to it, but, you know, lift the cap, increase the tax, change the economics of the dispersant, and then maybe the economics go towards, how do we reduce the scale of the cone to begin with? Can we lower things to concentrate the plume as it rises versus just let it go out? And certainly the dispersants expand that plume immeasurably.

Then maybe the economics go to how do we concentrate the plume as it rises to the surface, and then the other math is X amount of volume divided by X or Y amount of cleaners, how many of these vessels do we need.

Dr. SHORT. Uh-huh.

Chairman BAIRD. And so instead of saying we are going to do the cheap, short-term fix, we say we are going to concentrate it, and we are going to figure out how many of these vessels we need, and then with the cap eliminated and the real costs on the amount of dispersants or un-recovered oil. Then that economics comes in, and the oil companies are going to start saying, by golly, we are having to pay a heck of a lot of money for every gallon not recovered. Then we do the math in a different way, and then, again, whether it is

Mr. Costner's device or something else, we are actually trying to absorb this stuff, recover this stuff, and it changes.

And my fear is it is not just about this spill. If we are going to continue to drill anywhere, we need to change the economics of the recovery process, and we need—this business of "we will make this right." No, you will not. We will disperse this problem in space and in time so that you can feel that it is right, but that slogan is bologna. It is bologna. We will recapture this, we will remove it from the environment. That is getting close to making it right.

I just don't think dispersants are making anything right in my mind.

Chairman GORDON. Just a moment. We are going to be having votes soon, so we need to start concluding.

Chairman BAIRD. Yes. We will wrap this up shortly.

Chairman GORDON. This is not a hearing about who is at fault. This is not a hearing about, unfortunately, what do we do now. This really is a hearing about from what we have learned of the problems here what is the type of research, what is the technology that we need to have when this will unfortunately occur again, whether it is small or large or whatever.

So I would like to quickly, again, for our purposes to get your thoughts on where we need to concentrate our research for future technologies? Or—and whether or not Mr. Costner's—I would assume it does work well, but, you know, does it need to be expanded so it has a larger field or by catching the oil earlier? Where do we need to spend our time and money, the Federal Government, right now?

Dr. HAUT. Congressman Gordon, there are four approaches to clean-up. We have touched upon mechanical, chemical, and biological. There is also the thermal part that we haven't touched upon today, and that is the prescribed burns. There is a whole series of research that also needs to be done concerning what is happening during these prescribed burns, what is happening with the light ends of the crude oil that is coming up? The B–Techs, the benzene, thalene, ethylene, xylene that is also contained there. What can we do to model that, to fully understand the health effects into the future of that?

Chairman GORDON. Okay. Well, let me suggest this. Rather than you having—it won't be coming off the cuff because I know you have all thought about this—if you would submit to the committee your recommendations on what are the areas for future research where we could develop the technologies to deal with the kind of problems that we are seeing here presently.

I yield back. Thank you.

Chairman BAIRD. That is a very good suggestion, Mr. Chairman.

Ms. Woolsey, did you want a brief comment or question before we close?

Ms. WOOLSEY. Well, the Chairman closed it up, but I want to add one thing. With this, if we have an interagency committee, I would suggest we add EPA to it and have—not have 14 but have three. And then we still need to have a leader—a lead agency, that is, on top of this.

Mr. Costner, I would like to point out that James Cameron was brought into the room. You should have been there, too, to talk about technology so.

Mr. COSTNER. My wife was having a baby.

Ms. WOOLSEY. Oh. All right. As long as you were invited. Okay. That is all for me.

Chairman BAIRD. Congratulations on the baby.

With that and the gratitude of this committee, again, following up on the Chairman's comments, if you have additional material you feel is important to add that we haven't been able to cover, we would certainly welcome that, and we will take it seriously as we look forward to trying to move forward in some sort of response, not only to this bill but to broad direction in the future.

As is traditional and required, the record will remain open for two weeks for additional statements from members and for answers to any follow-up questions the committee may ask of the witnesses, and with that the witnesses are excused. The hearing is now adjourned with our gratitude. Thank you.

[Whereupon, at 1:23 p.m., the Subcommittee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Mr. Douglas Helton, Incident Operations Coordinator, Office of Response and Restoration, National Ocean Service, National Oceanic and Atmospheric Administration (NOAA)

Questions submitted by Chairman Brian Baird

Q1. To quote Secretary Chu in a June 8th BP Deepwater Horizon press release, "Transparency is not only in the public interest, it is part of the scientific process . . . We want to make sure that independent scientist, engineers and other experts have every opportunity to review this information and make their own conclusions." Scientific freedom, access to data, and transparency are key to informing decisions that benefit society. How are the Federal team and external experts working today to increase access to data and to deliver findings in a transparent manner?

A1. We believe transparency is important and NOAA is working to share its data with the public. We recognize the public's interest in the Federal Government's response to this crisis, and we are committed to providing verified data and information with clarity and transparency. To that end, NOAA has launched a Federal website—*http://www.geoplatform.gov/gulfresponse*—a central online location for detailed near real-time information about the response effort, as well as data collection associated with the Natural Resource Damage Assessment.

Q2. There has been unprecedented response to the Deepwater Horizon Spill, but it is worrisome that we seem to have few metrics to actually measure how effective our response is.

a. For example, how do we know if adding 5,000 gallons of dispersant per day is enough, or if 50,000 gallons are needed? How do we know what quantity is appropriate?

b. What resources or research are needed to establish such metric?

A2. As the Federal On-Scene Coordinator (FOSC) for this spill response, the U.S. Coast Guard is responsible for approving the use of the specific dispersant used from the National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the National Contingency Plan (NCP), Product Schedule. Because of the unprecedented nature of the dispersant operations, the monitoring and constraints on application volumes and methodologies were closely managed. In particular, the Environmental Protection Agency (EPA) specified effectiveness and impact monitoring plans, application parameters, and action thresholds. Any changes to specific BP Deepwater Horizon oil spill dispersant plans required the concurrence of EPA and other Regional Response Team decision agencies, including NOAA, under the NCP.

For all dispersant operations, the FOSC must activate the Special Monitoring of Applied Response Technologies (SMART) Monitoring Program monitoring team to monitor the effectiveness of the dispersant. SMART relies on small, highly mobile teams that collect real-time data using portable, rugged, and easy-to-use instruments during dispersant application and in situ burning operations. Data collected by the SMART program are channeled to the Unified Command to help address critical questions, such as whether the current volume of dispersants being applied is appropriate. NOAA advises the FOSC on when and where dispersants should be used to help determine the most effective and appropriate use of dispersants. The authorization given to BP to use the dispersant on oil present on the surface of the water included specific conditions to ensure the protection of the environment and the health of residents in affected areas.

The BP Deepwater Horizon oil spill has underscored the need for prioritizing research efforts on the environmental impacts of dispersant use, three-dimensional trajectory modeling including effects of dispersant use at the surface and at depth, fate and transport of oil at deep depths, medium and long term forecasting of oil fates, techniques for communicating risk to the public, long-term impacts of oil on shorelines, and improved spill clean-up and restoration methods to expedite ecological recovery.

Q3. What types of research need to be targeted, ecological as well as technology tools, for a more effective response to future spills?

A3. Existing research has resulted in advancing some response technologies; however, more can be done to strengthen our Nation's response capabilities, especially in deep water and Arctic environments. The BP Deepwater Horizon oil spill has un-

derscored the need for prioritizing research on the environmental impacts of dispersant use, three-dimensional modeling, fate and transport of oil at deep depths, medium- and long-term forecasting of oil fates, techniques for communicating risk to the public, and long-term impacts of oil on shorelines, and improved clean-up and restoration methods. A better understanding of how oil behaves at depth and disperses within the water column is needed to improve our predictions of how much oil will come to the surface, how much will stay at depth, and where small droplets that remain at depth will go.

Q4. What types of research infrastructure or funding mechanisms would help us truly advance the fields of oil spill prevention and cleanup? Specifically, what research do we need to invest in to significantly increase oil recovery rates? Is it physically possible to have greater recovery rates?

A4. Although NOAA is not the lead for developing technologies to advance the fields of oil spill prevention and cleanup, NOAA supports investment in research that would increase recovery rates. Most marine spills have recovery rates of 10 to 20 percent or less.[1] Recovery rates depend on the type of oil, size of spill, type of shoreline, weather conditions, and speed of response. As a natural resource trustee that works with co-trustees to assess and restore natural resources injured by an oil spill, the most effective performance metric is not always the oil recovery rate, but rather metrics that seek to reduce environmental harm and expedite recovery.

Currently, there exists a research infrastructure that is articulated in Section 7001 of the Oil Pollution Act of 1990 (33 USC 2761). The Oil Pollution Control Act established an Interagency Coordinating Committee on Oil Pollution Research (ICCOPR), chaired by the U.S. Coast Guard, to coordinate a comprehensive program of oil pollution research and development among 13 Federal agencies in cooperation and coordination with industry, academia, research institutions, state governments, and other nations. NOAA is a participant in the ICCOPR.

Q5. What additional challenges would NOAA face is the Deepwater Horizon spill had occurred in the Arctic?

A5. In general, there are many challenges to operating in the Arctic, including accessibility, remoteness of operations, communications, distance from support infrastructure for additional supplies and aid (beyond the resources and personnel that an operator is required to have on-site to respond to a "worst case" discharge), and unpredictable weather (including the severe nature of ice cover, winds, waves and other environmental conditions). The presence of ice in Beaufort Sea, Chukchi Sea, Bering Sea, and northern Bristol Bay from mid-September to late May effectively reduces the field season to only three months. Even in summer, ice and weather conditions can make day-to-day operations uncertain. The sparse or outdated nature of existing charts, the lack of accurate latitude, longitude, and elevation coordinates, and the lack of physical infrastructure (e.g. access, piers, utilities, roads, and other transportation) pose additional challenges and risks for those conducting work in this region. Consequently, operational costs are significantly higher than in the contiguous U.S. because of such factors as the need to compensate for infrastructure limitations, increased fuel and supply requirements, increased technological demands due to environmental conditions, and the costs of lost operational days due to weather.

With regard to oil spill response, injury assessment, and restoration, unlike the location of the BP Deepwater Horizon oil spill, the Arctic presents logistical support challenges (as noted above) for salvage and emergency response. The presence of ice during a potential oil spill in the Arctic presents additional layers of complexity that could severely limit responders' ability to conduct effective response operations, as compared to the open water conditions of the BP Deepwater Horizon oil spill. It is unclear how well the spill response equipment currently being deployed in the Gulf of Mexico would perform under the harsh environmental conditions in the Arctic. In addition, we understand much less about the natural resources in the Arctic than the Gulf of Mexico. Specifically, we lack baseline information and specific knowledge regarding the risks oil spills present to Arctic resources, or the best practices to restore Arctic resources.

Q6. There is a vast resource of knowledge and experience amongst spill response professional across the globe. And the International Spill Control Organization was incorporated in London in 1984 as a non-profit organization dedicated to improving worldwide preparedness for oil and chemical spill response

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[1] *Etkin, D.S. Worldwide Analysis of Marine Oil Spill Cleanup Cost Factors. Proceedings of the Arctic and Marine Oilspill Program Technical Seminar, June 2000*

a. How are we utilizing technologies from the international community into our Federal oil spill response and how could this be improved upon?

b. What specific measures is the United States taking to keeping abreast of new technologies or advance technologies?

A6. The United States is a leader in oil spill prevention, control, mitigation, restoration, and recovery, however, we continue to learn much from the experience of nations around the world. The Unified Command has accepted offers of international assistance to the BP Deepwater Horizon oil spill from more than 20 countries and international organizations. Offers include standard response supplies such as containment boom and sorbents as well as advanced technologies such as high speed/high volume skimmers. NOAA is currently employing facets of deep water oil spill models that were developed in part from the findings of the MMS Deep Spill Joint Industry Research Project done in 1999–2000 with international participation.

NOAA is able to keep abreast of new response technologies and best practices through academic partnerships and by actively participating in and benefiting from the work of the International Maritime Organization (IMO) Protocol on Preparedness, Response and Cooperation to Pollution Incidents by Hazardous and Noxious Substances (OPRC–HNS) Working Group. This includes a large conference held this past spring in Australia that included lessons learned from their recent deepwater drilling accident, the Montara Platform Spill. That conference, Spillcon 2010, was held in Melbourne. Australia from 12–16 April 2010, approximately 10 days before the BP Deepwater Horizon oil spill. NOAA has supported many international research efforts in the past, particularly in regards to oil behavior in the arctic climate.

Questions submitted by Representative Bob Inglis

Q1. Some have suggested that we transition our regulatory system from the current prescriptive-based framework to a "performance-based framework," noting that this is a trend among safety regulators worldwide, particularly in Norway. The argument is that the prescriptive-based regulatory approach tends to create a passive attitude among companies, which aim to pass regulatory inspections instead of focusing on system performance.

a. What is your reaction to this general approach?

b. Could it potentially improve drilling safety without adding excessive regulatory costs and other burdens on producers?

c. Is the Federal Government considering such an approach?

A1. NOAA defers to the Department of the Interior for response to this question, which is outside NOAA's area of expertise. NOAA is not a regulatory agency for oil and gas exploration and production. NOAA's role in the BP Deepwater Horizon oil spill is to provide technical and scientific support to the National Incident Commander, to conduct a natural resource damage assessment pursuant to the Oil Pollution Act of 1990 with co-trustees to assess and restore natural resources injured by the oil spill, represent the Department of Commerce in spill response decision-making activities through the National Response Team.

Q2. At last year's hearing, Mr. Edinger of the California Fish and Game listed in his testimony four technology areas that required improvements: reduced visibility or nighttime oil detection capabilities, containment in high velocity currents, greater use of chemical dispersants, and ship simulators for ship pilots to improve maritime navigational safety.

a. Given these suggestions, what, if any, progress has been made in the past year improving these technology areas?

A2. The four areas of technology development identified by Mr. Edinger last year are still relevant today. NOAA defers to the U.S. Coast Guard (USCG) regarding information on the advancements of these technologies over the past year. It is our understanding that the USCG has done some additional work on fast water booming strategies, and there are some promising remote sensing applications, but there is still much that could be done to advance these efforts.

Q3. What new technologies have been identified as having the potential for impact on oil spill cleanup methods and what is the current status of these technologies, both from a research and development standpoint and for current implementation in the BP spill?

A3. This question is outside NOAA's area of expertise as NOAA's role in the BP Deepwater Horizon oil spill is to provide scientific support to the Unified Command and National Incident Commander, to conduct a natural resource damage assessment pursuant to the Oil Pollution Act with co-trustees to assess and restore natural resources injured by the oil spill, and represent the Department of Commerce in spill response decision-making activities through the National Response Team.

Q4. In your testimony, you list ten areas of research that are needed to improve spill response effectiveness. How many of these research areas were being actively pursued before the current incident in the Gulf? Will you please provide the Committee with a list of the research activities and funding outlays NOAA has engaged in for the time since last June and up until this April?

A4. The Oil Pollution Act grants NOAA the authority to carry out research and development. Past research focused on spill preparedness, response, assessment, and implementation of optimum oil recovery strategies. For example, past efforts facilitated the development of the Environmental Response Management Application (ERMA). ERMA has been adapted for use in the BP Deepwater Horizon oil spill and was launched by NOAA to provide data and information with clarity and transparency. This Federal website serves as a central online location for detailed near real-time information about the response as well as data collection associated with the Natural Resource Damage Assessment (*http://www.geoplatform.gov/gulfresponse/*).

As the BP Deepwater Horizon oil spill is demonstrating, there is a need to understand how oil behaves and disperses within the water column when released at deep depths. The enhancement of three-dimensional models will improve our ability to predict the movement of oil at depth and allow us to direct precious resources to validate the model's trajectory. In FY 2010, Congress appropriated $20.1 million for the Office of Response and Restoration base, which included $1.4 million to build and maintain state-of-the-art three-dimensional models to predict contaminant movement in the environment 24 hours a day, 7 days a week. Specifically, $525,000 of the enacted funds are being used to support improved oil spill modeling through the development of an improved three-dimensional oil spill modeling capability and support for improvements to other innovative tools. NOAA is also working to implement FY 2010 funds to enhance three-dimensional models.

Q5. Last year when you testified in front of this Committee, you stated that, "Most of the models that we have focus on the surface layer, how the oil will move. We have less rigorous models predicting how the oil will move once it is dissolved into the water column?

a. In this admitted research gap, what advancements had been made from the time of your testimony up until the explosion on the Deepwater Horizon on April 20th of this year?

b. You talked about surface models, and models predicting what will happen once oil is dissolved in the water column. Up until two months ago, had there been any research on models for predicting the movement of oil from the sea floor to the surface? Do the models include the use of dispersants on the surface and sea floor?

A5. NOAA's surface trajectory models predict where the oil on the surface is going based upon wind, currents, and other processes, and visual overflights validate where it is now. As the BP Deepwater Horizon oil spill is demonstrating, there is a need to understand how oil behaves and disperses within the water column when released at deep depths. The emerging advancement in modeling three-dimensionally can greatly enhance response operations and mitigation efficacy. In FY 2010, Congress appropriated $525,000 to NOAA's Office of Response and Restoration to support improved oil spill modeling through the development of an improved three-dimensional oil spill modeling capability and support for improvements to other innovative tools. As this is the first year for appropriations, implementation is underway and therefore we have not made specific advancements since I testified before the Committee last year.

In regards to models that can predict the movement of oil from the sea floor to the surface, there has been work on the Comprehensive Deepwater Oil and Gas Blowout Model (CDOG), developed by Clarkson University researchers. This model simulates the behavior of oil and gas accidentally released from deepwater and helps predict whether gases will come to the surface, where the oil and gas will surface, and in what concentrations. In deepwater, the ultra-high pressure and cold temperature causes phase changes (changes from gas to liquid to solid states) in the released oil. These physical changes, combined with deepwater currents in some re-

gions, present extraordinary challenges for modeling jets/plumes from deepwater oil and gas blowouts. The CDOG model is three-dimensional and incorporates the phase changes of the released material, associated changes in thermodynamics, and the resulting impact on the hydrodynamics of the jet/plume. The CDOG model was integrated into the NOAA's trajectory model, the General NOAA Operational Modeling Environment, or GNOME, through a partnership with the Coastal Response Research Center at the University of New Hampshire. NOAA is using the GNOME model to support the response to the BP Deepwater Horizon oil spill by predicting when oil leaked at depth will reach the surface and, once surfaced, where and how fast the oil may travel from there. The currently available models do not take into account the use of dispersants.

Q6. In NOAA's role as the conduit of scientific information to the Federal On-Scene Coordinator, did NOAA inform the Coast Guard of the results of EPA's scientific testing of dispersants, or did EPA provide this information directly to the Coast Guard? How do the roles mandated by the Oil Pollution Act of 1990 help with the organization of the National Response Team?

A6. EPA provided the results of its toxicity testing of dispersants directly to the Federal Unified Command, which is led by the U.S. Coast Guard.

Given NOAA's role in the BP Deepwater Horizon oil spill is to provide technical and scientific support to the National Incident Commander, we did review the results of the EPA dispersant studies and continue to actively consult with the National Incident Commander to determine operational efficiency and effectiveness of dispersant use, both at the surface and sub-surface.

OPA, in Title IV, Subtitle B—Removal, calls for the development of the National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the NCP. The NCP is the Federal Government's blueprint for responding to both oil spills and hazardous substance releases. The NCP also sets out the structure and functions of the National Response Team (NRT), which is co-chaired by U.S. Coast Guard (USCG) and Environmental Protection Agency (EPA). The NRT's purposes are to develop a national response capability, promote overall coordination among the hierarchy of responders and contingency plans, and to provide the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants. The NRT consists of representatives from: USCG; EPA; Federal Emergency Management Administration; Department of Defense; Department of Energy; U.S. Department of Agriculture; Department of Commerce, through NOAA; Health and Human Services; Department of Interior; Department of Justice; Department of Labor; Department of Transportation; Department of State; Nuclear Regulatory Agency; and General Services Administration. Each of these agencies has expertise to lend to the coordinated response to a spill, in addition to other responsibilities, such as natural resource damage assessment and restoration by the natural resource trustees.

For a coastal oil spill, the USCG is the FOSC and has the primary responsibility for managing response and clean-up activities in the coastal zone. During an oil spill, NOAA's Scientific Support Coordinators deliver technical and scientific support to the USCG. NOAA's Scientific Support Coordinators are located around the country in USCG Districts, ready to respond around the clock to any emergencies involving the release of oil or hazardous substances into the environment.

Q7. As NOAA's role in developing the damage assessment, you state in your testimony that NOAA has been collecting data that will be used to determine what natural resources have been compromised. Further, you state that several technical working groups are gathering existing scientific information and developing a baseline.

a. Given NOAA's mission in protection and restoration, why doesn't NOAA already keep baseline data on natural resource values for all U.S. coasts on hand?

b. Is such a collection even feasible? Would updates be necessary? How often would these baselines be updated?

A7. The collection of such information at a national scale would be tremendously challenging and resource intensive. NOAA's responsibilities in the coastal and ocean environment are articulated through a number of laws. NOAA does not have a specific mandate to collect baseline data on natural resources for all U.S. coasts.

However, NOAA has directly conducted or sponsored numerous systematic, long-term monitoring studies thoroughly analyzing the toxic effects of contaminants, such as spilled petroleum, on endemic coastal and marine species in the Gulf of Mexico. For example, since 1986, the NOAA Mussel Watch program has managed the long-

est running estuarine and coastal pollutant monitoring effort conducted in the United States, including more than 100 sites from Texas to South Florida. At each site, more than 140 chemical contaminants, chosen through consultation with experts and scientists from academia and government, are measured and have served as a baseline for hundreds of scientific journal articles and technical reports since the program's inception. In response to the BP Deepwater Horizon oil spill, three teams of NOAA scientists and partners were mobilized to the Gulf to collect oyster, sediment, and water samples in advance of oiling in coastal Louisiana, Mississippi, Alabama, and Florida; thus, providing valuable pre-spill contaminant data and continuing the unbroken quarter-century record of the status and trends of chemical contaminants in the Gulf of Mexico.

Given the spatial extent of this spill and the biological diversity of the Gulf of Mexico, NOAA is working closely with other Federal agencies, including the Department of the Interior as a natural resource co-trustee, as well as all five Gulf Coast states and academic partners to gather existing historical base-line information and pre- and post-spill data for the Natural Resource Damage Assessment.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Captain Anthony Lloyd, Chief, Office of Incident Management and Preparedness, United States Coast Guard

Questions submitted by Chairman Brian Baird

Q1. To quote Secretary Chu in a June 8th BP Deepwater Horizon press release, "Transparency is not only in the public interest, it is part of the scientific process . . . We want to make sure that independent scientists, engineers and other experts have every opportunity to review this information and make their own conclusions." Scientific freedom, access to data, and transparency are key to informed decisions that benefit society. How are the Federal team and external experts working today to increase access to data and to deliver findings in a transparent manner?

A1. The Unified Area Command and National Incident Commander (NIC) are employing various means to inform and solicit ideas from the public, and to leverage the domestic and international community of scientists, engineers, academia and experts.

The Flow Rate Technical Group (FRTG), led by the Director of the U.S. Geological Survey (USGS), is comprised of Federal scientists, independent experts, and representatives from universities around the country. The Group's activities generally follow USGS procedures for data quality and transparency. Data is made publicly available through publication and dissemination of the FRTG science products, and much of the original data is posted on a DOE-hosted web site *http://www.energy.gov/open/oilspilldata.htm*. All FRTG science products undergo independent peer-review before release. As mandated by Federal law and policy, data that is proprietary or business sensitive is not available to the public. USGS is also involved in many other science activities related to the Deepwater Horizon oil spill. Policies for planning and conducting data collection and research to ensure that scientific goals are achievable, in addition to scientific ethics and peer review, are outlined in the Survey Manual *http://www.usgs.gov/publishing/policies.html*.

Additionally, in an effort to ensure the best available methods are used in the ongoing response to the Deepwater Horizon oil spill, the NIC established the Interagency Alternative Technology Assessment Program (IATAP) working group to collect and review oil spill response solutions from scientists and vendors. The Coast Guard's Research and Development Center (RDC), in collaboration with interagency partners, to include the Environmental Protection Agency, National Oceanic and Atmospheric Administration, and Department of Interior, issued a Broad Agency Announcement on *www.FedBizOpps.gov* calling for the submission of white papers that cover the following topics: oil sensing improvements to response and detection; oil wellhead control and submerged oil response; traditional oil spill response technologies; alternative oil spill response technologies; and oil spill damage assessment and restoration. The IATAP and the RDC screen submissions based on technical feasibility, potential effectiveness and deployment capability.

There is also an abundance of information posted at the following websites:
http://www.deepwaterhorizonresponse.com RestoreTheGulf.gov.

Q2. What types of research need to be targeted, ecological as well as technology tools, for a more effective response to future spills?

A2. Prior to the Deepwater Horizon spill, the Coast Guard's spill-related research plan included the following focus areas:

- High Latitude (Arctic Region) Spill Response;
- Submerged Oil Response;
- Existing Wrecks Response; and
- Spill Response Analysis and Tools.

Subsequent to the current spill, the Coast Guard adjusted this research plan to include a category titled "Deep Water Oil Spill Response." This category will include items such as:

- Improved methods for removing and handling emulsified oil;
- Use of biodegradable materials to bind oils and reduce exposure to birds and other shoreline flora and fauna;
- Improve the efficiency of removing and treating oil from sandy beaches while minimizing sand removal;

- Improve the mass handling/disposal of oiled debris/sand;
- Advance the capability and efficiency of skimmers and booms in the open sea environment including handling of recovered oil;
- Detection and extraction of subsurface oil in the water column and;
- The use and effectiveness of dispersants on subsurface oil.

The Coast Guard will continue to apply the lessons learned from the current spill to make any further adjustments to this plan.

Q3. What types of research infrastructure or funding mechanisms are needed?

A3. The Coast Guard believes that it has the appropriate and sufficient infrastructure and funding mechanisms to address this research plan.

Q4. What additional challenges would we face if the Deepwater Horizon spill had occurred in the Arctic?

A4. We would expect to face substantial response challenges for a Deepwater Horizon-type of spill in the Arctic. For example, even if the same number of assets and infrastructure were applied to an Arctic spill as have been used in the Gulf of Mexico, it is likely that much larger quantities of spilled oil would end up in the sediments and on the shoreline where it would reside in the environment for much longer periods of time than in the Gulf Due to the colder conditions and shorter days, natural weathering processes for oil would be greatly reduced. These same conditions would also impact the operational effectiveness of response equipment and personnel. Most of the existing booms and skimmers have been constructed for operation in temperate environments rather than the extremes of the Arctic. Sea states in Arctic waters typically exceed the known operational limits of existing skimmers and booms so that on-water recovery and in situ burning would be much less effective if it could be employed at all. Chemical dispersion is much more effective in temperate waters than in arctic waters and oil trapped in ice can't be skimmed. Biological activity is reduced in colder climates and therefore would not support extensive biodegradation of spilled oil as a possible mitigation mechanism. Finally, the Arctic region has sparse infrastructure to support the buildup of resources needed for a response. Not only are resources scarce, but so too are facilities where those resources can be marshaled and organized for deployment and launching.

Q5. There is a vast resource of knowledge and experience amongst spill response professionals across the globe. And the International Spill Control Organization was incorporated in London in 1984 as a non-profit organization dedicated to improving worldwide preparedness for oil and chemical spill response.

How are we utilizing technologies from the international community into our Federal oil spill response, and how could this be improved upon?

What specific measures is the United States taking to keeping abreast of new technologies or advice technologies?

A5. The U.S. oil spill response community continually shares information, best practices, and lessons learned with their international counterparts. This interaction occurs when both groups mutually support each other in incidents, during training, or when they attend the Triennial International Oil Spill Conferences (Spillcon in Australia 2007, International Oil Spill Conference in North America 2008, and Interspill 2009 in Europe). One of three conferences is held annually on a rotating basis.

In an effort to ensure that the best available methods are used in the administration's ongoing response to the Deepwater Horizon oil spill, the National Incident Commander (NIC) directed the establishment of the Interagency Alternative Technology Assessment Program (IATAP) working group to collect and review oil spill response solutions from scientists and vendors from around the globe. The Coast Guard's Research and Development Center (RDC), in collaboration with interagency partners, including the Environmental Protection Agency, National Oceanic and Atmospheric Administration, and Department of Interior, issued a Broad Agency Announcement on *www.FedBizOpps.gov* calling for the submission of white papers that cover the following topics: oil sensing improvements to response and detection; oil wellhead control and submerged oil response; traditional oil spill response technologies; alternative oil spill response technologies; and oil spill damage assessment and restoration. The IATAP and the RDC screen submissions based on technical feasibility, potential effectiveness and deployment capability.

Finally, the NIC has also established an interagency workgroup focused on offers of foreign assistance. This workgroup is responsible for screening and facilitating for

the Federal On-Scene Coordinator offers of equipment, personnel, expertise, and technology from the international community.

The U.S. oil spill response community interacts in a variety of venues where the latest cleanup technologies and techniques are demonstrated. Academia, industry, and Federal responders attend numerous workshops and conferences. Several major conferences host technology exhibitions and professional presentations. These conferences include:

Annual Clean Gulf Conference

Biennial Fresh Water Spills Symposium

Annual Inland Spills Conference

Biennial Clean Pacific Conference (inaugural conference held in September 2007)

Triennial International Oil Spill Conferences (Spillcon in Australia, International Oil Spill Conference in North America 2008, and Interspill 2009 in Europe)

At these conferences, Federal, state, and non-government officials from around the world display state-of-the-art oil spill response equipment and products. They also exchange information on the latest advances in spill prevention, preparedness, response, and restoration.

In addition, Federal and industry responders exchange information at various meetings throughout the year facilitated by Spill Control Association of America, Association of Petroleum Industry Cooperative Managers (APICOM), and the American Salvage Association (ASA).

Q6. What does the Coast Guard need to do, as Chairman of the Interagency Coordinating Committee on Oil Pollution Research, to truly improve our ability to respond to oil spills through research and technology?

A6. Annual oil spill totals have dropped dramatically since new regulations took effect in 1990 as a response to the Exxon Valdez tanker accident. Part of the reason for this significant decrease in spill numbers is due to the success of new prevention technologies developed and implemented, such as the design of double-hulled tankers. Lessons learned from this accident helped to shape 16 major research areas for the 1997 Interagency Oil Pollution Research and Technology Plan. Research conducted in these areas over the past decade has advanced oil spill cleanup techniques and strategies. These advances are currently being used in the Deepwater Horizon Response. For example, in situ burning, dispersants, vessel of opportunity skimming systems, and spill fate and behavior modeling, have all been researched heavily over the past decade by members of the ICCOPR. Consequently, the 1997 Interagency Oil Pollution Research and Technology Plan has proven to be an important strategic guidance document for oil pollution research.

Prior to the Deepwater Horizon spill, the ICCOPR had begun the process of revising the 1997 Interagency Oil Pollution Research and Technology Plan. The ICCOPR will need to closely examine the lessons learned from the current spill to better update the research strategies needed for the next decade. Just as the Exxon Valdez established a suite of needed research areas, the Deepwater Horizon accident will identify new problems and response challenges that will guide the response community for the next decade. The ICCOPR's updated research plan needs to reflect this. In addition, the ICCOPR will need to continue examining what response challenges will be presented by the Arctic and other sensitive ecosystems, which are facing increased oil exploration and transport activities.

The ICCOPR recognizes that progress in oil pollution research best occurs through continued collaboration between academia, industry, and government. Funding was initially authorized and appropriated in the early 1990s for the ICCOPR to award research grants to universities. The ICCOPR will continue to develop strategies for ensuring that universities, industry, and the government have a common awareness and collaboration concerning ongoing research.

Questions submitted by Representative Bob Inglis

Q1. Will you please give the Committee a brief overview of Coast Guard's role as chair of the Interagency Coordinating Committee for research and development? How frequently does the Interagency Coordinating Committee meet? As the Chair of the Interagency Coordinating Committee, does Coast Guard assess research gaps and ask the appropriate agencies with expertise in those areas to look into these gaps?

A1. The Oil Pollution Act of 1990 (OPA 90) designates the Coast Guard as the chair of the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR). The role of the Coast Guard is to ensure the provisions of Title VII of OPA 90 are addressed by the ICCOPR. This includes the creation of a research and technology plan, the execution of Port Demonstration Projects, the awarding of Regional Grants, and the continued coordination and awareness of funded oil pollution research projects. The chair is also responsible for providing a biennial report to Congress on the progress of these activities.

The ICCOPR continues to serve as a forum for its Federal members to coordinate and maintain awareness of ongoing oil pollution research activities. Members of the ICCOPR interact in a number of venues, including conferences, workshops, meetings of the National Response Team Science and Technology Subcommittee, and through formal meetings. The ICCOPR originally met on a quarterly basis. In recent years, formal meetings of the Interagency Committee are typically scheduled on a semi-annual basis.

Research under the ICCOPR is carried out individually by each agency within the committee. Each agency decides which specific research projects they will conduct. The goal of the member agencies is to align their respective projects with the oil pollution R&D focus areas specified in the ICCOPR's 1997 Oil Pollution Research and Technology Plan. The 1997 Plan highlights research need areas and directs research priorities for each member agency for R&D planning purposes. The ICCOPR, including the Coast Guard, examines lessons learned from incidents or issues encountered during conferences and workshops to determine where new research areas are needed. The plan revision the ICCOPR is currently conducting will incorporate many lessons learned from the Deepwater Horizon response.

Q2. The Oil Pollution Act of 1990 authorizes the Coast Guard to use more than $20 million from the Oil Spill Liability Trust Fund to use for research purposes. However, in the last several years, Coast Guard has only been using $0.5 million from the Fund for research purposes.

How is Coast Guard managing to coordinate the Interagency Committee set up in the Oil Pollution Act and conduct its own research with this amount of funding?

What research has the Coast Guard been able to conduct in the past five years with $0.5 million per year? What technology or best practices have resulted from this research?

Given the importance of research in preparing for future oil spills, does the Coast Guard plan to step up its role in the research and development of new technologies and best practices? If so, how will this be accomplished?

A2. $0.5 Million of funding appropriated for Coast Guard Research, Development, Test, and Evaluation (RDT&E) is derived from the OSLTF. The $0.5 million that the Coast Guard receives from the OSLTF is not specifically used by the Interagency Committee. Rather, the funding is used by the Coast Guard's Research, Development, Test, and Evaluation (RDT&E) Program to execute a research plan developed in conjunction with the Coast Guard Program Office that chairs the Interagency Committee. The RDT&E Program augments the $0.5 Million with a limited amount of additional funding from the RDT&E appropriations.

Coast Guard RDT&E research and focus areas are derived from requirements and capability gaps articulated by Coast Guard program offices as well as through input from other government agencies and, to a certain extent, private industry. Based on this information, the past five year's RDT&E Program efforts have focused on development of capabilities to detect and predict oil and hazardous materials spills, dispersant research, and submerged/heavy oil detection and collection. In fiscal year 2010, the program began research into development of capabilities to detect, contain and recover spills in ice-choked waters (Arctic and Great Lakes). The results of the RDT&E Program's initiatives include the following:

Laser Fluorometery: Compared various sensing technologies that can locate oil on or just below the surface of the water. Evaluated laser fluorometers and frequency-scanned radiometers for cost-effectiveness. Determined that the most promising technology(ies) were effective but cost prohibitive.

HAZMAT Spill Behavior and Trajectory Modeling: In conjunction with National Oceanic and Atmospheric Administration (NOAA), provided an enhanced Coast Guard standard model suite called CAMEO Front End, which was able to process more sophisticated Hazardous Material (HAZMAT) spill scenarios including effects on plumes as they float over water, development of a simple river dilution model to calculate chemical concentrations, and an evaluation of an exist-

ing oil tool for adaptation to chemical spills. This enhanced model was implemented by NOAA.

Dispersant Research: Cosponsored National Academy of Science (NAS) Study to evaluate the change in the state-of-the-art of dispersant science and toxicology since the NAS published its last report in 1989. Reviewed protocols developed by NAS to address monitoring and toxicity issues with new equipment and provided recommendations for guidelines on operational use of dispersants that address all stakeholder concerns, and identified further research needed to evaluate the safe use of dispersants for near-shore oil or large offshore blowout spills.

Submerged Heavy Oil (Type-V): Developed a blueprint for method(s) within the oil response industry to detect and recover heavy oil located on the sea bottom. Leveraged industry to develop three proofs of concept for heavy oil detection technologies and develop prototypes. Currently, recovery proofs of concept are under development. Prototype devices for the recovery of heavy oil will then be developed. Note that the work has not yet focused on detection/removal at the depths associated with the current spill.

Oil-in-Ice: Work has just begun in this area, and the emphasis includes the following: detection of oil-in-ice and under ice, tracking/monitoring of oil in ice, decision tools for Federal On-Scene Coordinators (FOSC), and removal/recovery of oil in ice.

Subsequent to the Deepwater Horizon Oil Spill, the Coast Guard modified this plan to include research items based on preliminary lessons learned from the current spill such as

- Improved methods for removing and handling emulsified oil;
- Use of biodegradable materials to bind oils and reduce exposure to birds and other shoreline flora and fauna;
- Improved efficiency of removing and treating oil from sandy beaches while minimizing sand removal;
- Improvements in the mass handling/disposal of oiled debris/sand;
- Advance the capability and efficiency of skimmers and booms in open sea environment including handling of recovered oil;
- Detection and extraction of subsurface oil in the water column; and
- Use and effectiveness of dispersants on subsurface oil.

Q3. The printed record for the hearing held last year in this Committee included the Oil Pollution Research and Technology Plan that was issued in 1997. Does Coast Guard have any intention of updating this plan? If so, when can we expect to see this report?

A3. Yes, the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR) began the process of revising the 1997 Oil Pollution Research and Technology Plan in the fall of 2009. Currently, the ICCOPR is conducting several public meetings, which are advertised in the Federal Register, to receive public comment on the priorities of oil pollution research to incorporate in the plan revision. The ICCOPR is also gathering lessons learned from the Deepwater Horizon oil spill response to incorporate in the plan update as well. The revision of the plan will take place over the next two fiscal years, as specified in the latest ICCOPR Biennial Report.

Q4. Last June, this Committee held a hearing to discuss H.R. 2693, the Federal Oil Spill Research Program Act. In this legislation, NOAA would replace the Coast Guard as the chair of the Federal Oil Spill Research Committee.

Do you think this would be an appropriate change in leadership?

If you believe Coast Guard is better suited to chairing the Interagency Coordinating Committee for research and development, why has there been no plan in 13 years?

A4. The Coast Guard has served as the chair of the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR) since its inception. By law, the Coast Guard is the lead Federal agency for ensuring that spills in coastal waters are effectively managed. NOAA currently delivers detailed research ideas and initiatives through the ICCOPR process, and the Coast Guard is positioned to harmonize R&D objectives with statutory oil spill response mandates and best operational practices as the ICCOPR chair.

Title VII of the Oil Pollution Act of 1990 did not mandate a revision timeline for its Oil Pollution Research and Technology Plan requirement. The most recent plan

was developed by the ICCOPR as a strategic guidance document for Federal oil spill research and development envisioned over the next decade. Prior to the Deepwater Horizon oil spill, the ICCOPR determined the need for a plan revision. The ICCOPR has scheduled several public meetings, which will be advertised in the Federal Register, to receive public comment on the priorities of oil pollution research. This input will be used by the ICCOPR as it continues its revision of the 1997 Plan. The ICCOPR is also gathering lessons learned from the Deepwater Horizon oil spill response to incorporate into the plan update. The revision of the plan will take place over the next two fiscal years as specified in the latest ICCOPR Biennial Report for Fiscal Years 2008 and 2009.

Q5. Some experts have suggested that we transition our regulator system from the current prescriptive-based framework to a "performance -based framework," noting that his is a trend among safety regulators worldwide, particularly in Norway. The argument is that the prescriptive-based regulatory approach tends to create a passive attitude among companies, which aim to pass regulatory inspections instead of focusing on system performance.

What is your reaction to this general approach?

Could it potentially improve drilling safety without adding excessive regulatory costs and other burdens in producers?

Is the Federal Government considering such an approach?

A5. Performance standards express requirements in terms of desired outcomes rather than specifying the means to those ends. The trade-offs of using performance based regulations rather than prescriptive regulations can include high initial compliance costs to the regulated parties due to the investment needed to identify and evaluate the most cost-effective alternatives for a specific application. Not all companies have the capacity to do this type of customized development, particularly in industries dominated by small companies that prefer clear, direct, and simple regulations. In addition, using performance based regulations places a huge burden on agency reviewers and field enforcement personnel because every company's solution to regulatory requirements might be custom-made and detracts from a consistent enforcement approach. Prescriptive requirements are easier to implement and enforce.

All leasing and operations on the Federal offshore are governed by laws and regulations that are designed to ensure safe operations and preservation of the environment, while balancing the Nation's needs for energy development. The Bureau of Ocean Energy Management Regulatory and Enforcement (BOEMRE), within the Department of the Interior, is the lead Federal regulatory agency for enforcing compliance with Outer Continental Shelf drilling regulations and periodically updates rules to reflect advancements in technology and new information.

Before recommending Federal regulatory action, an agency must demonstrate that the proposed action is necessary. Executive Order 12866 requires agencies to conduct a regulatory analysis for regulatory actions; OMB Circular A–4 provides guidance to Federal agencies on the development of regulatory analysis. Regulatory analysis is a tool agencies use to anticipate and evaluate the likely consequences of rules; the motivation is to (1) learn if the benefits of an action are likely to justify the costs, or (2) discover which of various possible alternatives would be the most cost-effective. The consideration of performance standards rather than design standards is one of several alternative regulatory actions evaluated during rulemaking development.

Coast Guard regulations in appropriate instances already use performance standards (for example, the vessel and facility response plan requirements at 33 CFR parts 154 and 155) and are replete with opportunities for regulated parties to request and justify alternate means of compliance. In countless cases, the Coast Guard has accepted alternatives that meet the performance objectives of prescriptive regulations. In our regulations, we seek a balance that accommodates the needs of sophisticated parties capable of pushing the technological envelope and other parties that operate best when given simple and predictable regulations to follow. In all cases, stakeholders are given the opportunity to influence the outcome of rulemaking proposals through public comment.

Q6. At the last year's hearing, Mr. Edinger of the California Fish and Game listed in his testimony four technology areas that required improvement; reduced visibility or nighttime oil detection capabilities, containment in high velocity currents, greater use of chemicals dispersants, and ship simulators for ship pilots to improve maritime navigational safety.

Given these suggestions, what, if any, progress has been made in the past year improving these technology areas?

A6. The Interagency Coordinating Committee on Oil Pollution Research (ICCOPR) is required to submit biennial reports on activities carried out under Section 7001 of the Oil Pollution Act of 1990. The latest report summarizes activities carried out and ongoing in fiscal years 2008 and 2009. The 2008 and 2009 report documented that extensive research was conducted for both chemical dispersants and oil detection capability technology areas. However, research in these two subject areas has been occurring for many years previous to the latest biennial report. In the past 13 years, ICCOPR member agencies have executed a number of projects related to fast water booming response, dispersants, and oil spill modeling and detection.

Although the ICCOPR members have not pursued specific research initiatives pertaining to ship simulators as a way to improve maritime navigational safety, maritime training facilities throughout the country have invested heavily in this concept. There are five advanced simulators at different facilities that provide invaluable safety navigation training to professional mariners, to include the Maritime Pilots Institute in Covington, LA, the Pacific Maritime Institute in Seattle, WA, the Maritime Professional Training Center in Fort Lauderdale, FL, the Massachusetts Maritime Academy in Buzzards Bay, MA, and SUNY Maritime in Throggs Neck, NY.

Q7. What are the technologies have been identified as having the potential for impact on oil spill cleanup methods and what is the current status of thee technologies, both from a research and development, standpoint and for current implementation in BP spill?

A7. The Coast Guard Research and Development Center (RDC), in partnership with the Interagency Alternative Technology Assessment Program (IATAP), have currently identified another thirty-three technologies for further evaluation. Since these evaluations fall within the Broad Agency Announcement process and contracting actions may be pending, only the technology groups are releasable. The technology areas are:

Traditional Oil Spill Response Technologies -6

Oil Sensing Improvements to Response and Detection -15

Alternative Oil Spill Response Technologies -2

Oil Spill Damage Assessment and Restoration -8

Wellhead Control and Submerged Oil Response -2

The IATAP has so far identified seven technologies as having immediate potential for impact on oil spill clean-up methods. Of these technologies, the Federal On-Scene Coordinator (FOSC) is immediately procuring two technologies for operational testing, and evaluating several others against the operational gaps, requirements and existing capabilities to determine the feasibility of implementation. Details on these technologies are described below with the first two currently under procurement.

Traditional Oil Response Technologies

1. A two wheel tractor with sand cleaner attachment that can remove debris from the sand to a depth of 8 inches. (also an Oil Spill Damage Assessment and Restoration item)
2. An absorbent sponge and its constituent polymers designed to filter, absorb, encapsulate, and solidify petroleum hydrocarbons and other contaminants on contact, while not absorbing water. The material can be made into two different types of booms, Emergency Absorbent Line Skimmer Boom and Emergency Tubular Oil Absorbent Boom.
3. An oil containment boom with added tension member that is combined with closed cell foam flotation. This oil and minimal debris barrier is typically for protected water and fast current.
4. Vacuum equipment that incorporates the ability to vacuum and pressure offload oil and other liquids or sludge.

Alternative Oil Response Technologies

1. A rapid deployment flood wall is a protective sand filled barrier. It is used to contain the oil spill materials at the shoreline and prevent the oil from migrating further on to the beach heads, wetlands, or other ecological habi-

tats. Once the oil is captured, it can be removed by a skimmer or vacuum machinery furnished by others.

Oil Spill Damage Assessment and Restoration

1. Recycling oil-contaminated sands, waters, and soils, and equipment, in particular absorbent booms rather than incineration or landfill. Proposed recycling mitigates solid waste in landfills, costs less than incineration, and creates employment opportunities in the disaster area.

The RDC is currently conducting an extensive efficacy evaluation of the A WHALE, which is a very large tanker that has been modified as a skimmer. The RDC is also involved in the drafting, observing and evaluating the efficacy of a Navy Airship as a platform for sensing and detecting oil as well as coordinating command and control efforts in directing surface assets.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Ms. Sharon Buffington, Chief, Engineering and Research Branch, Offshore Energy and Minerals Management, Minerals Management Service

Questions submitted by Chairman Brian Baird

Q1. To quote Secretary Chu in a June 8th BP Deepwater Horizon press release, "Transparency is not only in the public interest, it is part of the scientific process . . . We want to make sure that independent scientists, engineers and other experts have every opportunity to review this information and make their own conclusions." Scientific freedom, access to data, and transparency are key to informed decisions that benefit society. How are the federal team and external experts working today to increase access to data and to deliver findings in a transparent manner?

A1. The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), formerly known as the Minerals Management Service (MMS), disseminates the results of research and development (R&D) projects as widely as possible in appropriate scientific and technical journals, technical reports, and public information documents. The BOEMRE Technology Assessment and Research Program maintains a website at, *www.boemre.gov/tarphome*, which contains a listing of all R&D projects funded by BOEMRE as well as downloadable reports. The intent is to make our research results available to oil spill response personnel and organizations worldwide.

BOEMRE routinely participates in the exchange of oil spill research and technological information with Canada, France, Germany, Japan, Norway and the United Kingdom through cooperative research projects, workshops, and technical meetings such as the International Oil Spill Conference (IOSC), Interspill, and the Arctic and Marine Oil Spill Program Technical Seminar (AMOP). BOEMRE is also a member of National and International government research coordination groups to disseminate research results and to minimize duplication

BOEMRE works cooperatively with representatives from state and federal government agencies, academia and industry on the American Society of Testing and Materials (ASTM) F–20 Main Committee to develop test methods, specifications, (including equipment specifications), classifications, standard practices, definitions, and other standards pertaining to performance, durability, strength of systems and techniques used for the control of oil and hazardous substances spills. The work of the F–20 Main Committee is coordinated with other ASTM Committees and organizations having similar interests.

US Federal agencies share research data and findings through coordination committees such as the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR).

They also share research by publishing reports such as the Biennial Report to Congress, publishing data on the Internet, and delivering presentations at oil spill conferences.

Q2. There is a vast resource of knowledge and experience amongst spill response professionals across the globe. For example, the International Spill Control Organization was incorporated in London in 1984 as a non-profit organization dedicated to improving worldwide preparedness for oil and chemical spill response.

a. How are we utilizing technologies from the international community into our federal oil spill response, and how could this be improved upon?

A2a. BOEMRE works cooperatively with all major North American and European research and development programs. More than 40 percent of the projects initiated by the BOEMRE Oil Spill Response Research Program were jointly funded with state, Federal and foreign government agencies, academia and private industry. Results from these research projects and programs (e.g., improved containment booms and skimmers, dispersant application systems, new remote sensing and mapping capabilities) have been incorporated into our Federal response to the BP Deepwater Horizon spill. Improvements could be made by having access to more resources to conduct more projects.

BOEMRE interacts with the International Spill Control Organization (ISCO) through the International Maritime Organization and the International Petroleum Industry Environmental Conservation Association. We attend the same meetings, including the International Oil Spill Conference. We review the ISCO newsletter to keep informed about International Research and send information on our latest research results. BOEMRE has worked with other countries to improve skimmers, to

develop fire booms, to test in situ burn effectiveness and on Project "Deep Spill." Project "Deep Spill" was done off Norway to simulate a blowout or pipeline rupture in deep water and obtain data to verify the predictions of a deep water blowout model.

b. What specific measures is the United States taking to keeping abreast of new technologies or advance technologies?

A2b. BOEMRE routinely participates in the exchange of oil spill research and technological information with Canada, France, Germany, Japan, Norway and the United Kingdom through cooperative research projects, workshops, and technical meetings such as the International Oil Spill Conference (IOSC), Interspill and the Arctic and Marine Oil Spill Program Technical Seminar (AMOP).

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Q3. MMS grants permits for oil exploration and drilling in the Outer Continental Shelf and MMS granted BP's permits for the Deepwater Horizon well. Therefore, MMS has a unique perspective on this industry and the environment that could well be used. How has MMS used this perspective to advance our ability to assess future oil spill hazards?

A3. The authority/oversight granted to BOEMRE regarding exploration and development drilling on the Outer Continental Shelf (OCS) allows the agency to fund uniquely-related studies that assist in the assessment of spill impacts and subsequent response efforts. The information is pulled into the programmatic analyses conducted under the National Environmental Policy Act (NEPA) to ensure compliance regarding program planning, lease sale activities, and other related issues. The adaptive nature of the agency's Environmental Studies and Environmental Assessment Programs allows for the continual flow of data needs and new information distribution between the two groups.

Information is currently being gathered on specific Macondo spill characteristics, response efforts, and known impacts to develop better deepwater scenarios to be analyzed in upcoming Environmental Impact Statements (EISs) and site-specific NEPA analyses. BOEMRE scientists are also assisting with several ongoing Natural Resource Damage Assessment (NRDA) teams and working groups looking into the environmental impacts of the spill and subsequent response efforts. Additionally, the agency's Studies Program has developed/proposed several Macondo-related studies which have benefited from the NRDA involvement as it has helped ensure that BOEMRE efforts are complementary and not duplicative of research led by other resource agencies.

Q4. What has MMS done to advance our understanding of oil spills from deepwater drilling operations?

A4. The BOEMRE oil spill response research program includes numerous projects which advance our understanding of oil spills. Research and development projects specifically associated with deepwater oil spill response include:

- Technology Assessment Research (TAR) Project 32—Recapture of Oil from Blowing Wells
- TAR Project 85—Subsea Collection of Blowing Oil and Gas
- TAR Project 287—Fate and Behavior of Deepwater Subsea Oil Well Blowouts in the Gulf of Mexico
- TAR Project 311—Oil Spill Containment, Remote Sensing, and Tracking from Deep Water Blowouts—Status of Existing and Emerging Technologies
- Tar Project 324—Experimental and Analytical Study of Multi-phase Plumes in a Stratified Ocean with Application to Deep Ocean Spills
- TAR Project 377—Project "Deep Spill"

Following the investigation of the Deepwater Horizon oil spill and the Secretary-directed safety review of offshore drilling, BOEMRE will be reviewing the research to fill in any gaps.

Questions submitted by Representative Ben R. Luján

Q1. It is my understanding that MMS has categorically excluded exploration and drilling plans from environmental review.

- *Does MMS still consult with other federal agencies on drilling plans, such as the one BP was operating under when the Deepwater Horizon spill happened?*
- *If not, how do such drilling plans evade consultation?*

A1. Exploration and drilling plans are not automatically exempted from an environmental review.

The National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ) Regulations allow agencies to establish categorical exclusions (CEs) for categories of projects, plans, programs, and policies that the agency has determined do not normally have individual or cumulative significant environmental effects. In the case of the Macondo well, MMS categorically excluded the decisions associated with approval of BP's exploration plans and the approval of BP's four applications to permit drilling.

On August 16, CEQ released a report on NEPA procedures for environmental reviews by the former Minerals Management Service (MMS). Following the release of the Council on Environmental Quality's (CEQ) report on the former Minerals Management Service's NEPA program, Secretary Salazar and BOEMRE Director Bromwich announced that the department will restrict its use of some of its categorical exclusions for offshore oil and gas development to activities involving limited environmental risk, while it undertakes a comprehensive review of its NEPA process and the use of categorical exclusions for exploration and drilling on the Outer Continental Shelf. In addition to a programmatic EIS and subsequent sale-specific EAs or supplemental EISs prepared before any leases are offered for sale, BOEMRE will conduct an activity-specific NEPA/environmental analysis of each and every exploration/drilling plan under its Categorical Exclusion Review (CER) process.

BOEMRE consults with the National Marine Fisheries Service (NMFS) and Fish and Wildlife Service (FWS) on a programmatic basis during the coordination and preparation of each program/lease sale EIS. The associated opinions or consultation documentation provided by NMFS and FWS are developed to cover all of the exploration and drilling activities resulting from the OCS lease sales.

Questions submitted by Representative Bob Inglis

Q1. Could you please provide a more detailed explanation of the "over 120 projects directly related to oil spill research" that MMS has funded in accordance with the Oil Pollution Act that is cited in your written testimony?

a. How are these projects directly impacting current efforts to combat the BP spill?

A1a. Results from BOEMRE research are being directly used to support the response to the BP Deepwater Horizon spill. Projects are broken into topic areas below.

Remote sensing—A new aerial sensor for remotely mapping the extent and thickness of an oil spill was developed and successfully flight tested. The technology involves using a portable aerial multispectral camera and thermal imager mounted in an aircraft that flies over an oil slick, gauges the thickness of the oil, and rapidly maps the extent and thickness of an oil spill with greater accuracy than previous methods. The data are electronically relayed to a secure server that can be accessed by the command post and responders where cleanup equipment can be quickly deployed to the highest concentration of oil before it has time to spread. This new remote oil spill mapping and detection technology has been used in California three times in the past year to assist in response operations. It is currently being used for the Deepwater Horizon oil spill. The system collects, processes and disseminates digital Geographic Information System compatible oil slick thickness maps in near real time and transmits this information directly to response personnel in the command post to assist with operational response decisions and deployment of manpower and response countermeasures.

Mechanical Containment and Recovery—In most countries, mechanical recovery of spilled oil is the first and preferred response option. A containment boom is normally used in combination with an oil recovery skimmer. BOEMRE research has focused on methods to improve the effectiveness of equipment and techniques for the mechanical recovery of oil spills. Research on the processes of oil adhesion to the surface of oil skimmers improved recovery efficiency by 20 percent; however further

research demonstrated that changing the surface pattern of the drum improved recovery efficiency by over 200 percent. Results from this research project were patented and there are at least six types of grooved skimmers being commercially sold around the world. Many types of grooved skimmers were employed for the BP Deepwater Horizon spill.

Development of Standard Test Protocols—The U.S. Coast Guard (USCG) and BOEMRE have collaborated in an effort to develop a standard protocol for testing oil skimmers. The American Society of Testing and Materials (ASTM) Subcommittee on Skimmers recently adopted the standard methodology (ASTM F631–99 (2008)), for measuring the effective daily recovery capacity (EDRC) for a given skimmer system. The USCG uses EDRC as a key component in rating and regulating the oil spill response capability of responsible parties and oil spill removal organizations. Skimming systems being used for the BP Deepwater Horizon spill response have been tested at Ohmsett—The National Oil Spill Response Test Facility, in Leonardo, New Jersey, using this new ASTM protocol.

In Situ Burn—BOEMRE was designated as the lead agency for in situ burn research (ISB) in the Oil Pollution Research and Technology Plan prepared under the authority of Title VII of the Oil Pollution Act of 1990. Between 1995 and 2003, the BOEMRE partnered with the National Institute of Standards and Technology to conduct more than ten different ISB research projects involving hundreds of laboratory, small and full-scale and at sea burn experiments. Emphasis was on the emissions to air and water, equipment evaluations including fire resistant booms, smoke plume modeling, and research to extend the "Window of Opportunity" through the use of chemical herders and emulsion breakers.

BOEMRE and the Canadian Coast Guard funded development of a near full-scale screening test protocol for the effectiveness and durability of fire resistant oil containment boom that incorporates simultaneous testing in waves and flames. An enhanced propane underwater bubbler system designed to allow the testing of fire resistant booms in flames was installed at Ohmsett in the fall of 1998. Since the air-enhanced propane system was developed, eleven fire resistant boom systems have been tested. These include: three refractory fabric booms, one stainless steel boom, three water-cooled blanket prototypes, three reflective/insulating blanket prototypes and one water-cooled boom.

The technology to effectively predict downwind smoke plume trajectories and monitor particulate concentrations has evolved with the BOEMRE ISB research program. Smoke plume models and monitoring protocols have been developed and are available. A Large Outdoor Fire Plume Trajectory model was developed to predict and analyze the downwind distribution of smoke particulates and combustion products from large burns. Two versions are available one for flat terrain and the other for mountainous terrain. Monitoring capability can be readily deployed to support in situ burn operations.

To disseminate results of eight years of intensive ISB research, the BOEMRE assembled a comprehensive compendium of scientific literature on the role of in situ burning as a response option for the control, removal and mitigation of marine oil spills. All operational aspects of burning are covered in detail. The BOEMRE has distributed more than 5,000 ISB CD sets worldwide. Results from the BOEMRE ISB research program are currently being used to make operational decisions on use of burning as a countermeasure for the BP Deepwater Horizon spill.

Chemical Dispersants—The use of chemical dispersants is another important option in oil spill response. In the past seven years fifteen major dispersant research projects were conducted at Ohmsett addressing five critical operational areas described below.

- Quantifying under simulated at sea conditions the influences of the major factors limiting dispersant performance, namely properties of oils and emulsion (e.g., viscosity), wave energy and dispersant type and dose.
- Improving dispersant effectiveness monitoring by validating and improving existing visual and instrumental monitoring protocols, conducting in-use testing of monitoring instruments and methods and developing materials for monitoring training and practice.
- Addressing specific operational questions including a) how long do surfactants remain in dispersant treated slicks when slicks are treated and then sit on calm seas for many hours or days; and b) how effective are skimmers in collecting dispersant-treated but undispersed oil?
- Bridging the gap between bench-scale tests (e.g., the Swirling Flask Test) and the sea by, a) developing the capability of predicting dispersant performance

at Ohmsett from results of bench scale tests, and b) relating test conditions and dispersant performance at Ohmsett to conditions and performance at sea.

- Addressing specific controversial questions about dispersant usefulness under local conditions (e.g., dispersibility of Grand Banks or Alaskan oils under Arctic conditions) by conducting tests under simulated at-sea conditions.

Results from the BOEMRE research program were used to make operational decisions on use of chemical dispersants as a countermeasure for the BP Deepwater Horizon spill.

Training—Ohmsett is also the premier training site for spill response personnel from state and federal government agencies, private industry and foreign countries. While receiving state of the art training, students use full-size equipment with real oil in varying oceanographic conditions to increase their recovery proficiency. Many of the first responders from state and federal agencies and industry have received oil spill response training at Ohmsett.

b. What progress was made as a result of these projects, and, if they are not directly impacting the current effort, what research should have been done instead?

A1b. The progress that has been made as a result of these research projects is exemplified in the previous response. Moreover, the technologies described above were critical components of the unified command response efforts.

For example, an August report developed by an interagency team of scientific experts found that response efforts—and specifically many of the technologies described above—were successful in addressing 33% of the spilled oil. This includes oil that was captured directly from the wellhead by the riser pipe insertion tube and top hat systems (17%), burning (5%), skimming (3%) and chemical dispersion (8%).

Q2. With 7,400 active oil and gas leases in the Outer Continental Shelf region of the Gulf of Mexico, why hasn't MMS been more proactive in deep water oil spill response research, specifically addressing the research recommendations from Project "Deep Spill?"

A2. A joint industry project (JIP) was formed between the MMS (now BOEMRE) and 23 different oil companies to conduct Project "Deep Spill". The project consisted of an experimental release of oil and gas conducted in June 2000 off the coast of Norway. The most important recommendations from Project "Deep Spill" were studied by the University of Hawaii and Massachusetts Institute of Technology following the deep spill.

The experiments were conducted to provide qualitative insight into basic physical phenomena and quantitative data for the development and calibration of mathematical sub-models. The primary objectives of the laboratory investigation were to simulate 1) the break up of contaminants discharging into the deep ocean environment from well blowout and other deep oil spills; 2) the interactions between sea water, gas bubbles, and oil droplets within the plume; and 3) the macroscopic (global) behavior of multiphase plumes rising in a stratified water column. Experiments were also performed to study the behavior of multi-component plumes in a cross-flowing current. The experimental component of the research program is the subject of the subsequent report referenced as, *Study of Multi-Phase Plumes with Application to Deep Ocean Oil Spills*, Masutani, S.M., Adams, E., Hawaii Natural Energy Institute, University of Hawaii, 2001. The final report can be found at *http://www.mms.gov/tarprojects/377.htm*.

A workshop on Remotely Operated Vehicles was also done under project 446—*http://www.boemre.gov/tarprojects/446.htm*. This BOEMRE project was a technical assessment of present and future autonomous underwater vehicle (AUV)/ROV capabilities relevant to subsea deepwater oil and gas developments.

a. One of the recommendations that resulted from Project "Deep Spill" was more research specifically on the droplet size and exit velocity of subsea oil release. What research has been done in this area since the project concluded 10 years ago?

A2a. BOEMRE funded dispersant research that has focused on the technologies to measure the particle size and their distribution throughout the water column. Results of these studies can be found at: *http://www.BOEMREre.gov/tarprojectcategories/chemical.htm*. During all BOEMRE funded dispersant experiments, the dispersed oil particle size and their distribution are routinely measured.

Q3. The resultant study from the Project "Deep Spill" indicated that the lifetime of the water-oil emulsion was judged to be short enough to allow for natural dis-

persion—there was even some question as to whether the slick would surface at all from such depth. The researchers even offer a third response option: monitor the surface and subsea spreading with no combat measures.

a. Could this information have been misleading and contributed to an ill-informed and ineffective response plan?

A3. No, this information was an integral part of the response to the BP Deepwater Horizon Oil Spill . Under the direction of the Federal On-Scene Coordinator for the area, each Area Committee is responsible for developing an Area Contingency Plan (ACP) that, when implemented in conjunction with the National Oil and Hazardous Substances Pollution Contingency Plan will be adequate to remove a worst case discharge of oil or release of a hazardous substance. The ACP must also mitigate or prevent a substantial threat of such a discharge from a vessel, offshore facility, or onshore facility operating in or near the geographic area. Each Area Committee is responsible for working with state and local officials to pre-plan for joint response efforts, including appropriate procedures for mechanical recovery, dispersant use, shoreline cleanup, protection of sensitive environmental areas, and protection, rescue, and rehabilitation of fisheries and wildlife. The Area Committee is required to work with state and local officials to expedite decisions for the use of dispersants and other mitigating substances and devices. The intent is to foster a consistent team approach to managing a significant marine oil spill by initiating a Unified Command that is consistently structured and organized using the National Incident Management System's Incident Command System.

Q4. In your testimony, you indicate that a Secretarial Order was signed on May 19th to separate three distinct missions of MMS: energy development, enforcement and revenue collection.

a. Do you believe this separation will assist in more enforcement of the regulations that are already in place and prevent further oil spills offshore?

A4a. On June 15, Secretary Salazar appointed Michael R. Bromwich as the Director of the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). Mr. Bromwich is leading the changes in how the agency does business, including how it implements reforms that will raise the bar for safe and environmentally sound offshore oil and gas operations, and that will help our Nation transition to a clean energy future. The Secretary has asked his management team to develop a reorganization plan in consultation with others within the Administration and with Congress.

As was announced by the Secretary on July 14th, the structure established in Secretarial Order No. 3299 reflects DOI's conclusions regarding how best to achieve the goals of mission independence, appropriate checks and balances, and rigorous oversight, while maintaining ongoing communication and coordination necessary to facilitate an effective, efficient, and predictable process. Specifically, MMS's successor organization will be divided into three new entities. First, the Office of Natural Resources Revenue will perform the roles of the former Minerals Revenue Management organization and report to the Assistant Secretary for Policy, Management and Budget. Second, the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement will divide the duties of the former Offshore Energy and Minerals Management organization, with the former managing the development of conventional and renewable resources and minerals on the OCS, and the latter providing safety and environmental oversight. These new Bureaus will report to the Assistant Secretary for Land and Minerals Management.

In addition to the reorganization of MMS, the Secretary ordered the establishment of an Investigations and Review Unit (IRU) within the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), formerly MMS. The purpose of the IRU is to establish the internal capability in BOEMRE to: (1) promptly and credibly respond to allegations or evidence of misconduct and unethical behavior by BOEMRE employees as well as by industry; (2) oversee and coordinate BOEMRE's internal auditing, regulatory oversight and enforcement systems and programs; and (3) assure BOEMRE's ability to respond swiftly to emerging issues and crises, including significant incidents such as spills, accidents and other crises. As appropriate, the IRU's functions and capabilities will continue in the new organizations.

b. Which Bureau or Office within the newly reformed MMS will have the responsibility for oil spill research and oil spill response technologies?

A4b. Oil spill research and response technologies will be the responsibility of the Bureau of Safety and Environmental Enforcement.

Q5. In your testimony, you highlight all the methods that have been developed for use in cleaning up an oil spill.

a. Which of these methods have been used to address the spill in the Gulf?

A5a. All 8 of the methods listed in the testimony have been used in the response efforts to the BP Deepwater Horizon spill.

b. How effective have they been and what have you learned about their limitations from this incident?

A5b. There will be lessons learned and BOEMRE will use all data that are gathered including information on research gaps. Specific lessons learned about the effectiveness of different techniques include:

Remote Sensing—The new aerial thickness sensor and mapping system, developed through BOEMRE funded research and development is working above expectations. The system was flown twice a day during the oil spill response effort providing maps of oil thickness used for the response efforts. Information from the flights is downloaded to a secure server that can be accessed by responders and response vessels. The National Oceanic and Atmospheric Administration (NOAA) uses this information to validate their model predictions and to document potential oil beaching. Flights are also being conducted in coordination with the application of dispersants to document their effects. The NOAA Natural Resource Damage Assessment (NRDA) Shoreline Technical Workgroup Lead is applying the aerial imagery to document shoreline/marsh oiling assessments.

Mechanical Containment and Recovery—Mechanical containment and recovery worked to the capabilities of the equipment. Many different types of containment booms and skimmers were used in the response. In general, the mechanical equipment worked in calm seas and performance declined in bad weather and high sea states.

Dispersants—Dispersants applied surface and subsea have been effective in reducing the amount of oil impacting the shoreline.

In Situ Burn—In situ burn operations worked above expectations. Controlled burns were employed to efficiently remove oil from the open water in an effort to protect shoreline and wildlife. As of July 11, 2010 more than 10.3 million gallons of oil have been removed from the water by controlled burns.

c. Can you estimate what percent of the oil we have been able to effectively contain or mitigate through these efforts?

A5c. On August 4, 2010, an interagency science team assembled by the National Incident Command issued a report on the fate of the spilled oil. In summary, it is estimated that burning, skimming and direct recovery from the wellhead removed on quarter (25%) of the oil released from the wellhead. One quarter (25%) of the total oil naturally evaporated or dissolved, and just less than one quarter (24%) was dispersed (either naturally or as a result of operations) as microscopic droplets into Gulf waters. The residual amount—just over one quarter (26%)—is either on or just below the surface as light sheen and weathered tar balls, has washed ashore or been collected from the shore, or is buried in sand and sediments. Oil in the residual and dispersed categories is in the process of being degraded. The report below describes each of these categories and calculations. These estimates will continue to be refined as additional information becomes available.

Response efforts were successful in addressing 33% of the spilled oil. This includes oil that was captured directly from the wellhead by the riser pipe insertion tube and top hat systems (17%), burning (5%), skimming (3%) and chemical dispersion (8%)."

The report can be found at: *http://www.restorethegulf.gov/release/2010/09/09/bp-deepwater-horizon-oil-budget-what-happened-oil*

Q6. How much time and resources at OHMSETT are dedicated solely to testing technologies and best practices for oil spill cleanup? How much time and resources are dedicated to other pursuits?

A6. Ohmsett—The National Oil Spill Response Research & Renewable Energy Test Facility is the only facility where full-scale oil spill response equipment testing, research, and training can be conducted in a marine environment with oil under controlled environmental conditions (waves and oil types). The facility provides an environmentally safe place to conduct objective testing and to develop devices and techniques for the control of oil and hazardous material spills.

Ohmsett is a government owned, contractor operated facility; and is utilized by state, federal, and foreign government agencies, industry and academia. On average, Ohmsett is used approximately 65 percent for testing and developing equipment,

technologies and methodologies for oil spill response and for conducting basic research to support oil spill response. The facility is used approximately 30 percent for training first responders and emergency response personnel assigned to oil spill response duties. Since 2009, when the capability was added, about 5 percent of the usage days were used for testing renewable energy wave and hydrokinetic devices.

Q7. Some experts have suggested that we transition our regulatory system from the current prescriptive-based framework to a "performance-based framework," noting that this is a trend among safety regulators worldwide, particularly in Norway. The argument is that the prescriptive-based regulatory approach tends to create a passive attitude among companies, which aim to pass regulatory inspections instead of focusing on system performance.

a. What is your reaction to this general approach?

A7a. To provide effective regulation, BOEMRE's regulatory framework is designed with a mix of performance-based and prescriptive rules. Performance based standards describe the safety, environmental, property, and resource protection goals that are expected to be achieved. These standards identify the purpose of the detailed requirements and provide a basis for approving an alternative method for achievement of the stated purpose.

However, some regulations need to be prescriptive when there is just one best way to achieve the goal. Usually this means that data were gathered to determine the best approach.

We offer an example of a performance based standard under our training rule found at 30 CFR 250, Subpart O. The lessee must establish and implement a training program so that employees are trained to perform their assigned well control and production safety duties. However, lessees are free to determine the type, method, length, frequency, and content of the training program. The program material is included in a training plan which is made available to BOEMRE so we may periodically assess the training program by conducting an audit, interviews or testing, as needed. During an audit the lessee needs to show documented proof that they have actually implemented the provisions included in their program.

BOEMRE is considering the merits and appropriate use of performance based and prescriptive approaches to safety regulations.

b. Could it potentially improve drilling safety without adding excessive regulatory costs and other burdens on producers?

A7b. In general, there is no strict correlation between the burden cost and whether a regulation is either performance-based or prescriptive. The cost is a function of the goal to be achieved. Some goals are more costly than others to the industry and the regulator. However, the fundamental goal of any regulation is to ensure safety and environmental protection .

c. Is the Federal government considering such an approach?

A7c. BOEMRE is evaluating the appropriateness of increasing the use of performance-based regulations.

Q8. What new technologies have been identified as having the potential for impact on oil spill cleanup methods and what is the current status of these technologies, both from a research and development standpoint and for current implantation in the BP spill?

A8. Please see response to Congressman Inglis's question #1 above.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Albert Venosa, Director, Land Remediation and Pollution Control Division, National Risk Management Research Laboratory, Office of Research and Development, Environmental Protection Agency

Questions submitted by Chairman Brian Baird

Q1. We have an unprecedented response happening to this spill, but it is worrisome that we seem to have few metrics to actually measure how effective our response is.

- *For example, how do we know if adding 5,000 gallons of dispersant per day is enough, or if 50,000 gallons is needed in order to be effective? How do we know what quantity is appropriate?*

A1. Applying the optimal amount of dispersant to effectively disperse oil depends on several factors including the type of oil, temperature, and ambient conditions. Typically, the amount of dispersant needed for effective dispersion relative to the volume of spilled oil, called the dispersant-to-oil ratio (DOR), is approximately 1:20 to 1:50 (5% to 2% based on surface application). The U.S. Coast Guard, as the Federal On-Scene Coordinator (FOSC) for the Deepwater Horizon oil spill, in consultation with the EPA, is responsible for daily operational decisions on dispersant application and amounts. As a result of the capping and sealing of the well, dispersants have not been applied since July 19, 2010.

In addition, a recent peer-reviewed report, issued by the Federal Interagency Solutions Group, estimated that 16% of the oil had been chemically dispersed: (*http://www.restorethegulf.gov/sites/default/files/documents/pdf/OilBudgetCalc_Full_HQ-Print_111110.pdf*) . Based on the information available to date, EPA believes the dispersant application amounts were effective in achieving oil dispersion.

- *What resources or research are needed to establish such metrics?*

A1. Much is already known about the optimum DORs needed for effective dispersion of surface oil into the water column. EPA has done a substantial amount of research in the laboratory on DOR and has found that a DOR of about 1:25 works best for light to medium weight crude oils. The peer-reviewed literature supports this DOR, where most reports show good dispersion takes place at a DOR between 1:20 to 1:50. EPA in conjunction with the Department of Fisheries and Oceans Canada (DFO) built a wave tank on the property of DFO's Bedford Institute of Oceanography in Nova Scotia in 2004. In these studies, a DOR of 1:25 was always used, and the research showed that such a DOR was effective in accomplishing adequate dispersion. Application of dispersants into a subsurface oil plume, such as the case in the Deepwater Horizon spill, by directly injecting dispersant into a blowout well had never been studied prior to this event. EPA found that subsurface application, in effect, reduces the volume of chemicals applied because the dispersant can be added based on the estimated oil flow rate.

Nonetheless, more wave tank research is needed in this type of blowout situation to confirm the best DOR approach, especially for other types of oils. Specifically, injecting light crude oil heated to 100 °C into the wave tank at extreme velocity with and without dispersant injection would help answer the critical question of how much oil is chemically dispersed vs. physically dispersed. Obviously, the 150 atm pressure characteristic of the deep sea cannot be reproduced, but just about every other condition can be. We can also determine the best tools to answer the question of how best to monitor effectiveness in the field. For this, we would use the LISST droplet size distribution analyzer and further develop a better fluorometric method that quantifies dispersion effectiveness using two different emission wavelengths (one for 2-ring PAHs and the other for 3-ring and higher PAHs) and an excitation wavelength that is more suited for the PAH fraction in crude oil. This kind of research will be extremely useful not only for future spills involving deep sea blowouts but also for surface applications.

Q2. What types of research need to be targeted, ecological as well as technology tools, for a more effective response to future spills? What types of research infrastructure or funding mechanisms are needed to support these research priorities?

A2. EPA has been engaged in oil spill research for over 20 years. The Deepwater Horizon oil spill demonstrates that gaps in the knowledge base regarding response technologies remain and that a larger commitment to researching the near- and long-term effects of spilled oil and dispersant use is needed. With the $2 million appropriated to EPA under the Supplemental Appropriations Act of 2010, EPA plans

to issue grant awards to universities to study the potential human and environmental risks and impacts of the release of crude oil and the application of dispersants, surface washing agents, and other mitigation measures listed in the National Contingency Plan Product Schedule. Planned research will determine the potential exposure and human health and environmental impacts of chemical dispersants and dispersed oil; the efficacy of dispersants and other oil spill mitigation measures; and the potential near and longer-term impacts of the Gulf Spill to human health and a broader range of aquatic and land species.

Q3. What additional challenges would EPA face if the Deepwater Horizon spill had occurred in the Arctic?

A3. EPA has responded to oil spills in the Arctic and Subarctic regions. Responding to oil spills in this region raises challenges such as the potential remoteness of the response, the extreme temperature changes experienced throughout the year and the difference in properties of oil in this region compared to the crude oil in the Gulf. The unique nature of the Arctic region imposes additional technology challenges for oil spill prevention and response, such as predicting the behavior of dispersants and dispersed oil at low temperatures and in an environment where snow and ice are prevalent. Dispersants that were developed and evaluated at room temperatures may function differently in the cold Arctic waters. Likewise, staging an oil spill response on the remote Alaska's North Slope would add significant logistical challenges, including disposal of the oil spill waste material.

Q4. There is a vast resource of knowledge and experience amongst spill response professionals across the globe. And the International Spill Control Organization was incorporated in London in 1984 as a non-profit organization dedicated to improving worldwide preparedness for oil and chemical spill response.

a. How is the U.S. utilizing technologies from the international community into its federal oil spill response, and how could this be improved upon?

b. What specific measures is the United States taking to keeping abreast of new technologies or advance technologies?

A4. EPA actively participates with the international community through a number of research projects and conferences. For example, EPA partnered with Department of Fisheries and Oceans Canada in a jointly owned wave tank facility built to study dispersant effectiveness as a function of mixing energy. EPA's international collaboration on the wave tank was recognized in the National Academy of Science (NAS) 2005 report entitled Oil Spill Dispersants—Efficacy and Effects. EPA has also developed a working relationship with the French group CEDRE (Centre of Documentation, Research, and Experimentation on Accidental Water Pollution) in studying dispersants and surface washing agents as spill mitigation technologies. Future collaborations are planned with this research body.

In addition, EPA sponsors or participates in several oil spill technical conferences, including the International Oil Spill Conference (IOSC), Freshwater Spills Symposium, Clean Gulf Conference and Exhibition, and the Arctic and Marine Oil Spill Program (AMOP).

Q5. As a member of the Interagency Coordinating Committee on Oil Pollution Research, how does the EPA solicit and respond to proposals from non-federal entities, such as private companies and university laboratories, regarding oil spill response technologies?

A5. Periodically, other federal agencies such as NOAA and BOEMRE advertise Broad Agency Announcements (BAAs) or Requests for Proposals (RFPs) to solicit white papers (similar to pre-proposals) or full proposals that address research needs specified in the BAA or RFP. EPA has responded and successfully received funding on four such advertisements in the recent past and will continue to do so in the future. In addition, EPA will be soliciting academic partnerships in FY 2011 through the Supplemental Appropriations Act of 2010 as noted in response to Question 2.

As for the private sector, EPA is actively engaged through participation in several oil spill-related conferences and workshops that includes non-federal entities such as private companies and university laboratories. As a result of the Deepwater Horizon spill, EPA has established a relationship with several private companies interested in partnering with EPA in Cooperative Research and Development Agreements (CRADAs) to further develop spill mitigation techniques.

EPA also participated in the Interagency Alternative Technology Assessment Program (IATAP), a cross government effort to more efficiently and responsively address and evaluate possible technology solutions for the oil spill response efforts.

EPA has primary "jurisdiction" for submissions deemed by the USCG RDC as "Alternative Oil Spill Response Technologies." The category "Alternative Oil Spill Response Technologies" includes *in-situ* burning, alternative chemical treatment, and innovative applications not commonly used for oil spill response.

Once a submission was referred to EPA, it was quickly evaluated by the appropriate EPA technical expert(s) to determine whether the submission was either immediately deployable, supported the current response, or required further evaluation. For submissions that were determined to require further evaluation, EPA sought additional information from the vendor/submitter that might entail laboratory testing for toxicity or field testing for feasibility in order to evaluate environmental impacts.

Q6. MMS collaborated with over 20 companies in a Norwegian experiment on deepwater oil spills. How did EPA coordinate with MMS to leverage the findings of this study?

A6. EPA was not specifically involved in the Department of the Interior's Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), formerly Minerals Management Service (MMS)/Norwegian research study mentioned. The study did not involve use of dispersants in the deep sea. It was intended to study the behavior of oil in a deep sea blowout. EPA works closely with the international oil spill community either through collaboration or by joint participation in international conferences and/or workshops. EPA's interaction with the international oil spill community allows EPA to share its research findings and listen and engage in dialogue relating to emerging and relevant internationally research. The Department of the Interior is one of the 15 member agencies on the National Response Team (NRT) engaged in interagency sharing of research in oil spill response technologies, training drills, and actual real time response collaboration. EPA and BOEMRE have collaborated on several research studies both in the past and currently involving the study and testing of dispersants for treating oil spills on the surface of the water.

Questions submitted by Representative Bob Inglis

Q1. Last year when you testified in front of this Committee and discussed the Interagency Coordinating Committee, you admitted that "we haven't been as good about reporting to Congress as much as we should, but at least we do what we are supposed to be doing in terms of the directive". Admiral Watson of the Coast Guard agreed, but expressed some concern with the quality of leadership in the area private sector involvement and University research.

a. What has been done to remedy this situation, and what needs to be done to make improvements in this area?

A1. EPA meets regularly with our federal partners and academia in a variety of forums, including the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR) semiannual progress review meeting. Many federal agencies that participate in the ICCOPR meetings also participate on the National Response Team's (NRT's) Science and Technology (S&T) monthly subcommittee meetings. Therefore, we are actively engaged on several levels within the federal government. Like the NRT S&T subcommittee, the ICCOPR led by USCG has met on a regular basis over the years to provide research coordination, including reporting to Congress every two years. This year, the ICCOPR has already met twice and is planning two more meetings in the coming months to address research needs and lessons learned from the Deepwater Horizon oil spill. Based on these meetings and telephone communications with the USCG, it is anticipated that the coordination among the federal ICCOPR members will continue to be engaged much more actively than ever before. EPA will be awarding research grants to the academic community as part of the Supplemental Appropriations Act of 2010.

Q2. How effective are dispersants in assisting in the overall clean up effort and what are the perceived advantages of their continued application?

a. As you may recall from last year's hearing, the California Fish and Game mentioned that one gap in oil spill technology was the delivery system for dispersants and that gel or encapsulating forms showed promise. Have these technologies been developed?

A2. The application of dispersant is part of a broader environmental response strategy to minimize environmental impacts. The spill management strategies, practices, and technologies that have been implemented include containment, mechanical removal techniques (booming and skimming operations), *in-situ* burning, and dispers-

ant use. Environmental tradeoffs are associated with the widespread use of large quantities of dispersant. However, dispersants are generally less toxic than oil, they reduce risks to shorelines, and degrade quickly over several days to weeks, according to modeling results. To be clear, dispersants were only used in the Gulf where oil was present.

Evidence suggests that dispersants were effective in mitigating the ecological damage from the Deepwater Horizon spill by dispersing the oil into tiny droplets that biodegrade over time. The advantages of continued use during the spill (before the well was permanently capped) include reducing extensive ecological damage to the coastal land environment by limiting the amount of oil reaching land, mitigating the suffocating effect on waterfowl that come in contact with oil floating on the surface, and mitigating the need for excessive handling and disposal of waste debris from use of conventional cleanup options.

EPA encourages the development of non-toxic dispersant products that minimize the ecological and environmental effects of using such chemicals to clean up oil spills in seawater. Of course, any new product would still have to undergo protocol testing to be listed on the NCP Product Schedule for use in an oil spill response. We are aware of new products on the market that promise to be effective and safer technologies for spill mitigation, but they have not been submitted to the Agency for testing and inclusion on the NCP Product Schedule for use in an oil spill. There are gelling and encapsulating agents on the NCP Product Schedule and new technologies have been submitted to the Agency for review. The challenge for these technologies is the ability to apply sufficient agent on a large oil spill surface area and then to recover the gel or encapsulated oils to remove them from the environment.

EPA will also encourage the use of Cooperative Research and Development Agreements (CRADAs) with private industry to help further the development of such technologies and advance the marketability of domestic products. Any new technology will need to be tested for ecological, human health, and environmental effects in addition to efficacy of treatment.

Q3. EPA is responsible for providing recommendations on the concentration and application of dispersants listed on the National Contingency Plan (NCP) product schedule, a preapproved list of dispersants that may be used in the event of an oil spill.

a. What volume of dispersant listed on the NCP is approved for use?

b. It has been widely reported that the amount of dispersant used in the current clean up far exceeds what has been used before. If a spill of this magnitude was supposed to be planned for in the NCP, why was the volume of dispersant approved far below actual needs?

A3. The National Contingency Plan does not stipulate volumes or concentrations for dispersants, the criteria are site-specific. Applying the optimal amount of dispersant to effectively disperse oil depends on several factors including the type of oil, type of dispersant, temperature, and ambient conditions. Typically, the amount of dispersant needed for effective dispersion relative to the volume of spilled oil, called the dispersant-to-oil ratio (DOR), is around 1:20 to 1:50 (5% to 2% based on surface application). However, based on the more limited impact to the shoreline than initially expected compared to initial estimates, EPA believes, to date, the dispersant application amounts in the Gulf were effective in reducing impacts to the shoreline.

Q4. EPA was to have conducted toxicity testing for the use of dispersants in a subsea environment.

a. Given that this is a relatively new application of the technology, what tests were conducted? How long did these tests take?

b. Why is EPA confident about the testing procedures used in this case, yet under normal circumstances, testing would take a much longer time? Is EPA relaxing its standards for this emergency? Or is the agency capable of conducting testing at a much quicker pace but is ordinarily hampered by bureaucracy?

A4. EPA conducted toxicity testing on dispersants prior to the Gulf oil spill as well as more recent toxicity tests on eight dispersants listed on the National Contingency Plan (NCP) Product Schedule, including Corexit 9500A, the dispersant in use in the Gulf. EPA's testing showed that for all eight dispersants tested in both test species, the dispersants alone were less toxic than the dispersant-oil mixtures. Oil alone was found to be more toxic to mysid shrimp than the eight dispersants when tested alone. Oil alone had similar toxicity to mysid shrimp as the dispersant-oil mixtures. Results are published on EPA's website: *http://www.epa.gov/bpspill/dispersants-testing.html*.

In order for any product to be listed on the NCP Product Schedule for use in an oil spill response, the manufacturer must report to EPA the results of standard acute toxicity tests on its product, the same tests that were conducted by EPA. Dispersant manufacturers are required to submit test results and supporting data, along with a certification signed by responsible corporate officials of the manufacturer and its testing laboratory stating that the test was conducted on a representative product sample using generally accepted laboratory practices, and confirming that they believe the results to be accurate. The difference between the standard testing required in the NCP and the one used by EPA in the Gulf is that the test oil for listing a product on the NCP Product Schedule is No. 2 fuel oil, whereas the oil released from the Deepwater Horizon spill that was tested by EPA is Louisiana crude oil. In addition, EPA conducted the tests for the all dispersants in one laboratory, ensuring a more effective consistent, reproducible, and repeatable way to compare the data.

Prior to applying the dispersants subsea, several tests were conducted subsea to ensure the efficacy of the application. In addition, the EPA/USCG May 10, 2010 directive required BP to test samples of the seawater at various depths using the Rototox® assay as well as testing for dissolved oxygen, and other parameters whenever subsea dispersants were used. The Rototox® assay is specified in the BP dispersant monitoring directive because it is a rapid test that can be performed on a ship. The data was collected and reviewed daily by the Unified Command as well as by EPA and NOAA Headquarters and Regional staff to ensure subsea application could continue the next day.

Q5. At the time of the hearing, MMS issued a release that announced their development of a preliminary estimate of the amount of oil flowing from BP's well. They estimate a flow rate range between 12,000 and 19,000 barrels per day.

a. Given the fact that the range has a difference of almost 60%, how is the concentration of dispersant to be applied determined?

b. What type of monitoring is EPA conducting that tracks the effectiveness of the dispersant?

A5. Applying the optimal amount of dispersant to effectively disperse oil depends on several factors including the type of oil, type of dispersant, temperature, and ambient conditions, and these conditions were evaluated on a daily basis by EPA and the Unified Command in determining the amount of dispersant to use The most important factor, however, is the amount of oil spilled, which directly influences the dispersant dosage. Typically, the amount of dispersant needed for effective dispersion relative to the volume of spilled oil, called the dispersant-to-oil ratio (DOR), is around 1:20 to 1:50 (5% to 2% based on surface application). However, based on the limited impact to the shoreline compared to initial estimates, EPA believes that the dispersant application amounts were effective in reducing impacts to the shoreline.

The joint USCG/EPA May 10, 2010 directive to BP outlined a monitoring plan for surface and subsurface application of dispersants which for subsurface include shutdown criteria for dissolved oxygen levels and rotifer toxicity tests. Concerns were not raised regarding depletion of dissolved oxygen or toxic effects measured by the Rototox assay.

Q6. Is it possible that the subsurface application of dispersants limits the effectiveness of in situ burning? How does the subsurface application of dispersants and subsequent surface application of "chemical herders" affect the recovery/ in situ burn efforts?

A6. Both *in-situ* burning (ISB) and the subsurface application of dispersant occurred on a regular basis. To EPA's knowledge, chemical herders were not used in the Gulf response effort. While the subsurface application of dispersants reduced the amount of oil on the surface that would need to be burned, it is believed that dispersant application did not limit the effectiveness of *in-situ* burning. Typically, if the seas are calm, dispersant use on the surface is less effective, while ISB is more effective. The reason is that dispersants need wave energy or turbulence to create the small dispersed oil droplets, and ISB requires calm seas to enable effective containment and ignition of the oil. On days when the weather was calm, the Unified Area Command and Incident Commander were in a position to decide to use ISB in favor of surface application of dispersants. On days when the seas were rough, decisions would be more favorable to use surface dispersant application instead of ISB.

Q7. Some experts have suggested that we transition our regulatory system from the current prescriptive-based framework to a "performance-based framework," noting that this is a trend among safety regulators worldwide, particularly in Norway. The argument is that the prescriptive-based regulatory approach tends to

create a passive attitude among companies, which aim to pass regulatory inspections instead of focusing on system performance.

a. What is your reaction to this general approach?

b. Could it potentially improve drilling safety without adding excessive regulatory costs and other burdens on producers?

c. Is the Federal government considering such an approach?

A7. EPA defers to the Department of the Interior (DOI) with respect to its regulation of offshore oil and gas drilling safety, and notes that DOI is taking a series of steps to strengthen its oversight regime.

Q8. At last year's hearing, Mr. Edinger of the California Fish and Game listed in his testimony four technology areas that required improvements: reduced visibility or nighttime oil detection capabilities, containment in high velocity currents, greater use of chemical dispersants, and ship simulators for ship pilots to improve maritime navigational safety.

a. Given these suggestions, what, if any, progress has been made in the past year improving these technology areas?

A8. Because nighttime oil detection capabilities, containment in high velocity currents, and ship simulators are not in EPA's jurisdiction, we defer to NOAA, the USCG, and BOEMRE to address these issues. EPA focused on monitoring the use of dispersant in the spill response. Through its monitoring and sampling plans, EPA ensured that dispersant use was minimized to preclude negative ecological and environmental effects. The Deepwater Horizon response has brought greater attention to the need for oil spill technology development.

The Interagency Alternative Technology Assessment Program workgroup (IATAP), established by the National Incident Commander for the Deepwater Horizon oil spill, (USCG), established a process for collecting and reviewing oil spill technology solutions. EPA was involved in reviewing these proposals and providing recommendations on which ones merited consideration for trial testing. The Deepwater Horizon oil spill reminds us that new technologies to meet our domestic energy needs will require new response technologies not previously envisioned. Progress has been made in our wave tank with collaboration with our Canadian neighbors, especially in the areas of determining the mixing energy needed for effective dispersion, developing better means of measuring dispersion effectiveness using particle size analyzing equipment and innovative fluorescence measurements, and conducting caged fish assays to quantify induced toxicity to various species. However, much more definitive work still needs to be done to fully understand dispersant technology.

Q9. What new technologies have been identified as having the potential for impact on oil spill cleanup methods and what is the current status of these technologies, both from a research and development standpoint and for current implementation in the BP spill?

A9. The Interagency Alternative Technology Assessment Program workgroup (IATAP), established by the National Incident Commander for the Deepwater Horizon oil spill (USCG) established a process for collecting and reviewing oil spill response solutions from scientists and vendors. The IATAP and the USCG's Research and Development Center (RDC) screened and triaged submissions based on technical feasibility, efficacy, and deployability. Several thousand proposals were submitted to the IATAP workgroup, and EPA worked with the USCG to review various proposals, as needed. However, we defer to USCG for an account of these submissions.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Jeffrey Short, Pacific Science Director, Oceana

Questions submitted by Chairman Brian Baird

Q1. We have an unprecedented response happening to this spill, but it is worrisome that we seem to have few metrics to actually measure how effective our response is.

For example, how do we know if adding 5,000 gallons of dispersant a day is enough, or if 50,000 gallons is needed in order to be effective? How do we know what quantity is needed to be effective?

What resources or research is needed to establish such metrics?

A1. We have reasonably good data from laboratory studies on the ratio of dispersant dissolved into oil needed to be effective. Ratios of dispersant to oil between 1:10 and 1:100 usually achieve substantial dispersion, at least with relatively fresh oil (Fingas 2001). Evaluating effectiveness in the field is considerably more problematic for a number of reasons. First, it is difficult to know how much oil is in a given area as methods for estimating the volume of oil contained within a surface slick are very imprecise. Further, judging the amount of dispersant that should be applied to effect dispersion requires allowance for the proportions of dispersant that are swept away in the air and that fall useless outside oil patches. Once applied, the proportion of oil dispersed is almost never estimated; success is usually judged on the basis of the appearance of a brownish-white suspension below the sea surface soon after application. Without knowing how much of the oil targeted for dispersion remains, how much would have dispersed naturally had no dispersant been applied, or how much of the dispersed oil recoalesces because of leaching of the dispersant back into seawater, the reliability of claims for dispersant effectiveness in the field will remain questionable.

More generally, progress on developing better oil spill response methods is hampered by three institutional barriers: aversion to exploiting spills of national significance as research opportunities to rigorously compare response methods, the inability to conduct realistic field tests in the waters of the United States and reluctance to embrace statistically-rigorous sampling and other measurement methods.

The first, best way to address this problem would be to dedicate resources to measuring, in a robust manner, our successes and failures in responding, especially during spills of national significance. For example, currently it is nearly impossible to assess differences in the performance of oil skimmers deployed during a spill because the proportion of oil in the collected material is rarely measured—only the sum of oil and water is. Part of the reason for this failing is that spill responders are reluctant to divert resources from response efforts toward studies on the effectiveness of the different methods used for fear of losing the opportunity to capture more oil. This leads to a vicious circle that materially retards identification of more effective methods.

Evaluating the effectiveness of response methods is also hampered by the complexity of oil and its behavior once released into the environment. Crude and refined oils vary considerably in properties and composition, which can change dramatically following discharge. Response officials need to be able to identify which combinations will be most effective with the least collateral damage for the particular situation confronting them. What worked well in one spill may not work as well in the next. This suggests the need to develop a robust body of performance results, quantitatively measured, in a broad variety of situations.

An obvious remedy would be to conduct experimental oil spills in waters of the United States, but the U.S. Environmental Protection Agency has not to my knowledge allowed willful discharge of crude oil for such research purposes for decades.

The resources and research most urgently needed to establish performance metrics for response methods include reliable field methods for measuring oil once it is released. These methods can be either new technologies, such as optical sensors for remote sensing, or adoption of statistical methods for quantifying oil in diverse environmental compartments. Currently, estimates of oil in the environment tend to be given as minimums, with little effort devoted to estimating the precision of such estimates. While efforts to estimate the precision are more expensive, they are considerably more informative. For example, knowing how much oil is in an oiled coastal marsh is much more useful for policy makers than simply knowing there is at least some minimal amount, with little idea of what the maximum might be. Such methods were first developed for the 1989 Exxon Valdez spill (Brodersen et

al. 1999, Short et al. 2004), and will hopefully be developed further and adopted more widely for the Deepwater Horizon blowout.

Q2. What types of research infrastructure or funding mechanisms would help us truly advance the fields of oil spill prevention and cleanup? Specifically, what research do we need to invest in to significantly increase oil recovery rates? Is it physically possible to have greater recovery rates?

A2. There are three factors that limit the effectiveness of current response methods: weather, scale, and substrate complexity. At small scales in calm weather and in open water, there are many methods available for collecting and separating oil from surface water once the oil is sufficiently corralled by booms or other means. Unfortunately, booms are only effective for corralling oil at sea states below about 5 feet, so these approaches only really work in calm weather. Development of larger-scale skimmers that can operate effectively in higher sea states would, therefore, be especially helpful.

Further, surface oil can spread and fragment so rapidly in large-scale spills that the primary difficulty becomes keeping track of where all the fragments are, prioritizing them for response, and then getting the oil recovery equipment to the highest-priority fragments before knowledge of their location is lost. On the basis of discharge rates produced since my written testimony was submitted it appears that the rate of oil slick creation in the case of the Deepwater Horizon blowout, is closer to a football field *per second*. Given that rate and the fact that oil is appearing at random within a circle of about 2 miles in diameter and immediately fragmenting and drifting apart (especially at night), our ability to corral the oil near the discharge site is simply overwhelmed, and there probably are not enough skimmers in the world to keep up. Tracking the largest fragments of oil slick that escape the immediate area by aircraft surveillance or satellite is helpful and, to a considerable extent is already being done, although the effectiveness of these methods as also limited by weather. Nonetheless, development of better methods for remotely sensing oil slicks on water and estimating their volume would be very helpful. Unfortunately, such methods are unlikely to work for oil that attains near-neutral buoyancy, when slight disturbance of the sea surface by wind can temporarily submerge much of the oil associated with the surface, obscuring it from surface observation.

It may be feasible to maintain an inventory of oil spill response capacity capable of dealing with very large spills. It is likely, however, that the cost of maintaining several such inventories near regions of large-scale offshore oil development would be prohibitive, especially given the very low frequency of such catastrophic events (on the order of once per decade or less).

Better methods for removing oil from complex habitats such as porous rocky shorelines or coastal marshes are urgently needed, and the prospects for developing more effective methods are considerably brighter. Research on the application of bioremediation techniques has lead to noteworthy improvements over the last two decades, and additional support is likely to prove rewarding. One of the main difficulties limiting the effectiveness of these methods is in keeping oil-degrading microbes continuously supplied with the nutrients they need to remain active. A related area where research may well prove rewarding is development of microbes that can degrade oil in the absence of oxygen. Development of methods to deliver the right microbes and nutrients on a sustained basis should be feasible and would be very helpful if successful.

One obvious source of funding for these efforts would be the Oil Spill Liability Trust Fund. Ideally, these funds would be administered through a permanently-constituted body similar to that described below in my response to Chairman Baird's question number 6. As for infrastructure, NOAA's Office of Response and Restoration has experience overseeing such research, as does the U.S. Coast Guard and the Bureau of Ocean Energy Management, Regulation and Enforcement. An oversight body composed of representatives from these Federal agencies should provide guidance as to the research agenda and priorities, to review proposals and monitor performance. Federal agencies, academic institutions, and industry should be eligible to apply for funds, but only provided strict scientific standards are met (see my response to Chairman Baird's question number 4 below). Finally, such research should be coordinated and, as appropriate, in collaboration with the considerable on-going efforts in Canada, France, the United Kingdom and Norway.

Q3. Since April 20, 2010, the country has seen many Federal agencies actively responding to the Deepwater Horizon spill.

In your 30 years experience dealing with oil spills, how has this response been different?

How have research findings from the larger oil spill response community been adopted into the response of the Federal Government overall?

A3. Federal agencies have developed procedures for coordinating their responses to oil spills, which work reasonably well for small to moderate discharges and have not changed dramatically since implementation of the Oil Pollution Act of 1990. These procedures come under increasing strain with large spills, because they can overwhelm staff trained for such purposes and because staff are required to train others who are re-assigned to help. Consequently, although agencies strive to address their ongoing responsibilities along with the dramatically increased burdens placed upon them by catastrophic events, performance necessarily suffers in one if not both domains. Making matters worse, as the interval between major spill events increases, there is increasing pressure to reduce budgets for agency resources and infrastructure to deal with large-scale events. This is rather like constantly cutting the budget for the fire department, then wishing it were bigger when a serious fire breaks out.

Because agency budgets have been so constrained, resources for research and evaluation of response options have been severely limited, so that agencies find it difficult to independently assess how well various response options actually work in the field, in turn constraining their ability to improve response efficiency. Because most funding for research on oil spill response technology comes from the private sector, government agencies are often placed in the unfortunate position of having to accept industry claims for performance without an independent means of verifying it.

This situation could be remedied if sufficient inducements were in place to encourage industry to adhere to higher scientific standards when developing new response technologies. For example, Federal permitting agencies could decline to recognize any response technology that has not been demonstrated to meet specified performance requirements under field conditions, if such performance is relied upon to satisfy oil spill response capability in environmental impact statements and other regulatory documents to assure the public that proposed oil field development is environmentally safe.

Q4. Rigorous scientific standards are very important as the country engages in a variety of oil pollution and cleanup research and development initiatives. In your written testimony you note that "all too often, field tests fail to meet basic scientific criteria for experiments".

What steps should the Federal Government take to ensure that reasonable criteria for studies are developed?

Should the development of criteria be a public-private activity?

A4. Research on oil spill response technologies is primarily driven by the fact that industry has to demonstrate capability to deal with accidents in order to obtain regulatory approval to explore for and develop oil fields. Because most of the funding for such research comes from industry, industry currently decides which standards to use for evaluating performance. These standards may amount to little more than a demonstration of limited success under ideal conditions. In contrast, rigorous scientific standards include clear answers to questions such as: (1) are the results repeatable? (2) what results would have been found had the treatment not been applied? (3) what range of conditions are the results valid under? (4) what range of oil products and weathering states are the results valid for? (5) what is the uncertainty of the results (i.e. how precise are the results claimed)?

New response methods that have limited actual utility are routinely recommended by private industry. For example, private companies made enthusiastic claims to the Exxon Valdez Oil Spill Trustee Council in support of a commercial product and application method to remove residual oil on beaches of Prince William Sound, Alaska, despite scant actual hard data on performance in the field. The EVOSTC reluctantly agreed to a limited test, insisting that performance be rigorously assessed by NOAA. My colleagues and I at NOAA's Auke Bay Laboratories did the evaluation. In the end, we found the method did succeed in removing a significant amount of oil from the treated beaches, but at a cost of around $1 million dollars to recover about 65 gallons of oil. Worse, our monitoring indicated that several more such treatments would have to be applied over the course of several years to clean the beaches completely (Brodersen et al. 1999). Most agreed this was not worth the expense and collateral damage inflicted on the treated beaches, and the project ended after the first year. A program to evaluate these new technologies coupled with a stringent requirement to demonstrate their efficacy before drilling occurs would help to alleviate this circumstance.

More often, such projects go forward with little or no monitoring to determine effectiveness. We see an example now in the Deepwater Horizon blowout with the pro-

posal to bulldoze oiled sand farther into the surf zone to facilitate oil removal, with no data put forward to inform us of how much oil such a procedure would actually remove from the sand, or what the cost per gallon of oil removed would be. Currently, plausible-sounding ideas such as this are put forward and all too often adopted with little or no attempt to evaluate their effectiveness.

This situation could be largely remedied if the Federal agencies involved simply insisted on adherence to scientific standards similar to those imposed by the Food & Drug Administration on applicants for product approval. Such products must be demonstrated to be safe and effective under the conditions of their proposed use. Experiments to demonstrate this would be facilitated by allowing experimental oil spills in U.S. waters, because then we could perform un-biased performance trials.

Q5. In your testimony you cite that NOAA's Office of Response and Restoration has lost about 30% of its staff over the last eight years. This office is responsible for providing scientific advice to guide oil spill response efforts and to evaluate the environmental damages caused by oil pollution.

How could the Federal Government's response to the BP Deepwater Horizon spill be different if OR&R were better funded and OR&R staff had not been cut?

Since NOAA's staff has been cut, who in the Federal Government has been doing scientific research on oil spill response?

A5. One immediate consequence of the shortfall is that OR&R has had to suspend work on most if not all the other oil spill cases on which it was working in order to marshal its response to the Deepwater Horizon blowout. The interests of the United States are not well served if smaller-scale polluters, whose impacts in aggregate over the span of several years may rival those of the Deepwater Horizon, are ignored for want of investigative capacity. Furthermore, OR&R has had to focus on its response capability *per se*, leaving little capacity available to conduct or even oversee research that would improve the efficiency of oil spill response. Also, while OR&R could and should support research on the environmental damage caused by oil spills, such efforts currently receive scant attention.

Other Federal agencies that do scientific research on oil spill response include the U.S. Coast Guard, the Environmental Protection Agency, and the Bureau of Ocean Energy Management, Regulation and Enforcement.

Q6. BP has pledged $500 million for independent research into the consequences of the Deepwater Horizon spill. How should these funds be managed to ensure they go to the most appropriate institutions and are used most effectively?

A6. I strongly urge that the example set by the Exxon Valdez Oil Spill Trustee Council be followed as a model for administrative oversight of the funds pledged by BP. The essential elements of this model include: (1) a clear statement of the scope, issues, questions and objectives that the research is intended to address, at minimum including the perturbations caused by the Deepwater Horizon blowout in comparison with natural variability in the functioning of marine and coastal ecosystems, the fate and effects of the oil, the identification of the most important ecological areas that are vulnerable to either direct impacts from the oil or to indirect impacts from cleanup efforts or from ecosystem disruption; (2) a rigorous scientific peer-review process for proposals submitted for consideration; (3) subsequent review by a public advisory group to ensure that studies address questions deemed important by the public; (4) co-ordination of these procedures by a Chief Scientist; (5) a final review and approval process by the Trustee Agencies; (6) an administrative process that monitors performance of funded proposals to ensure that progress and final reports are submitted in a timely manner; and (7) an Executive Director to co-ordinate the overall process. It is crucial that the scientific review be conducted first, to eliminate proposals that lack scientific merit or do not address the objectives identified, before review for other considerations.

Questions submitted by Representative Bob Inglis

Q1. What skimming technologies or advancements do you believe to be available that have not been, fully developed?

A1. As noted in my response above to Chairman Baird's question number 2 above, development of oil skimmers that can operate in heavier seas would improve our ability to collect oil from surface slicks substantially. Also, technologies to allow operations to be conducted safely into the night would be very useful.

Q2. Are you aware of any technologies developed overseas, as have been referenced by representatives of the Unified Command, which could have been, further developed or procured prior to the Deepwater Horizon spill?

A2. The international community involved with oil spill response technology meets biannually at the International Oil Spill Conference (*www.iosc.org*) to exchange information on, among other things, new developments in response technologies. U.S. Federal agencies, including the Coast Guard, NOAA, EPA and BOEMRE are among the sponsors of this conference, along with several petroleum industry organizations. This sponsorship and participation ensures that U.S. agencies remain at the leading edge of developments and awareness regarding advances in oil spill response technology.

Q3. In your written statement, you claim that "response options at sea cannot be applied to more than a small fraction of the oil discharged during a large-scale release" and that this is due to "the difficulty of bringing the necessary resources. for applying these mitigation methods at the scale required".

One of the purposes of the Oil Pollution Act of 1990 was to facilitate and expedited the movement of resources to where they are needed. Are you saying that the problems exhibited with moving resources during the response to the Exxon Valdez spill still exist today?

What can be done to bring these resources together? Does it require a greater understanding of existing response resources and where they are located?

Would a national clearinghouse for response equipment and latest technological advancements alleviate some of these difficulties?

A3. I have substantially addressed these issues in my response to Chairman Baird's question number 2 above. Basically, when very large spills such as the Deepwater Horizon occur, they overwhelm our capacity to deal with them. While the Oil Pollution Act of 1990 succeeded in improving our ability to move resources where needed, we still face serious limitations in keeping track of a rapidly expanding oil slick that is fragmenting and dispersing, and in getting skimmers or other response hardware to even a fraction of the oil fragments that are floating away from each other in the ocean. So, it is not a matter of having the response resources located in the right places prior to a spill, it is a matter of tracking thousands of oil slick fragments and getting boats to them before nightfall.

While a national clearinghouse for response equipment and use of the latest technological advancements (provided they can be demonstrated to actually work; see my response to Chairman Baird's question number 4 above) might marginally improve responses in some instances, for very large spills we should be realistic about what to expect even if all goes perfectly.

Q4. In your written testimony, you state that Federal agencies need to insist that scientific standards are met before relying on results touted for new approaches to oil spill response and mitigation.

How wide-spread is the use of technology for oil spill cleanup whose effectiveness relies on data that does not meet rigorous scientific standards? Are you aware if this practice violates any Federal policies regarding scientific integrity?

Has any of this technology been used in the current Gulf oil spill response and cleanup? If so, how has that technology performed? Has it hampered or impeded cleanup efforts in any way?

Do you have any recommendations for the Committee on any legislative fixes that might address this potentially disastrous loophole?

A4. This question is very similar to Chairman Baird's question number 4 above, to which I refer for my answer. However, I want to emphasize here that I do not think Federal agencies are violating existing Federal policies regarding scientific integrity. Rather, they are too often confronted with a difficult choice between accepting industry claims about the effectiveness of technologies with little capacity for verifying those claims independently, or rejecting them again on little basis and thus exposing themselves to criticism for impeding progress.

Dubious technologies are recommended routinely by those that developed them. It is usually difficult to assess whether these technologies actually helped or impeded the response effort because quantitative evaluations of performance are so often simply not done.

As noted above in my response to Chairman Baird's question number 4, however, there are two legislative fixes that would go a long way toward improving the utility and reliability of technological advances for oil spill response. First, standards comparable to those used by the U.S. Food and Drug Administration for their approval

of new products could be modified for application to oil spill response technologies, whereby candidate technologies must demonstrate they are safe and effective under the conditions of their recommended use. Second, agencies involved in the oil field permitting process could simply refuse to acknowledge any technology that fails to meet these standards when considering spill response plans submitted by the industry for new oil field development. Such an oversight standard would quickly lead to clear-cut and reliable data on performance.

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ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Samantha Joye, Professor of Marine Sciences, University of Georgia

Questions submitted by Chairman Brian Baird

Q1. "How are experts working with the Federal team to increase access to data and to deliver data in a transparent manner?"

A1. With respect to Deep water research, independent scientific experts submit data from their research cruises, along with daily reports, to the Deep water Integrated Ocean Operations Planning commanders and these data are being posted on a Wiki site (*https://www.st.nmfs.noaa.gov/confluence/display/OOP/Home*). I was told such data would be used to plan/organize the response but it is unclear to me how this process works. The urgent nature of this disaster has required all scientist involved in the response to expedite the usual scientific vetting process and provide data in ways (e.g. to the media) and on timescales (e.g. within days to weeks instead of months) that we are not accustomed to. While it is essential to convey information as soon as possible, the emergency response situation makes it even more critical than usual to analyze the data critically and thoroughly so that the message conveyed is robust and correct.

From my own experiences, I feel there is, at best, opaque, inefficient transfer of information from Federal agencies to independent scientists—the situation is one-sided: independent scientists provide data to agencies but agencies do not provide data to scientists. The lack of rapid, free exchange and discussion of ideas, missions, and effort allocation has slowed and seriously impacted (negatively) the response effort; this is a particularly serious issue with respect to blue water work.

Q2a. ". . . we seem to have few metrics to actually measure how effective our response is. How do we know if adding 5,000 gallons of dispersant per day is enough, or if 50,000 gallons are needed to be effective? How do we know what quantity is effective?"

A2a. Most of what we know about dispersant effectiveness is based on a very limited number of studies performed by academic scientists, the EPA or NALCO (the company who produces COREXIT). The effective ratio stated in most of the literature is 10:1 (oil:dispersant) but in reality, the ratio may vary depending on the type of oil (weathered, fresh), its composition, etc. Further, it remains unclear to me how the scale/size of the dispersant application is being determined, particularly at the seafloor. I believe there are more unknowns (esp. regarding "costs") than knowns (both "benefits" and "costs"), with respect to the efficacy and potential negative impacts of dispersants, and together these unknowns leave me extremely concerned about the level of dispersant use in this incident response and about the potential the long term negative impacts of dispersants on both the oceanic system, the coastal systems, and on humans exposed to these chemicals and their breakdown products, some of which may be harmful.

Q2b. ". . . we seem to have few metrics to actually measure how effective our response is. What resources or research is needed to establish such metrics?"

A2b. Using dispersants as one example, clearly there was a strong need to study the environmental impacts and degradation kinetics, for example, of these compounds prior to their large-scale introduction to the Gulf of Mexico. A basic research program, potentially funded by oil and gas industry royalties, on efficacy, toxicity and biodegradation of dispersants is sorely needed. Along those lines, more basic research on oil and gas degradation and what controls their degradation in the environment (with and without dispersants) is absolutely necessary. Much of these sorts of data are needed now, but "better late than never".

Q3. "What types of research and research infrastructure or funding mechanisms would help us truly advance the fields of oil spill prevention and cleanup? Specifically, what research do we need to invest in to significantly increase oil recovery rates? It is physically possible to have greater recovery rates?"

A3. This is outside my area of expertise but I want to make a few comments. As long as research funding related to oil spill cleanup is only available for a year or two after a major spill, there will be essentially no progress. Indeed, our understanding of the natural processing of oil and gas in the ocean is extremely limited because there are very few funding mechanisms available to support this work. "Biodegradation" of hydrocarbons is often considered too applied for some funding

agencies; that, or the topic is said to be "more appropriate" for MMS or EPA. One could argue that spill prevention and cleanup research should be funded by the industry. I agree but I feel the funds should be distributed through a Federal agency. Perhaps such a research program could be administered through an arm of the new Bureau of Ocean Energy Management, Regulation and Enforcement?

With respect to the recover rates, YES, recovery rates could have been much higher, much earlier in the incident. The biggest issue, in my opinion, is that BP underestimated the size of the leak (5000 bbl rather than 50000 bbl or more) and their capacity to recover was based on the 5000 leak rate. Had they documented the size of the leak correctly, early on, recovery would have been improved (in all likelihood).

Q4. "What additional challenges would we face if the Deepwater Horizon spill had occurred in the Arctic?"

A4. This is a possibility I have spent quite some time thinking about since the Deepwater Horizon sank: I believe this incident would have been 100 (or more) times worse had it occurred in the Arctic. The Arctic is ice covered much of the year. The nearest source of booms is likely Seattle. The nearest Coast Guard station is likely 1000–2000 miles away. How would an under ice blowout be controlled in such an isolated, extreme environment? Answer, it might not be controllable; establishing control would take much longer; the environmental impact could be catastrophic. The mere possibility of a blowout in the Arctic, particularly in ice-covered regions, is, in my opinion, reason enough to take Arctic Ocean drilling "off the table".

Q5. "Please describe potential targeted research programs that you think should be conducted on the BP Deepwater Horizon Oil Spill to truly advance our understanding of oil pollution and cleanup."

A5. First, let me say that this is not an "oil spill", it's a **hydrocarbon**—oil + gas—spill and we need to understand the impacts of hydrocarbons, in general, on the system. I will outline what I see as the phases of research and since my expertise is oceanography, I will focus on the blue water impacts rather than coastal, nearshore impacts though I stress that by doing so, I am not inferring that one system is more or less important than the other. I will divide the research into what I see as the critical components for dealing with deepwater blowout.

If a situation like this ever arises again—and I sincerely hope it does not—the first step taken should be to assemble a diverse, interdisciplinary scientific advisory panel. This panel could serve both as a source of ideas regarding research effort and it would help guide the Federal Response. I believe it would be wise to establish regional advisory boards in advance so that they are in place in the event of such a disaster. Perhaps the National Academy of Science "Ocean Studies Board" or the "Oil in the Environment" group could assemble such teams.

Research Areas and Needs

I. Spill Verification: Document the magnitude of oil and gas release immediately and continuously during the event. Such measurements should be made by an independent science team comprised of the most qualified experts, preferably those with experience in the habitat in question, rather than the company in charge of containment/control of the wellhead. Understanding the temporal signature of leakage could teach us a lot about how the reservoir is behaving. Such measurements require sophisticated acoustic and optical instrumentation, access to ROVs (which are limited in availability in the UNOLS fleet), and development and continual improvement of mathematical models to simulate fluid jets and plumes.

II. Determine hydrocarbon distributions and concentrations in the spill zone: Weeks went by before field measurements of oil concentration and vertical distribution in the water column began. More than a month went by before similar studies commenced on dissolved gases such as methane. Subsequent to the Pelican cruise, many vessels have used optical sensors to map the distribution of colored dissolved organic matter in the water column. Only a handful of research cruises have measured dissolved gases (perhaps two other cruises aside from my cruise). No studies that I am aware of to date have looked at the sedimentation of oil on the seafloor. The distribution of hydrocarbons—gas and oil—needs to be determined and tracked through time. How much is on the surface? How much is at depth and where is it? How much is on the bottom? What are the sizes of surface slicks and how do they change? Where are the subsurface plumes of oil and gas and how are they changing over time? How fast is oil sedimenting to the bottom? There are people who can make these measurements and answer these questions. Unfortunately, there is not a cohesive structure to the scientific response (i.e. NOAA's efforts) and there has not been enough additional funding (i.e. through the NSF) to allow independent scientists to make the required measurements.

III. Determine breakdown rates of hydrocarbons (biotic and abiotic) and how these rates(s) impact/influence other important elemental budgets (e.g. oxygen): How fast are oil and gas degraded biologically? Do dispersants increase or decrease such processes (why)? What are the relative proportion of biotic vs. abiotic degradation of oil and how does this split vary with time and space? What factors regulate (biotic) oil and gas breakdown? Do these factors vary? How does oil and gas breakdown influence carbon and oxygen cycling? Does breakdown lead to low oxygen waters? Does breakdown lead to ocean acidification? Are the impacts localized or large scale?

IV. Which hydrocarbons [oil and gas] are incorporated into the food web? How does this happen? What are the fisheries implications? The general assumption is that not much oil ends up getting bioaccumulated. What about the dispersants? Are they bioaccumulated? Does dispersant application alter bioaccumulation of oil and gas?

V. Background Research to provide baseline data and basic understandings. There is a critical need for baseline data on hydrocarbon distributions and metabolism in the Gulf of Mexico (and other systems). Establishing a series of basic research programs on "hydrocarbon ecosystems" could go a long way in providing both of these needs. In the past, MMS has supported some research along these lines but much of this work was focused on chemosynthetic animal communities. These habitats are critical but more work on basic biodegradation, microbiology, and environmental regulation of biodegradation in both sediments and the water column is needed. Again, royalty revenue could be used to fund such a research program but the program could be jointly administered by NSF, NOAA, and the new "MMS".

Q6. "BP has pledged $500 Million for independent research into the consequences of the oil spill. How should these funds be best managed to ensure they go to the most appropriate institutions and are the most effective?"

A6. For the sake of transparency and fairness, the funds should be made available through competitive grants and the competition should be administered by a Federal agency with experience in this area. It is still unclear to me how these funds will be distributed; the process has already been politicized and become far too complicated (i.e. why should state Governor's have a say in how the funds are distributed? What makes a Governor the appropriate judge of a study's scientific merit or lack there of? Having a single institution (LSU?) or a person at an institution (Chris D'Elia at LSU) in charge of disbursing funds could be problematic.

I feel strongly that these funds should be distributed in a non-political way-and that would b best done via a competitive grants process that is administered by a Federal agency (NSF, NOAA, SeaGrant) or by some third party (consulting firm or non-profit, Nature Conservancy) that has no vested interest in the process.

Finally, I do not believe $500M ($50M a year for ten years) is nearly enough to evaluate properly the various impacts and long term consequences of this oil spill on coastal and offshore habitats. In reality the cost to do this right would be 2–4 times that amount.

Questions submitted by Representative Bob Inglis

Q1. ". . . provide a brief summary of your understanding of what research has been done on sub-surface dispersants since the Oil Pollution Act of 1990? Do you believe this research has been executed appropriately and in a manner that considers the overall environmental impact of oil spills as well as oil spill response methods, like the use of dispersants?"

A1. I am not an expert on dispersants but I have learned a lot more about them since April 22, 2010. There is insufficient data to conclude with any certainty that an oil spill is less dangerous to the environment (reduced toxicity or increased bioremediation) when dispersants are employed. Quite the contrary, we learned from the Exxon Valdez Oil Spill that dispersants are toxic to many larvae. We do not know the impacts of dispersants on oceanic neuston nor do we know the impact on oceanic microbial communities or their activity. We know next to nothing, yet dispersants are being applied as if there is absolutely no problem. I fear this [large-scale dispersant use and use of known toxic dispersants] may end up being one of the most costly gambles of this oil spill.

Q2. "You point out that the Gulf of Mexico system is accustomed to natural inputs of oil and gas and biological communities have adapted to endure, and in some cases metabolize these materials. What impact do you think a spill like the DWH

incident will have on the biota of the GoM? What adaptation mechanisms currently exist that would give the Gulf ecosystems the resiliency needed to recover?"

A2. On a daily basis, the DWH spill is introducing 25–60 times the volume of oil (35000 to 60000 bbl) that is naturally introduced across the entire GoM (1000 bbl); this oil and gas is being injected into a very localized area. The impacts will be severe. Aromatic components of oil can be toxic (quickly). Microbial metabolism of oil and gas will result in concomitant consumption of molecular oxygen that is dissolved in the water. Oxygen consumption below critical levels (2 mg/L) makes water uninhabitable to higher organisms (any oxygen-respiring creature). Sedimentation of oil to the bottom could suffocate organisms there. The biotic impacts are likely widespread and severe and we are not quantifying these impacts sufficiently at present (in my opinion).

Because natural seepage is diffuse, most organisms around natural seeps are not exposed to high concentrations of toxic compounds. The exception is some oil seeps where invertebrates, like mussels and clams, can be exposed to high levels of PAH. These organisms have developed or many hundreds if not thousands of years, quite a tolerance for PAH. The majority of the pelagic biota are not similarly adapted so would be susceptible to toxicity effects related to, e.g., PAH. Other mechanisms to endure the spill include movement (i.e., flee affected areas) or biological selection, though selection would only prove an efficient mechanism in this situation for organisms with a very short lifetime (i.e. high turnover rate), like microorganisms.

Q3. ". . . Mr. Helton has testified that NOAA is currently gathering all available data and building a baseline from existing, yet cobbled together, data? Do you think this will be sufficient to build an accurate baseline? If not, what would you suggest to remedy this type of situation for future oil spills?"

A3. A baseline cannot be built when there is no data and for some things, like dissolved methane and higher alkane concentrations, microbial distributions and activity, there is next to no data. What NOAA puts together will certainly be useful but I fear there will be enormous holes in the data set that severely restrict its use.

I believe we need a routine monitoring program for the Gulf of Mexico where critical parameters are tracked over time. I am only aware of one offshore, blue water site where biological, geochemical, and geophysical monitoring is ongoing: Mississippi Canyon 118 (1000m water depth), a site 8 miles or so upslope of MC252. Sediments at this site have been collected and various parameters measured, roughly annually, since 2006. The MC118 Gas Hydrate Observatory program is funded by the National Institute of Undersea Science and Technology, which is a NOAA-funded Institute. The goal for the program this year is to expand the monitoring program into the water column. This program could serve as a model for others in the Gulf of Mexico. In fact, the program director would like to expand the program down slope to include two to three deeper sites but he has not secured the funding to expand the program to date.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Richard Haut, Senior Research Scientist, Houston Advanced Research Center

Questions submitted by Chairman Brian Baird

Q1. What types of research need to be targeted, ecological as well as technoloical, for a more effective response to future spills?

A1. The Houston Advanced Research Center (HARC) has worked with the Research Partnership to Secure Energy for America (RPSEA) to establish a process to determine an effective research program to address the needs of all stakeholders. On July 22, 2010, HARC will host a RPSEA Technical Forum where all stakeholders will meet to discuss the issues and determine research priorities. The forum will focus on identifying and prioritizing research and technology development required in four main areas:

- Enhance Technologies to Minimize Incidents—What is needed to prevent incidents from occurring?
- 'What else can go wrong'? in Ultra-Deepwater.
- Identify, Develop and Improve Proactive and Reactive Response Procedures and Processes—What is needed to minimize the time to respond to an incident? What is needed to minimize the environmental impact?
- Develop Understanding of the Value of Ecosystem Services and Identify Locations of High Value in a Seasonally Dynamic Ecosystem—what is needed to understand the movement of marine life/wildlife that may be affected by an incident? What is needed to understand the impact on ecosystems? What is needed to understand the value of ecosystems at risk?

The agenda for the forum and the current list of participants that have registered are given in Appendix A: ***Research and Technology Needs for Deepwater Development—Addressing Oil Recovery and Effective Cleanup of Oil Spills***.

A white paper will be written and available to all stakeholders after the forum. A copy of the white paper will be sent to Janie Wise when it is available. Types of research needed to be targeted, ecological as well as technological, for a more effective response to future spills fall into three categories:

- **Technology enhancement to minimize incidents**—A program aimed at preventing incidents from occurring in the first place may be developed. A review of the state-of-the art of technologies that may be used to improve safety, protect the environment, and ensure wellbore integrity of offshore operations will identify priorities, as well as technology gaps and further research needs. The review should consist of an evaluation of existing safeguards and international offshore procedures, standards, and practices. It should also identify promising technologies to address safety and environmental concerns associated with deepwater, harsh environments.
- **Identification, development, and improvement of proactive and reactive response procedures and processes** will address the research required to minimize response time to an incident, so that environmental impact is minimized. The primary response objectives in any open-water marine spill are:
  - Prevent the spill from moving onshore
  - Reduce the environmental impact
  - Speed the degradation of any unrecovered oil while minimizing the harm on the ecosystems
  - Mobilize rapid well intervention/containment standby equipment
- **Development of an understanding of the value of ecosystem services and location identification of high value in a seasonally dynamic ecosystem**—This program will aim to determine the value of ecosystems. The goal is to study deepwater, coastal regions and Gulf Coast wetlands, in order to identify high value areas to place monitoring and early warning devices. Valuation of ecosystem services can furthermore be used to prioritize spending on ecosystem protection.

Q2. What types or research infrastructure or funding mechanisms would help us truly advance the fields of oil spill prevention and cleanup? Specifically, what

research do we need to invest in to significantly increase oil recovery rates? is it physically possible to have greater recovery rates?

A2. The Research Partnership to Secure Energy for America (RPSEA: *www.rpsea.org*) is an effective research infrastructure that could manage a program to advance the fields of oil spill prevention and cleanup. RPSEA is a multi-purpose entity established to facilitate a cooperative effort to identify and develop new methods and integrated systems for exploring, producing, and transporting-to-market energy or other derivative products from ultra-deepwater and unconventional natural gas and other petroleum resources, and to ensure that small producers continue to have access to the technical and knowledge resources necessary to continue their important contribution to energy production in the U.S.

Through the Energy Policy Act of 2005 Section 999, RPSEA administers a public-private partnership that performs research and development for the ultra-deepwater in the Gulf of Mexico, unconventional onshore natural gas, and other petroleum resources of the United States, namely for small producing companies. RPSEA has over 172 members, including 26 research universities, companies, and other organizations and manages the 37.5 million dollars per year of U.S. Government funds, plus cost share funds from project groups. Government funds are generated from royalties and funneled to RPSEA through the National Energy Technology Laboratory (NETL), on behalf of the U.S. Department of Energy. Additionally, NETL has a $12.5 million dollar per year complementary program under the same Act. The two groups work together to ensure that research is properly prioritized and funding is effectively utilized.

Deepwater offshore exploration and production is challenging in many respects. Each prospect is full of unknowns, and the industry must be prepared for the worst. Its toolkit is vast but it has not kept up with the challenges. A proactive approach that studies possible outcomes, plans and prepares people, contains the proper amount of safety features and methods to employ them, sets responsible oversight and regulations, and is available to all for use is paramount to the safe and environmentally responsible success of the judicious use of America's oil and gas resources. RPSEA, through its oversight by the Department of Energy through NEIL, stands at the forefront of the development of systems to enable the industry to improve energy security. RPSEA uniquely provides the structure for researchers and other interested parties from a multitude of companies, research universities, environmental and safety organizations, and others to exchange ideas, transfer technologies, and provide unbiased science to develop sound policy. It is because of the role of the Federal Government through the EPAct Section 999 Program that RPSEA has been successful and that its members are willing and anxious to participate—to lead—in these activities that are so important to our country.

RPSEA was recently named as part of the coalition of the Gulf Project in response to the Deepwater Horizon incident by the governor of Texas.

RPSEA's various experts, who cover all technical disciplines, develop a plan that is updated annually. Specifically, the annual plan (*http://www.rpsea.org/annual-plans*) is submitted by RPSEA only after an exhaustive and comprehensive review of technology ideas generated by nine committees of subject matter experts. More than 700 individuals work to identify and develop these ideas and the subsequent plan. RPSEA takes its direction from the Secretary of Energy when he approves the annual plan after consultation with a Federal Advisory Panel. The needs are prioritized, RPSEA balances near and long term goals, and then publicly issue requests for proposals. Proposals are evaluated by independent experts and projects are selected that follow Federal Acquisition Regulations. Each project must not only meet the technical objectives, but it must also provide a plan that ensures that the technology will be safe and have no adverse environmental impact. In fact, some of the current projects specifically address improved safety and environmental performance. Although the projects are managed by RPSEA, they utilize industry advisory boards to assure that they meet their objectives. This process is meant to act as a check-and-balance, and it also assists in early development and commercialization of any related technologies, ensuring effective technology transfer. The aggressive technology transfer efforts ensure the work being conducted is applied in a cost effective manner.

The value of collaborative research is important. It is precisely because of government funding that a combined group from academia, research organizations, and industry can perform this type of research, which otherwise would not be cost effective. Thanks to government funding through the Energy Policy Act, coupled with significant industry cost share, the higher risk technology challenges are being addressed. The Section 999 funding of $50 million per year ($37.5 million to RPSEA and $12.5 million to NETL for complementary research), has been far from suffi-

cient to address all the concerns. The program could be far more effective if additional funds that have been authorized were appropriated.

RPSEA is currently in the process of developing their 2011 Annual Plan for research. The Deepwater Horizon incident has greatly influenced the Plan, and, as a result, even more emphasis will be placed on safety and environmental research. We must do all we can to make certain that an incident like that involving the Deepwater Horizon never happens again.

RPSEA's annual plans identify the needed research to increase oil recovery rates in a economically, safe, and environmentally sensitive manner.

Q3. Across the Federal Government there appear to be barriers to tech transfer. Please elaborate on what you see as the most restrictive practices or policies currently obstructing the transfer of innovations to both the private sector and Federal agencies. Has there been a lack of demand by industry, a lack of supply by the research sectors, or a communication disconnect between industry and research sectors?

A3. Effective technology transfer requires a public/private partnership that has sustained funding to develop, promote and sustain relationships. For example, The Houston Advanced Research Center (HARC) managed the Shared Technology Transfer Program to effectively transfer technology from NAVSEA Carderock, one of the Navy's laboratories, to the offshore and maritime industry. This program established a web-based catalog of Navy technologies available to the public, held technology workshops and forums five times a year, and established relationships with NAVSEA technology experts and industry representatives. The program was co-funded by the U.S. Department of Energy and industry. Another effective technology transfer effort is the university/national laboratory alliance that HARC has established in the Environmentally Friendly Drilling Systems Program, see: *http://www.efdsystems.org/EFDResearch/UniversityNationalLabAlliance*.

One of the issues that industry faces is that there are numerous companies that are involved in activities associated with operations in the Gulf of Mexico. Many of these are small to medium size companies that do not have research organizations. To make real progress with breakthrough technologies and technology transfer, it takes a group such as RPSEA to be properly funded and supported by both the U.S. government, state governments and by industry. The original concept of funding RPSEA at $150 million per year, as authorized in the Energy Policy Act, should be revisited, with the majority of this funding going towards safety and environmental issues. RPSEA should be responsible for organizing and supervising this research and technology development, as RPSEA can do it a cost-effective manner.

A very successful technology transfer event was recently held in Houston June 22–23 by RPSEA in which over 300 leading offshore researchers and users of technology met to review and comment on the program's current projects. This event was made possible by the Section 999 funds of the Energy Policy Act.

Through various organizations, industry has been successful in technology transfer that hold technical conferences and workshops. Examples include the largest energy technology transfer event in the world, the Offshore Technology Conference held each year the first week of May in Houston. This year some 70,000 people participated. Since the U.S. government has such a minor role technology development it has traditionally had a small presence. However, many other international governments that have an offshore role, and that have invested in technology, had a significant presence at the OTC promoting their industry and new technologies—countries such as Norway, Canada, Nigeria, China, The Netherlands, Brazil, and Australia, just to name a few.

There are also several technical organizations like the Society of Petroleum Engineers, International Association of Drilling Contractors and the Society of Exploration Geophysics that hold annual technology conferences and regional workshops focused on offshore and safety that excel in technology transfer. They also publish the results. Other organizations like the American Petroleum Institute (API), NOIA, and ASME hold regular technical committee meetings that work on standards, best practices, and reporting on new technologies.

Technology transfer is only truly successful through application, not by publishing papers. Face-to-face meetings among researchers and between technology developers and end users within industry are required for effective transfer. Only in this way are research challenges identified and prioritized, making sure the technology provider and the users have common goals that are aligned.

The former MMS (now the Bureau of Ocean Energy Management, Regulation, and Enforcement: BOEMRE) has held the Gulf of Mexico Region Information Transfer Meetings (ITM) for many years. These meetings began in 1980 as an annual meeting to foster sharing results, methodologies, and ideas related to environmental

studies, both inside and outside of MMS. Scientists in these meetings present, discuss, and share their findings in support of the Offshore Energy and Minerals Management Program. To date, during this meeting series, exciting discoveries have been presented, such as chemosynthetic communities, observations and sound of sperm whales in the Gulf, technological advances by the offshore oil and gas industry, and new developments in alternative energy technology, guidance, and regulations.

A significant deterrent to technology transfer results from the stringencies of the Federal procurement rules, which discourage many organizations from participating in the early stages of government-funded research and development. Most companies do not have a cost accounting standard that is acceptable under the current procurement rules. Intellectual Property (IP) issues are also usually huge barriers. Negotiating an acceptable Cooperative Research and Development Agreement (CRADA) takes a long time and consumes manpower—discouraging industry from working with government laboratories, or government entities from working with one another in some cases.

Communication is enhanced by local contacts. Opening the U.S. Department of Energy's office in the greater Houston area has enabled closer cooperation and collaboration between the DOE, RPSEA, industry, universities and others. Communication at the local level needs to be encouraged, supported and enhanced. Only in this manner can appropriate oversight be achieved along with successful technology transfer.

Questions submitted by Representative Bob Inglis

Q1. You describe a research program to develop ecosystem management tools and metrics applicable to coastal and offshore regions that would include data collection from satellite observations and ecosystem service models that could evaluate the changes in benefits received by humans from the environment.

a. Are you aware of this type of research being performed by any of the agencies that sat on the first panel?

b. What about agencies that we have not called to testify, such as the Department of Energy?

A1. I believe it is best to answer both parts of these questions together. The Houston Advanced Research Center (HARC) has worked with the Research Partnership to Secure Energy for America (RPSEA) to engage all stakeholders, to ensure that there is communication between various research organizations, to minimize duplication of effort and to enhance collaboration. On July 22, 2010, HARC will be hosting a RPSEA technical forum where all stakeholders will come together to discuss research and technology needs. Information about the forum, including a list of participants that are currently registered, is given in Appendix A: ***Research and Technology Needs for Deepwater Development—Addressing Oil Recovery and Effective Cleanup of Oil Spills***.

HARC currently chairs RPSEA's Environmental Advisory Group (EAG). In 2009, the EAG was requested to provide comments to RPSEA's management concerning onshore and offshore environmental issues and how RPSEA's research efforts might better take these into consideration. This effort included a review of the tremendous amount of environmental research funded by the Federal and state governments as well as through private foundations. A copy of the report is given in Appendix B: ***Environmental Research***.

One of RPSEA's funded programs, the Environmentally Friendly Drilling Systems Program, compiled a review of the U.S. Department of Energy's Environmental Program. A copy of the report is given in Appendix C: ***Review of the U.S. Department of Energy's Environmental Program***.

The National Oceanic and Atmospheric Administration (NOAA) has funded ecosystem services work on the value of coastal wetlands and marine resources. The Environmental Protection Agency (EPA) and its Office of Research and Development has the Ecosystem Services Research program which undertakes ecosystem services research with the goal of better protecting or restoring ecosystem services. The Department of the Interior's Bureau of Ocean Energy Management, Regulation and Enforcement (Formerly the Minerals Management Service (MMS)) has conducted work related to ecosystem services valuations, most relevantly as related to the market and non-market valuation methodologies referred to in CERCLA and the Oil Protection Act related to the estimation of damages from oil spills.

Other U.S. Government agencies involved in ecosystem services research include the USDA's Forest Service which has conducted work related to the development of markets and payments for ecosystem services from forested areas and water-

sheds. The Agriculture and Food Research Initiative issues competitive grants for research on the maintenance of ecosystem services with the context of agroecosystems management. The Department of Defense (DOD) pursues work on ecosystem services as part of their sustainability drive for DOD installations. In particular, the Environmental Security Technology Certification Program has issued a Request for Proposals for demonstrations of ecosystem services technologies and models that can be applied to DOD installations on a large scale. The U.S. Department of Energy (DOE) has undertaken research of ecosystem services related to the development of bio-fuels. DOE-funded research has examined ecosystem services including soil fertility, crop productivity, control of greenhouse gasses, water supply and contamination, and biodiversity. This work has taken place under the DOE's Office of Biological and Environmental Research.

Additionally, the NOAA Gulf of Mexico Regional Coordination Team sent a letter to populate a database (*http://gulfseagrant.org/oilspill/database.htm*) to share research activities regardless of the funding source. As of July 12, there were 56 projects listed in the database. A copy of the letter and the abstracts to the projects listed are included in Appendix D: ***Oil Spill Research Activities Clearinghouse***.

In 2009, HARC, with funding from industry, initiated a project concerning ecosystem services measurement and assessment. An executive summary of this project is given in Appendix E: ***Ecosystem Services Measurement and Assessment Project***. Although the project focused on Alaska, the project included a review of ecosystem management tools and metrics applicable to coastal and offshore regions that included data collection from satellite observations and ecosystem service models.

The goal for the first phase of this ongoing project was to review available remote sensing technologies and ecosystem service models and then to apply them to a pilot study to monitor and measure ecosystem attributes in relation to the production and delivery of ecosystem services. The review included research that has been or is being undertaken by Government agencies, universities, and businesses. In total, more than 150 experts actively working in various fields related to remote sensing, marine ecosystems, and ecosystem services modeling were utilized for this project. From this work, HARC developed a research program that brought together the best elements from accomplished experts, available technologies and models.

A key driver for the HARC research effort is the need to develop a method for monitoring changes in ecosystem functioning and delivery of benefits that is both reliable and cost-effective. This will be essential as ecosystem services continue to gain traction on all sides of natural resource management issues. In particular, many of the market and non-market valuation methodologies are individually referred to under CERCLA and the Oil Pollution Act to evaluate damage from oil spills (and other environmental accidents). HARC's efforts offer a methodology that holistically considers ecosystem functioning and ecosystem service benefit values.

The HARC review included leading ecosystem services models such as the Multiscale Integrated Models of Ecosystem Services (MIMES) model at the Gund Institute for Ecological Economics at the University of Vermont and the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) model being developed through the Natural Capital Project at Stanford University. Both the U.S. Business Council for Sustainable Development and the World Business Council for Sustainable Development have reviewed numerous ecosystem services models, frameworks and guidelines; however, MIMES and InVEST are the most advanced toward achieving broad modeling capabilities. During the initial phase of the project, neither MIMES nor InVEST had developed modeling capabilities for marine environments, although both have since initiated activity in this area. In particular, MIMES has begun examining ecosystems based management approaches. The MIMES team has developed a spatial dynamic model to look at species dynamics as influenced by externalities from different economic sectors In Massachusetts, they are looking into LNG pipelines, wind farms, freight routes, fishing commercial and recreational, and whale watching.

The Houston Advanced Research Center (HARC) is working with the Research Partnership to Secure Energy for America (RPSEA) to ensure that there is appropriate communication among all stakeholders concerning research and technology needed to produce energy from deepwater reservoirs in an economically, safe and environmentally sensitive manner.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Nancy Kinner, University of New Hampshire, Co-Director, Coastal Response Research Center

Questions submitted by Chairman Brian Baird

Q1. To quote Secretary Chu in a June 8th BP Deepwater Horizon press release, "Transparency is not only in the public interest, it is part of the scientific process. We want to make sure that independent scientists, engineers and other experts have every opportunity to review this information and make their own conclusions." Scientific freedom, access to data, and transparency are key to informed decisions that benefit society. Flow are experts working together and with the Federal team to increase access to data and to deliver findings in a transparent manner?

A1. Data that is collected under the auspices of Federal agencies or by agency scientists is posted on a variety of websites (e.g., *http://www.epa.gov/bpspill/dispersants-testing.html* and *http://ecowatch.ncddc.noaa.gov/*). Distribution of the information is *not* instantaneous because the data must undergo rigorous quality control to insure it is as accurate, precise, and representative as possible. In addition, most of the data is released with some form of analysis. While the delay in the release of data is often viewed skeptically by the public, as if something were being hidden, it is standard practice in all peer reviewed studies to subject the data to standard quality assurance/quality control metrics prior to its being released to be sure it is valid. EPA has detailed criteria for precision and accuracy of most established chemical analyses. In addition, statistical analysis of the data is standard to ensure that the conclusions drawn from the data are valid with a certain confidence (e.g., 95% confidence intervals).

Q2. We have an unprecedented response happening to this spill, but it is worrisome that we seem to have a few metrics to actually measure how effective our response is.

For example, how do we know if adding 5,000 gallons of dispersant per day is enough, or if 50,000 gallons is needed in order to be effective? How do we know what quantity is appropriate?

What resources or research are needed to establish such metrics?

A2. There are standard metrics that have been used in spills prior to the DWH incident. These include: the volume of oil recovered by mechanical means (e.g., skimmers); the volume of oil burned; the number of birds recovered—dead, cleaned, released; the miles of protective boom deployed; and other similar metrics. The difference in the DWH incident is that the source was so large and unabated that it was equivalent to a very major spill every day. In addition, because of the difficulty of assessing the size of the release and accessing the site, there were a large number of key unknowns (e.g., the volume of oil released per day; in the early days of the spill the location of the leaks). These unknowns were the focus of much of the media attention, especially as it became clear that initial estimates were very low compared to what "visual" observations seemed to indicate. Ironically, some of the data such as the number of dead animals has been low, especially when compared to the numbers at previous large spills (e.g., dead birds in the Exxon Valdez 34,000 vs. <5,000 in the DWH.

Peer-reviewed research by Tuler and Webler, funded by our Coastal Response Research Center (*www.crrc.unh.edu*), on previous oil spills, indicates that there is often a disconnect between what responders deem as metrics and success (e.g., low numbers of birds killed; gallons of oil recovered, evaporated or burned; miles of beaches protected from fouling) vs. the public (e.g., number of fisherman out of work, square miles of waters closed to commercial fishing). They determined that the success of a response is more likely to be viewed with similar metrics if, during the planning, preparation and training phases there is more interaction between responders and the public. For example, if nearshore waters are closed and fisherman are out of work for a period of time, it may be a necessary public health precaution. Equally important may be to have the fishing community etc, understand *before* spills occur, why dispersants may be the most viable response to protect nearshore fisheries.

With respect to the question of 5,000 gallons vs. 50,000 gallons of dispersant being used, the dispersant:oil ratio (DOR) for a variety of crude oils and several dispersants is known and published in the peer-reviewed literature. For specific oil and dispersant mixtures, there are standard tests that have been developed to as-

sess the DOR (e.g., swirling flask test). The key is knowing the volume of oil being dispersed, and the efficacy of the dispersant release and mixing *in situ*.

In many cases, the research and resources needed have been fairly well defined already. For example, there is a dispersants R&D plan that establishes what research must be performed to determine the efficacy and effects of dispersants used on the surface (*http://www.crrc.unh.edu/dwg/index.htm*). What is new in the DWH incident is the subsurface use of dispersants at the wellhead. No R&D plan exists for those conditions. Similar R&D plans exist for submerged oil, human dimensions related metrics and many others. Even for those new topics related to deepwater spills, the consensus R&D plans can be developed fairly rapidly. The difficulty is obtaining the funding for their implementation, ensuring that this research meets rigorous peer review standards, and that the results are translated into practice in a timely manner.

Q3. What types of research and research infrastructure or funding mechanisms would help truly advance the fields of oil spill prevention and cleanup? Specifically, what research do we need to invest in to significantly increase oil recovery rates? Is it physically possible to have greater recovery rates?

A3. The question regarding spill prevention and preparedness is best handled by the U.S. Coast Guard and BOEM with respect to marine transportation and offshore spills. Greater recovery rates are clearly possible for deepwater wellhead releases with the proper equipment; investments need to be made in this type of research. However, I do not believe it is reasonable to assume that percent recoveries will ever exceed 30–50% when the release is uncontrolled (i.e., when a ship's fuel tank is breached or prior to capping a well). This is because true recovery of oil is limited to mechanical methods (e.g., skimming and oil/water separation methods). These typically require devices, which must be transported and deployed at the site. For a large and rapid release, the oil spreading rate on the water is so great that the issue is often not the capacity of the skimmer (e.g., 200,000 gallons oil/day), but the encounter rate (i.e., the oil spreads to a layer a few millimeters thick on the surface and covers 100s of square miles and a given device can only recover oil from a swath 100ft wide). In addition, mechanical recovery devices are much less effective as wind and waves build, mixing the oil into the water.

The reality is that in most spills there will be environmental impacts and restoration will be necessary. R&D on restoration and recovery is rarely funded as the focus is almost always on improving response and preparedness. This is clearly demonstrated by the fact that NOAA's Office of Response and Restoration (ORR) was given no R&D budget in OPA 90.

Q4. What additional challenges would we face if the Deepwater Horizon spill had occurred in the Arctic?

A4. The Arctic challenges would include:

- Lack of any spill response infrastructure in the region
- Limited R&D on response technologies
- Lack of baseline information/data on the ecosystems and species
- Lack of information on physical conditions (e.g., currents; weather; ice thickness; movement; location)
- Little integrated ocean observing equipment (e.g., buoys, satellite information)
- Limited under ice observing and detection capabilities
- Limited information on effects of oil on Arctic species
- Lack of restoration technologies
- Logistical issues to support response (e.g., housing and food for responders, transportation of needed resources to response sites, poor operating conditions (e.g., winder darkness, storms, cold))

For more information see CRRC's report on "Opening the Arctic Seas: Envisioning Disasters and Framing solutions" (link below). The CRRC will be releasing a workshop report on Natural Resource Damage Assessment Issues and R&D in September 2010 and a copy will be forwarded to the Committee upon its completion.

Q5. Across the Federal Government there appear to be barriers to tech transfer. Please elaborate on what you see as the most restrictive practices or policies currently obstructing the transfer of innovations to both the private sector and Federal agencies. Has there been a lack of demand by industry, a lack of supply by the research sectors, or a communication disconnect between industry and research sectors?

A5. Of the many barriers, I will highlight three major impediments to technology transfer:

a. Often, R&D conducted in the private sector or academia is difficult to translate into practice because it has been developed without consultation with responders. As a result, some aspects of the technology may not be practical or useful. This can be overcome by ensuring, interaction between practitioners, responders and researchers during the development phase.

b. If academics are spearheading in the R&D, it is crucial to involve industry (potential licensees or manufacturers) of the product in the process as soon as possible.

c. The lack of demand and long periods of time between major spills discourages investment in response R&D. Unless regulatory requirements for response equipment are imposed, there is little demand for the equipment. Even then, few pieces of equipment are even purchased and most sit idle because the occurrence of spills is relatively rare. This combination of factors makes the demand for response R&D and the technology transfer limited.

Questions submitted by Representative Bob Inglis

Q1. You repeatedly state in your written testimony that the main reason for the apparent current shortfall in oil spill cleanup research and development is the general belief that another spill on the scale of the Exxon Valdez simply would not occur again in light of regulations and prevention measures. Could you please list the relevant government agencies that operated under this notion despite the passage of the Oil Pollution Act of 1990? What research was ignored and what funding was not requested as a result?

A1. The historical oil spill data since 1990 and the advancement of agencies such as NOAA, MMS and Coast Guard support the notion that the probability of another Exxon Valdez occurring was extremely low. The key to this decrease in oil spilled post Exxon Valdez requirements that all tankers in the U.S. waters must be double hulled. The spills since that time have been mostly associated with Hurricane Katrina and with freighters which remained single hulls, but which contain large fuel tanks to operate the engines. The Coast Guard's emphasis on prevention was also key (e.g., booming around vessels off loading oil). The platforms associated with the DWH are more closed linked to the lack of regulation. enforcement of the offshore oil and gas industry, largely by MSS, coupled with the difficulty of operating in very deep waters. As I said in testimony before the U.S. House Committee on Transportation and Infrastructure on May 19, 2010, I believe these agencies had pressing budge issues with meeting other parts of their missions and they could not justify increased funding to spill response when the data showed a decreasing trend in oil volume spilled.

The R&D needs regarding oil spills were clearly identified, especially since 2005, and are outlined in a number of workshop reports found on the CRRC's website (*www.crrc.unh.edu*). Topics include: dispersed oil, submerged oil, liquid asphalt, human dimensions, integrated modeling, PAH toxicity, Arctic Disasters and NRDA in the Arctic. These R&D plans were developed by workshop participants representing Federal and state agencies, NGOs, industry, practitioners, scientists, engineers, from the U.S. and abroad.

Q2. One of the main issues facing the implementation of oil spill R&D is the lack of a robust system for peer review, not only within private industry, but at the state and Federal level. How would you address this issue and in what ways could you provide incentive to private stakeholders to ensure the R&D is universally accepted, and conducted in a way that is both efficient and useful?

A2. Peer review can be conducted at several levels. I have outlined some of these below.

- Peer review of R&D program: Each R&D program should have a five year review of its activities to be certain it is meeting its mission. The review can be conducted by an independent board that consists of independent scientists and practitioners.
- Peer review of proposals: Proposal review is often conducted using only personnel from within the organization (e.g., agency staff). This is called peer review, but is problematic because it breeds parochial and self-fulfilling project funding. For example, an agency many begin to repeatedly fund on one research entity because they know that group will produce results. This does

not mean the research entity is bad, but it does often result over time in less innovation and scientific inquiry. Proposal review by a mix of internal and external scientists and practitioners is much more time consuming, but will results in a wider pool of scientific discovery and information.

- Peer review of ongoing projects: Once funded, peer review should continue on at least an annual basis by both agency staff and either a project advisory committee or liaison as well as the agency's dedicated project officer. This insures the project starts off and remains on track and anticipated issues that often arise during research are addressed promptly.
- Peer review of project upon completion: Most programs require a final report on the project results. This should undergo external as well as internal peer review. If at all possible, the results of the project should also be published in the peer-reviewed literature (e.g., Journals). This disseminates the research more widely and lends credibility to the findings because they have met the high standards of journal review.

There are few incentives to private sector to conduct peer reviews research, especially if it results in proprietary information (e.g., revealing information about a cleanup device). One area where this can be over come is to conduct the research using a team experimental design approach. In this case, the Project Committee (PC), consisting of public and private sector scientists and practitioners, jointly agreed on an experimental design that is in the Request for Project (RFP) released. Once a project team is selected by peer-review, they conduct the research (with the appropriate peer review). The incentive in this model for industry to join the PC is to have a say in how the project is conducted. Put simply, it is better to be at the table with a say in the process than looking on from the outside.

Q3. You mention in your testimony that one issue with the research conducted by some academicians Is the practical usefulness their findings; particularly in development of technology to address the problem. In addition to an assigned NOAA point of contact, how could we address this issue?

A3. The point of contact (POC) is any practitioner who would be an end user or beneficiary of the research. Another approach (mentioned above), is to designate a Project Committee comprised of a mix of advisers to the project team that reviews interim reports and meets (in person or virtually) with the project team annually or semi-annually to discuss the progress being made. This oversight during the project (from start to finish) is crucial to insure the results are useful. Furthermore, there should be a mechanism through the funding agency to help formulated the transfer of the information or technology into practice. Most R&D funding ends when the research is completed and the technology transfer is not pursued.

Q4. What other response tools, such as the various models and field guides you reference in your testimony, are currently being developed for or as a result of the Deepwater Horizon spill? Which tools or products have been the most successful and how can this be incorporated into further models for R&D?

A4. This is covered in my testimony of July 21, 2010 to the Senate Committee on Commerce, Science and Transportation, Subcommittee on Oceans, Atmosphere, Fisheries, and Coast Guard. Please see the attached copy of it.

Q5. What deficiencies from workshops held by the Coastal Response Research Center are the most relevant to the current spill or other large-scale spills going forward?

A5. The CRRC's dispersants R&D plan that identifies numerous deficiencies is probably the most relevant (links to 2005 report and May 2010 report below). Also many of the issues identified with respect to submerged oil and human dimensions (links below) also apply. There are also some relevant issues in the 2009 five-year R&D plan (notably): ecological monitoring during spills; environmental forensics; ecological effects of spills; acquisition synthesis and management of information; and response technology. In addition, there should be a workshop on issues unique to deepwater release.

Report links:

2005 Dispersant R&D: *http://crrc.unh.edu/dwg/dispersant_workshop_report-final.pdf*

May 2010 DWH Dispersant Report: *http://crrc.unh.edu/dwg/dwh_dispersants_use_meeting_report.pdf*

Submerged Oil R&D: *http://cac.unh.edu/submerged_oil/submerged_oil_workshop_report.pdf*

2009 Oil Spill R&D: *http://crrc.unh.edu/workshops/r_and_d_09/2009_r&d_workshop_report.pdf*

Opening the Arctic Seas: Envisioning Disaster & Framing Solutions: *http://crrc.unh.edu/workshops/arctic_spill_summit/arctic_summit_report_final.pdf*

Testimony to the U.S. Senate
Committee on Commerce, Science and Transportation
Subcommittee on Oceans, Atmosphere, Fisheries, and Coast Guard
July 21, 2010
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Hearing: *Turning Ideas into Action: Ensuring Effective Clean Up and Restoration in the Gulf*

Chairman Cantwell, Ranking Member Snowe, and distinguished members of the Committee on Commerce, Science and Transportation's Subcommittee on Oceans, Atmosphere, Fisheries, and Coast Guard , thank you for the opportunity to appear before you today on behalf of the Coastal Response Research Center and the Environmental Research Group at the University of New Hampshire. My perspective on the use of the applied research during the Deepwater Horizon (DWH) spill response, and obstacles that impede transforming research results into practice, is highly influenced by my work with the Coastal Response Research Center (CRRC). In order to make that perspective clear, I will first give you an overview of the Center's history, mission, activities and its approach to oil spill research and development (R&D).

1. Overview of Coastal Response Research Center

In 2002, NOAA's Office of Response and Restoration (ORR) became increasingly aware of the lack of oil spill R&D in its areas of primary responsibility: fate and behavior of spills and their impacts on natural resources and human activities. ORR recognized the role that a research university could play in addressing these needs, and started working with the University of New Hampshire to address this problem. The CRRC (http://www.crrc.unh.edu), a partnership between NOAA ORR and the University of New Hampshire, was created to address the need for improved spill response and restoration. The Center oversees and conducts independent research, hosts workshops, and leads working groups that address gaps in oil spill research in order to improve response, speed environmental recovery, and reduce the societal consequences of spills. In 2004 the partnership was codified by a memorandum of agreement between the University of New Hampshire and NOAA. CRRC acts as an independent, non-partisan entity to bring together members of the oil spill community, as well as those in relevant fields outside the spill community, including industry, local stakeholders, and state, federal and international agencies to address the many technical, economic, social, and environmental issues associated with oil spills in marine environments. Funding for the Center has been largely by Congressional appropriation (Table 1) with some allocations from ORR's base budget.

Table 1
CRRC Funding History

Fiscal Year	Appropriation	Grant to UNH	*[Other funding: specify]*
2002	$750,000	$701,997	
2003	$750,000	$714,580	
2004	$2,000,000	$1,978,955	
2005	$2,000,000	$1,694,312	
2006	$3,000,000	$2,481,900	$75,000 (Marine Debris/NOAA, ORR)[1]
2007	$1,800,000	$1,435,249	
2008	0	0	$49,000 (eSCAT/NOAA, ORR)[1] $60,000 (ERMA®/NOAA, ORR)[1] $36,000 (In-situ/API)[2] **$145,000 (2008 Subtotal)**
2009	0	0	$25,000 (Workshop/ExxonMobil)[2] $63,000 (Workshop/NOAA OCRM)[3] $162,000 (ERMA®/NOAA, ORR)[1] **$250,000 (2009 Subtotal)**
2010	0	$200,000	$220,000 (ERMA®/ for Gulf/NOAA)[1] $30,000 (eSCAT for Gulf/NOAA)[1] $65,000 (NOAA, OCRM)[3] $139,000 (NOAA, ORR)
TOTAL 02-10	**$10,300,000**	**$9,206,993**	**$924,000** **($139,000 for CRRC's Direct Oil Spill R&D Use)**

[1] eSCAT and ERMA® funding is primarily for the UNH Research Computing Center to work on computer programming. Marine Debris funding was for an Environmental Research Group project.
[2] $61k to the Center for Spills in the Environment from API ($36k for In Situ Burning) and $25k from Exxon Mobil for partial support of the 2009 R&D Workshop)
[3] Funding for workshop on Ocean Thermal Energy Conversion (OTEC) from NOAA OCRM - not oil spill related.

The Center is served by a multi-agency advisory board, comprised of members from U.S. EPA, NOAA, USCG, state-based R&D programs, and industry that provide guidance on program direction. The board, in conjunction with the UNH and NOAA co-directors, developed five objectives for CRRC: (1) funding and oversight of relevant, peer-reviewed research that is able to be developed into practical improvements in oil spill response; (2) hosting topical workshops and working groups that include representatives of all spill community stakeholders to focus research efforts, and ensure that crucial real-world experience from oil spill practitioners is considered; (3) educating the next generation of spill responders through outreach and support of undergraduate and graduate student projects; (4) involving members of the international oil spill community to tap into expertise from around the world; and (5) develop response tools to aid responders.

Funding of relevant, peer-reviewed research is accomplished through a periodic request for proposal (RFP) process. Proposals are reviewed by three to four experts in the area of the proposed research. They are ranked by their scientific validity and how well they address key research needs related to the fate, behavior and effects of oil in the environment, and is likely to lead to practical improvements in oil spill response and restoration. A panel of leading scientists and practitioners then review the peer-reviewed and ranked proposals and recommend which should be funded. Each funded research project is assigned a NOAA liaison to ensure the research can be transformed into practice, and, in addition, CRRC's Science Advisory Panel meets annually to review progress of the research and provide feedback to improve the quality and efficacy of the research.

2. Use of Applied Research Available and Implemented During DWH Incident

There are numerous examples of information and technology created during applied oil spill R&D being used during the DWH incident. I will highlight a few that CRRC has been involved with.

A. CDOG/GNOME Model Linkage

One of the first projects that the Center funded was conducted by Dr. Poojitha Yapa of Clarkson University. Dr. Yapa developed a computer model to predict the fate and behavior of oil and gas as it rises to the surface from a deepwater well blowout. The development of the Clarkson Deepwater Oil and Gas (CDOG) model was funded by the Minerals Management Service (MMS). NOAA's Office of Response and Restoration (OOR) uses its GNOME model to predict the fate and behavior of oil in surface water. A key issue, identified by NOAA modelers, was the inability to input data from the CDOG model into the GNOME model. This link is essential to the understanding of the fate, behavior and trajectory of the oil from a leaking deepwater well, as well as developing impact predictions (i.e., where the oil from a leaking deepwater well would appear on the surface and what resource it would potentially impact). With this information, responders can determine the best response strategy to protect these critical resources. During the DWH response, ORR modelers used the CDOG/GNOME predictions to generate daily trajectories for the Unified Command to aid in decision-making.

B. Environmental Response Management Application (ERMA)®

In the spring of 2006, the Center began funding a collaboration between NOAA ORR scientists and UNH computer researchers to display spill related information in a graphical and user-friendly manner. Data visualization can increase situational awareness during a large spill, especially when many of the decision makers are in different locations (e.g., for the DWH incident: Houma, LA; Mobile , AL; Tyndall, MS; St. Petersburg, FL; Washington, DC). In addition, it is important that the application is in a common format that allows most individuals to easily use it. The common way to display geographical data (referenced by its latitude/longitude) uses GIS software that requires special expertise and high-end computers to operate.

The NOAA/UNH collaboration resulted in the Environmental Response Management Application (ERMA) ®, a web-based platform that displays data (e.g., spill trajectories, current and predicted wind direction and strength) on a map that is familiar to most people. In this way, data can be overlaid on a common geospatial grid (e.g., the Gulf of Mexico) to see resources at risk of oiling, the predicted trajectory, and the assets available to protect oil from contacting the sensitive resources.

ERMA® is a good example of how a data management and visualization tool used in one field (wastershed management) can be applied to another (oil spill response) as a result of interactions between scientists and spill response practitioners. The method in which ERMA® evolved was crucial to its development and successful transfer from academia to the DWH Incident Command systems. In June 2006, after a very basic prototype was developed for Portsmouth, NH harbor. CRRC hosted a workshop that brought together Region I spill responders to demonstrate how ERMA® could aid in spill response. The workshop helped identify a team of practitioners who were willing to work with ORR and UNH researchers to develop a more detailed version of ERMA. During the next several months, development continued, as did demonstrations of ERMA's® capabilities to various agencies and the private sector. EPA Region II then funded an ERMA® for the Caribbean which was fully developed and used in a spill exercise in 2009.

When the DWH blowout occurred, the base platform of ERMA® was used to create and populate a Gulf of Mexico ERMA (GOMEX ERMA) specific to the incident, and has been in use ever since. A public site (www.geoplatform.gov) was created, and much of the information is also available to the public.

C. Other Applied Research Being Used During the DWH Incident

CRRC facilitated a webinar the third week of June hosted by the Interagency Solutions Group (IASG) of the National Response Team (NRT). The purpose of the webinar was to determine what data is available and being collected regarding the efficacy and effects of surface and subsurface dispersant use during the DWH incident. Over 70 representatives from federal and state partners participated, and data was presented by USGS, USCG, NOAA, U.S. EPA, and DOE scientists and practitioners. Much of the data was being collected using techniques developed and modified for use in oil spills during the last decade (e.g., Tier II/III SMART dispersant monitoring protocols, LISST particle counter, holographic imagery to determine particle size and distribution). While many of these tools are in use, they are not at a stage where the interrelationships among them and the ability to use their output in a quantifiable manner are possible. This is in large part because the resources to fund such research and development have not been available.

I would be remiss if I did not also acknowledge that as is typical during most prolonged environmental events, technology has also been developed and applied during the spill. Some noteworthy examples include the work of the Flow Rate Technical Group (FRTG) where members used mass balance, plume analysis, and nodal and reservoir analyses methods to estimate the flow of oil from the wellhead. Their work has refined the estimate of the size of this leak from its initial estimated 1,000 to 5,000 barrels/day (BPD) to the range of 35,000 to 60,000 BPD. Additional post-spill R&D will improve the ability to predict the flow and yield a more precise estimate. Another example is the Oil Budget tool being developed by USGS, NOAA, and the USCG which will help estimate the mass of oil that is naturally weathered (e.g., evaporated, biodegraded, dispersed) as well as that mechanically recovered and chemically dispersed or burned. Again, the tool is a prototype and will need further development, testing, and refinement before it is part of the standard package of a response, but it is well on its way.

Obviously, it is not desirable to have to build tools or response /restoration technologies during a spill, but as has been demonstrated over history, "necessity is the mother of invention." This is especially true because oil spill R&D has been typically under-funded since the mid-1990's.

3. Obstacles that Impede Transformation of Research into Practice

There are several obstacles that impede the transformation of research results into practice, but the most significant among them is that much of the necessary oil spill response and restoration research is not funded. I was delighted to read the two pieces of legislation that accompanied the invitation from Chairman Rockefeller to speak before you today. The establishment of a Federal Oil Spill Research Committee and improvement of NOAA's, USCG's, and the coastal states' abilities to sustain healthy ecosystems through the spill preparedness, prevention, response, restoration, and research will help address the lack of adequate resources to do the R&D needed. As you clearly know, the existing R&D structure codified in OPA 90 has not been adequate to address the gaps in data, tools, and techniques that have been highlighted in the DWH incident and in many of the workshops the CRRC has held since 2003. (Table 2).

Table 2: CRRC-led R&D Needs Workshops.

U.S. Coast Guard Arctic Response - April 23, 2010
NRDA in Arctic Waters: The Dialogue Begins - April 20-22, 2010
Sea Grant & NOAA ORR Collaboration - January 25, 2010
Ocean Uses Atlas - January 12-14, 2010
Response to Liquid Asphalt Releases in Aquatic Environments - October 21, 2009
2009 Research & Development Needs - March 17-19, 2009
Oil Spill Modeling Working Group Meeting - September 16-17, 2008
Opening the Arctic Seas: Envisioning Disaster & Framing Solutions - March 18-20, 2008
HEA Metrics Workshop - December 4-6, 2007
Environmental Response Data Collection Standards - September 25-27, 2007
Modelers' Summit - June 26, 2007
Submerged Oil Workshop - December 12-13, 2006
Innovative Coastal Modeling for Decision Support: Integrating Physical, Biological, and Toxicological Models - September 26-28, 2006
Toxicology Working Group Summit - August 15 & 16, 2006
Workshop on Research Needs: Human Dimensions of Oil Spill Response - June 13-15, 2006
Research & Development Needs for Making Decisions Regarding Dispersing Oil - September 20-21, 2005

In fact, the Center, in its workshop reports has outlined consensus R&D plans for dispersants, dispersed oil, submerged oil, modeling, Arctic response, National Resource Damage Assessment (NRDA), and human dimensions, as well as a 5-year overall R&D plan that includes proposals for oil forensics, geospatial data management, and spill response during disasters. These workshops have included participants from federal, state and international agencies, NGO's, industry, academia, and private sector researchers. The issue is not identifying the needed R&D, but rather it is having the funds to support this work. The Center maintains five working groups (Table 3) that consist of members of oil spill R&D community. These working groups coordinate which agency funds specific R&D projects to help avoid duplication of effort and best use of scarce financial resources. In addition, these working groups help to disseminate results among practitioners and monitor which research needs have been addressed. The CRRC typically works in concert with other working group members to hold educational sessions at conferences such as Clean Gulf where practitioners meet to learn about recent developments in oil spill R&D. Some examples are found in Table 4.

Table 3: CRRC-led Working Groups

Dispersants Working Group
Modeling Working Group
Submerged Oil Working Group
Toxicity Working Group
Ephemeral Data Working Group

Table 4: Conferences Where CRRC Hosted/Co-Hosted 1/2 Day Technology Transfer Sessions for Practitioners

Conference	Date	Title of Session	Sponsors
Clean Gulf	November 17-19, 2009	Applied Research for the Spill Response Community	LOSCO, OSRADP, TGLO, and CRRC
Clean Gulf	October 28-30, 2008	Applied Research for the Spill Response Community	LOSCO, OSRADP, TGLO, and CRRC
International Oil Spill Conference	May 4-8, 2008	Efficacy and Effects of Dispersants in Oil Spill Response: Progress since the 2005 NRC Report	CRRC
Clean Gulf	Nov 15-16, 2007	Applied Research for the Spill Response Community	LOSCO, OSRADP, TGLO, and CRRC

Another key issue with R&D funding is that it follows a "boom and bust" cycle, usually centered only spurred by major oil spills. A large infusion of funding for oil spill preparedness, prevention, and response came after the Exxon Valdez in 1989, encouraged in part by implementation of OPA 90. While R&D funding was authorized and appropriated for USCG, MMS, and EPA, as well as the two Alaska regional citizen's advisory councils (RCACs) and the Oil Spill Recovery Institute (OSRI), the budgets have not grown commensurate with inflation, resulting in less R&D as time goes on. For example, the MMS full-scale oil spill research tank in Leonardo, NJ (OHMSETT) has run a number of equipment and

training studies with mechanical recovery devices and dispersants. However, these tests are expensive and maintenance on such a facility is high. A fixed budget has diminished what can be tested at OHMSETT, and many research and development budgets cannot accommodate the costs of doing full-scale testing there, even though it would be desirable.

Technology transfer is an arduous process and is often very costly and time consuming. It requires linking the researcher and the end user together, so that the goals and capabilities of each party are identified clearly so that the technology can be best adopted to meet their final goals. It is not only the researcher who must continually modify and adapt, but often also the practitioner who begins to "see" the potential and weaknesses of the new technology and revises his/her understanding of its application. The CRRC addresses this by assigning NOAA liaisons to each funded project to help ensure the project remains focused on the end user. As with ERMA®, this may evolve into interactions with teams of end users as the technology matures. For example, several CRRC staff and students worked with NOAA Assessment and Restoration Division (ARD) scientists/practitioners to develop a field manual on acute toxicity data for polycyclic aromatic hydrocarbons (PAH), a common contaminant during release of oil to the environment. The information and format of the manual was presented to a cross-section of private sector and federal and state end users on several occasions via webinar. Each time, the end users have excellent recommendations for improving the product, some of which were addressed in subsequent editions of the manual. The toxicity manual is currently being used as a source of toxicity information during the DWH incident because each data point included has met the most rigorous quality control standards (i.e., the data have all been carefully validated) and it is in format available and useful to practitioners.

A significant obstacle to continued oil spill R&D is the infrequent nature of oil spills. The last major well blowout in the Gulf of Mexico was the IXTOC in 1979. In the interim, drilling and production technology for offshore oil and gas has grown tremendously and allowed work to proceed at water depths greater than 5,000 feet, tapping reservoirs many miles below the sea floor. R&D for the requisite response technology needed to address such a deepwater accident as the DWH has not occurred.

The Center is currently involved in organizing a series of meetings with a broad spectrum of stakeholders on the R&D issues identified during the DWH incident, using models we have used for similar topics in the past (e.g., dispersants R&D workshops followed by working groups) including federal, state, and local stakeholders, NGO's and the private sector. These workshops will also involve a commensurate effort to identify and collect existing literature on related topics to ensure research efforts are not being duplicated. The stakeholders involved in the spill as a result of BP's funding of LA, MS, AL, and FL researchers at universities and institutes will also be included. This is absolutely necessary and must be done immediately to avoid duplication of effort, insure that the practitioners' research needs are addressed and the research is transferred to end users for incorporation in future spill response and restoration.

Even if the needed spill response or restoration technology is developed as a result of an R&D effort, the incentive for a private sector partner to produce it for commercial sale is minimal. This is less true if use of the technology is mandatory. For example, if the DWH incident results in regulations requiring caps to be available for immediate deployment in case of a blowout, there will be a fairly major incentive to manufacture the caps (i.e., there are roughly 4,000 platforms of production platforms alone in

the US waters of the GOM). The incentive to manufacture large numbers of technology-enhanced skimmers and booms is less clear. The reality is that a fleet of such devices is expensive to maintain, especially when the likelihood they will be used more than a few times, if at all during their useful life. Even then, the "fleets" will likely be regional and not site specific as it is almost impossible to predict where and when a spill will occur. In this regard, the Arctic poses an even more difficult challenge, as assets may only need to be deployed seasonally when there is open water.

While R&D can develop solutions to address a variety of oil spill response and restoration issues, there is always the problem of adapting those technologies to a specific spill and the prevailing environmental conditions. Each spill is unique in its timing, location (e.g., water depth), and variables (e.g., flow rate, type of oil) as well as the habitats and resources that must be protected. While this dictates some direct investment in site-specific technologies (e.g., skimmers designed to collect and process oil in broken sea ice), it often can be addressed by building in flexibility in devices or developing robust templates, as with ERMA®, that can be used and adapted quickly to a given spill. These are details that must be addressed in the initial stages of an R&D project.

Finally, it is important to address human dimensions-related issues, a topic that, with the exception of how to incorporate volunteers in response, has been largely under-funded for oil spill response and restoration. Human dimensions R&D relates to risk communication, valuing natural resources, social impacts, coordination in response and restoration, subsistence, and environmental ethics. It is a factor in every spill. It involves regional and local culture and can render a "successful" spill response in the perspective of the local community a "disaster." One major problem is the frequent disconnect between the metrics used by responders to assess success of a clean-up vs. those used by the local community. For example, the number of gallons of oil recovered per day in on-sea activity by skimmers and in-situ burning may be meaningless to local residents or fishermen if the beaches are fouled or commercial fisheries are closed. Likewise, in Alaska, responders who do not incorporate local knowledge of currents and seasonal migration may find that they are greeted suspiciously. Indeed, this may turn to scorn if generated oil trajectory is incorrect and the oil goes where the local fisherman predicted it would. Going forward, human dimensions research, such as that conducted by Tuler and Webler for CRRC, must become a R&D priority (Table 5).

Table 5: Socio-economic research by SERI (Thomas Webler, Seth Tuler)

"Establishing Performance Metrics for Oil Spill Response, Recovery and Restoration"	$229,362	Completed 2007
"Social Disruption from Oil Spills and Spill Response: Characterizing Effects, Vulnerabilities, and the Adequacy of Existing Data to Inform Decision-Making"	$239,335	Fall, 2010

Conclusion

- There are several impediments to translating oil spill R&D into practice:
  - The lack of adequate, sustained, funding for R&D on a long-term basis
  - The need for rigorous peer review at all stages of the R&D process
  - The need for coordination between federal, state, and international governmental agencies and other critical stakeholders (e.g., NGOs, industry) regarding oil spill R&D
  - The need to facilitate the translation of the results of spill R&D into practice
  - The infrequency of major spill events and the resulting disincentive for the private sector to produce technologies that may be in low demand
  - The site specific nature of most spills that dictates specialized technologies (e.g., for use in the Arctic) and/or robust templates that can be adapted quickly to a given spill
  - The issues of diverse and specific human dimensions related aspects to a given spill involving: (a) the ecological role of humans as proximate *causes* of ecosystem stress, and underlying social drivers of those causes, (b) *consequences* of ecosystem stress for the achievability, sustainability, and trade-offs among diverse societal objectives, and (c) human mitigation and adaptive *responses* to ecosystem stress, that must be addressed to insure productive interactions with local and regional stakeholders.
- Going forward, R&D needs can be identified using an inclusive stakeholder approach with specific R&D workshops and coordination of subsequent efforts by working groups.
- R&D must incorporate rigorous peer review by scientists, engineers and practitioners and end users as well as human dimensions related stakeholders to ensure the technologies developed will meet the needs identified. This may include assigning practitioners as liaisons during R&D and in using the team approach to review as the technology matures.
- There must be coordination of R&D across the stakeholder groups for the U.S. to succeed in spill response and restoration technology development and implementation. This requires cross-agency federal coordination, as addressed in legislation being considered in Congress, but must also encompass other governmental agencies (e.g., state, local, international), as well as NGO, academia, industry and the private sector.
- Federal R&D funding must be authorized and appropriated on a consistent, long-term basis.
- Federal R&D funding should require the research to address: existing data and appropriate literature on the topic, technology transfer by incorporating end users in all aspects of the process, flexibility to adapt to spill specific conditions, and consideration of human dimensions.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Mr. Kevin Costner, Partner, Ocean Therapy Solutions, WestPac Resources

Questions submitted by Chairman Brian Baird

Q1. We learned from the first panel of witnesses that the Minerals Management Service (MMS) Ohmsett facility in New Kersey is the world's only full-scale oil spill response testing facility. Has your technology been tested by the MMS Ohmsett facility?

A1. Yes, we had a very successful demonstration at OHMSETT, the U.S. Navy and Coast Guard facility in New Jersey in January 1999. We successfully tested our oil water separator under real-life oil spill conditions. Then in 2002 we again hosted a demonstration for the U.S. Coast Guard Task Force for Contingency Planning at Terminal Island in California. Attendees included representatives from the California Coastal Commission, MMS, EPA, FEMA and Fish and Game. Over the past decade we also hosted numerous other demonstrations for government leaders and the oil industry with all the same results, absolutely no follow-up action by the government or industry. We hosted these demonstrations on our own dollar, as we were repeatedly told that there was not sufficient funding to test our machine in each subsequent round of new equipment testing. This also raises another interesting point. If you look at all the agencies involved in the interagency group responsible for spill response, it could take you years and thousands of dollars, which I know about because that is what I did, to demonstrate and prove your technology in front of them. A lot of time, money and effort for no results. That doesn't seem right. There should be one entity and that entity should either accept the technology and be the one to help navigate through the bureaucracy or tell the industry to go back to the drawing board and come back with a more refined product. In my case, I was not looking for a handout, just a helpful hand. So consequently no one moved forward, we didn't as a company and the government and industry was left with decades old technology to respond to this catastrophic spill.

Q2. Across the Federal Government there appear to be barriers to tech transfer. Please elaborate on what you see as the most restrictive practices or policies currently obstructing the transfer of innovations to the private sector and Federal agencies. Has there been a lack of demand by industry, a lack of supply by the research sectors, or a communication disconnect between industry and research sectors?

A2. I myself did not have problems with the actual technology transfer, the purchasing of a licensed patent from the Department of Energy (DOE) facility. Actually working with the Idaho National Laboratory on this technology transfer for a centrifugal force oil-water separator was never the problem; the problem arose once we developed the machine as a commercially viable technology. After all the demonstrations and tests, not one door opened for us, it was difficult as a company to figure out how to move forward. Our product sat on the shelves for more than ten years while we watched on the sidelines powerless to assist in the cleanup of the oil spills occurring on a regular basis. During the Valdez, like now, everyone was focused on the devastation of the oil spill and what to do to address it more effectively. After the Valdez spill, Congress passed the 1990 Oil Pollution Act (OPA) designed to research and develop oil spill prevention and spill clean-up measures. The Executive Branch was directed to conduct research to develop more advanced spill clean-up technology. Today as we look out in the Gulf and see booming and skimming and rubber boots, we know now that more could have been done. That is exactly what we ran up against time after time, no one in authority either in government or industry who wanted to move the ball forward to find and/or develop the next best available technology. Instead of looking at our technology as a way forward, we were met with regulations as impediments. It may be fair to assume that that lack of demand within the private sector to take on a technology transfer from the government is rooted in the understanding that even if you are able to do a successful transfer and succeed with R&D to produce a commercially viable product, you won't have a market to sell to, and the government won't be willing to listen or advise you further. It is critical that government develop a structure to follow up with industry after a technology transfer to see the fruits of that labor come to fruition. If they do not, private industry is going to have little interest in developing environmental technologies that are highly valuable and often necessary for the safety and benefit of the general public. The industry and government spent very little to de-

velop new technologies over the last 20 years, that is clear. Looking back at what went right and what fell deficient after implementation of the 1990 OPA, we can chart a way forward. I think this spill and our collective response to it has identified exactly where we need to be putting research funds: developing and deploying 21st century technologies to address spills, both small and catastrophic. In the recently passed America COMPETES bill, the Committee included a provision that creates Federal funding for research and development agreements (CRADAs) to be used by the national labs to partner with industry. Would such instruments be helpful in overcoming the technology transfer issues you describe? What else would you recommend?

Q3. In the recently passed America COMPETES bill, the Committee included a provision that creates Federal funding for research and development agreements (CRADAs) to be used by the national labs to partner with industry. Would such instruments be helpful in overcoming the technology transfer issues you describe? What else would you recommend?

A3. I believe that the establishment of the Cooperative Research and Development Fund in the recently passed COMPETES bill is a step in the right direction. As you are well aware, I solely funded the research and development of the oil-water separator once I obtained the patent from DOE. In addition, during the Committee hearing I mentioned we needed someone akin to a "parole officer" to assist in the transition from Federal research to commercial applicability. I believe it would be very beneficial to both the national laboratories and the businesses investing in these patents to have an ongoing cooperative working relationship, an entity or person that understands the uniqueness of this technology transfer. These technology transfer patents should be considered in a new category because these technologies were funded partly by U.S. taxpayers and brought to commercial viability by the private sector. American ingenuity found in the public sector and the private sector partnered together for the betterment of the Nation and the American people. I cannot tell you how their status should change or what competitive advantages they should be given, I leave that to you, but I do think it requires some study to figure out how to maximize the taxpayers funding in this type of process.

Questions submitted by Representative Bob Inglis

Q1. As I am sure you are aware, the Deepwater Horizon Response website has a link for the general public to offer suggestions on how to cap the well and how to clean up the spill. After hearing your experiences, it is conceivable that there are other technologies out there that have had the same difficulties you have had. Did you use this outreach tool? Do you think it's an effective means of making stakeholders aware of what technologies are out there? If not, what would you suggest?

A1. At the beginning of the catastrophe, we called the 800# to register with the Unified Command and left our information. We knew we had a product that could be extremely effective in cleaning up this spill. We knew we should be deployed immediately for maximum effectiveness. Luckily, a local official who had seen one of our demonstrations in Houston a decade ago, and someone who was desperate to save his beloved coast and way of life, and desperate to get on with the job of cleaning up his waters, gave us the opening we needed, and made sure our technology was put directly in front of the Unified Command, the very people who should have been seeking us out. I believe the same issues that prevented us for the last 15 years to get recognized are evidenced still in the Unified Command structure. I understand the importance of the Unified Command, that all relevant agencies need to be represented, but it also makes the group too unwieldy to work to quickly assess and deploy new technologies. There needs to be one entity, one decision maker that the private sector can go before and demonstrate their technology, both during a crisis and in times of no crisis. In addition, it is important to allow the deployment of technology during a crisis, not as an experiment, but as a calculated decision to change the economies of spill clean-up. This seems to have been done with dispersants, but not with our technology. We were held to a different standard that needs to be looked at seriously. My company has partnered with a UCLA scientist who is in the field right now collecting scientific data on the V–20, our largest machine currently deployed in the Gulf. This data will give us quantifiable data on the machines performance with and without chemical dispersants in the water. We will be glad to share this data with the Committee when our research completed. Once again, my company is undertaking this, at our own expense, because we do not have on-water controlled spills in this country to test technology. Other countries use

these spills as a tool to get to the best available technologies for spill clean-up. The Committee should review this policy as you move forward. Thank you for this opportunity.

Appendix 2:

Additional Material for the Record

LETTER FROM NOEL JONES, LEGISLATIVE AFFAIRS SPECIALIST, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230
OFFICE OF LEGISLATIVE AFFAIRS

Jane Wise
Research Assistant, Energy and Environment
Committee on Science and Technology
2321 Rayburn House Office Building
U.S. House of Representatives
Washington, DC 20515

Dear Ms. Wise:

The following are corrections to the Committee transcript following the June 9, 2010, hearing entitled Research and Technology Needs for Oil Spill Recovery:

Pg 64, line 1363. should read "*where* the primary slick is..."
Pg 81, line 1781. should be "calculations", not "custodians"
Pg 85, line 1883. should "efficacy *and* will they stay around..."

Also, while we understand that the Committee is only interested in corrections that have resulted from errors on the part of the Stenographer, Mr. Helton wanted to note one additional item that could use clarification (please consider the information as appropriate):

Pg 43, Line 841. We would like to clarify that the international liability regime Mr. Helton was referring to, the IOPC fund, is applicable only to tanker spills. See http://www.iopcfund.org/

Sincerely,

Noel Jones
Legislative Affairs Specialist
National Oceanic and Atmospheric Administration

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