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

HEARING CHARTER

Deepwater Drilling Technology, Research, and Development

Wednesday, June 23, 2010
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

PURPOSE
The purpose of this hearing is to explore the technologies, standards, and practices for prevention and mitigation of oil spillage during deepwater oil and natural gas drilling operations; the role of government-sponsored technology development programs in advancing these technologies; and, in the wake of the Deepwater Horizon tragedy, how firms will assess risk as it relates to incident prevention and mitigation.

WITNESSES

- Mr. Christopher A. Smith - *Deputy Assistant Secretary for Oil and Natural Gas, Office of Fossil Energy, U.S. Department of Energy*. Mr. Smith will address the Fossil Energy program's current, planned, and potential activities in development of incident prevention and mitigation technologies for deepwater drilling.

- Mr. James Pappas - *Vice President, Technical Programs, Research Partnership to Secure Energy for America (RPSEA).* Mr. Pappas will discuss the unique technological challenges of oil and natural gas drilling in deepwater and ultra-deepwater, as well as the role of RPSEA in developing technologies to prevent and mitigate incidences.

- Dr. Benton Baugh – *President, Radoil, Inc.* Dr. Baugh will address the adequacy of existing systems for incident prevention and mitigation, as well as the need for technological advances and the processes for deploying new technologies in the field. Dr. Baugh is a member of the National Academy of Engineering and an Adjunct Professor at the University of Houston.

- Mr. Erik Milito - *Group Director, Upstream and Industry Operations, American Petroleum Institute*. Mr. Milito will address technical standards and best practices for deepwater drilling incident prevention and mitigation.

- Dr. Gregory McCormack – *Director, Petroleum Extension Service, University of Texas at Austin.* Mr. McCormack will address advances in worker training as well as health and environmental safety practices in the oil and natural gas drilling industry.

BACKGROUND

BP Deepwater Horizon Incident and Blowout Preventers (BOP)

On April 20, 2010, an explosion and fire occurred on the Deepwater Horizon drilling rig in the Gulf of Mexico. The rig, owned by Transocean and leased by BP, was in the final stages of drilling an exploratory well at the Macondo prospect in BP-operated Mississippi Canyon Block 252, and had achieved a depth of approximately 18,360 feet in 5,000 feet of water. The accident resulted in the death of eleven workers, a massive release of oil into the Gulf, and a national response effort by federal and state government agencies as well as BP. Oil continues to flow from the well at an estimated rate of up to 60,000 barrels per day, and will likely continue at this rate until two relief wells are completed in August. While an investigation into the exact cause of the Deepwater Horizon accident is ongoing, it is understood to be a confluence of critical human errors and the failure of certain wellhead equipment designed to stop an incident. Through this hearing the Committee seeks to better understand the possible improvements in technologies to prevent and mitigate accidents during drilling operations, and the appropriate role of government-sponsored technology development programs in advancing these technologies and other methods to ensure safety.

At the Macondo well, initial investigations indicate that the primary technology failure lied in the Blowout Preventer (BOP), which is a large mechanism that includes a series of high pressure hydraulic valves designed to stop an uncontrolled flow of oil and gas from the wellbore. The Deepwater Horizon's BOP included elements of three different types of valves, or "rams." One type, known as a pipe ram, stops flow by sealing around the tubular components of a well. Another is a "blind ram," which closes over an open wellbore that does not contain pipe. The final line of defense, and likely the most critical failure in the Macondo accident, is the "blind shear ram," which uses two blades to cut through the metal drill pipe and seal the wellbore.

A BOP can be activated either remotely by personnel from the rig via electrical signal, automatically via a "deadman switch" in the case of a catastrophic incident in which the rig becomes disconnected from the BOP or a signal cannot otherwise be activated by personnel, via acoustic signal from a vessel other than the drill rig, or manually by remotely-operated vehicles (ROV). Crew members aboard the Deepwater Horizon attempted unsuccessfully to activate the BOP, including the blind shear ram, before the fire forced an evacuation. Furthermore, the automatic deadman switch did not appear to activate the BOP, nor was it equipped with an acoustically-activated switch. A number of subsequent attempts to activate the BOP using an ROV also failed. Gamma ray imaging of the BOP - devised by the Department of Energy for this incident – indicates that one of the two blades of the blind shear ram activated, but it is otherwise unknown when and how this occurred.

Several factors may have led to the failure of this BOP, but it appears that a leak in a "shutter valve" caused a catastrophic and irreparable loss of hydraulic pressure that rendered the blind shear rams too weak to cut through the drill pipe and seal the wellbore. It is not clear whether this leak happened before or after the blowout. However, even under normal operating conditions, the strength and reliability of blind shear rams have repeatedly been called into question by a number of studies and tests conducted in the last decade. In fact, some tests have concluded that the blind shear rams could only be counted on to fully activate approximately half of the time.

Cutting through hollow drill pipe requires several thousand pounds per square inch of pressure from each of the two blades. However, up to one-tenth of the length of the drill string is made up of more solid joints that connect the drill pipes, and these joints are virtually impossible to cut with blind shear rams that currently are designed to cut only through hollow drill pipe. This is compounded by the apparent fragility of the hydraulic system, and possibly the effects of deep ocean pressures and temperatures, which weaken can weaken the force the hydraulic system can apply and increase the resiliency of pipes. Some operators in the Gulf have opted to increase the reliability of their BOPs by including two blind shear rams in case one fails, yet two-thirds of the rigs operating in the Gulf still have only one blind sheer ram. Still, many others both inside and outside of the industry, including the CEO of BP, have concluded that the design of blowout preventers must be rethought altogether.

Deepwater and Ultra-deepwater Drilling Technologies

Completed in 2001 in South Korea by Hyundai Heavy Industries, the Deepwater Horizon was a semi-submersible ultra-deepwater mobile offshore drilling unit (MODU) capable of operating in harsh surface conditions and water depths up to 10,000 feet with a crew of approximately 135 personnel. It was a dynamically-positioned vessel, meaning that it was not moored to any fixed point, but instead maintained its position above the well using multiple propellers and thrusters. Though state of the art when introduced, by 2010 the rig was one of approximately 200 deepwater rigs capable of drilling in greater than 5000 feet of water, and some are drilling at depths greater than 10,000 feet. In 2009 the Deepwater Horizon set the record for the deepest oil well in history by drilling to a depth of 35,000 feet.

Often likened to space exploration in its complexity, deepwater and ultra-deepwater drilling presents a unique set of technological challenges, including for safety and incident prevention and mitigation. For instance, the greater the depth of water, the longer the drill string must be suspended without support from the rig, and the more important it then becomes for a rig to maintain its position above the well. Deviations can put considerable strain on equipment, causing failure or even a disconnection of the rig from the subsea (seafloor) architecture. This is made all the more difficult for a rig floating in open ocean that must endure high swells, high winds and strong currents. Consequently, the drill string must be considerably thicker and stronger for deeper wells, and thus requires larger BOPs with much higher pressure rams to shear the drill string. Greater depths also add significantly to the weight of the fluid column in the drill string, and thus add greater bottom hole pressure and require more energy to lift drilling fluids and other materials from the well. Furthermore, because of the tremendous overburden, the hydrocarbon reservoir may be under intense pressures far beyond those encountered in more conventional operations.

To overcome some of these challenges, deepwater drilling operations utilize subsea installations to conduct a range of functions that would otherwise be done at the surface. Such equipment must be robust enough to operate under the extreme pressures and temperatures which can cause everything from hydraulic equipment to the hydrocarbons to behave differently. Because of the high cost of testing technologies in the field, the industry is increasingly reliant on simulations and modeling to predict the performance and failure of equipment at depth. However, the extreme conditions of deepwater drilling are impossible to fully replicate in a lab.

The industry has devoted billions of dollars to researching and developing technologies for subsea and surface facilities specific to deepwater and ultra-deepwater drilling, especially those technologies which represent an increase in production efficiency. However, many contend that the industry has not devoted similar resources to the development of technologies and methods for accident prevention and mitigation. If there is a critical technology gap, the question remains as to the appropriate role of government-sponsored programs in assisting industry in developing more reliable technologies, overseeing their deployment, ensuring the development of more robust industry standards, and disseminating best practices.

Department of Energy Programs

The Office of Oil and Natural Gas, in the Department of Energy's Office of Fossil Energy, supports research and policy options to ensure clean, reliable, and affordable supplies of oil and natural gas for American consumers. However, funding for this program in recent years has been relatively limited, resulting in few initiatives to develop technologies to avoid and mitigate incidences such as the Deepwater Horizon accident. From fiscal years 2007 through 2011, both the Bush and Obama administrations have made no request for funding of any oil technology research. However, Congress has continued to appropriate small amounts solely towards exploration and production technologies. The last appropriation to the Office of Fossil Energy's Petroleum – Oil Technology program was in 2009 for just under $5 million.

Under section 965 of the Energy Policy Act of 2005, DOE has the authority to conduct research and development in oil and gas exploration and production as well as related environmental research. DOE has a wide range of intellectual and technical resources, including the national labs, that could be leveraged to conduct research and advance technologies in areas that individual companies alone are not likely to aggressively pursue.

DOE also funds oil and gas R&D through authorization of $50 million in annual mandatory spending from offshore oil and gas royalty revenues collected by MMS. Through authorization in Section 999 of the Energy Policy Act of 2005, DOE conducts approximately $12.5 million of "in-house" research at the National Energy Technology Laboratory (NETL). The remaining $37.5 million in R&D is managed by a public-private research consortium.

EPAct 2005, Section 999 – Ultra-deepwater R&D and the Research Partnership to Secure Energy for America (RPSEA)

Section 999 of the Energy Policy Act of 2005 authorizes the Secretary of Energy to establish an ultra-deepwater and unconventional onshore resources research and development program. Management of the program was awarded to a research consortium headquartered in Sugar Land, Texas, known as the Research Partnership to Secure Energy for America, or RPSEA, which is overseen for DOE by the National Energy Technology Laboratory (NETL).

The program under RPSEA is divided into three parts: ultra-deepwater architecture and technology (UDW); unconventional onshore natural gas and other resources; and technology challenges of small producers.

According to RPSEA, and consistent with EPAct 2005, the mission of the Ultra-Deepwater Program is to identify and develop economically viable (full life cycle) acceptable risk technologies, architectures, and methods for exploration, drilling, and production of hydrocarbons in formations under ultra-deepwater, or in the Outer Continental Shelf (OCS) in formations that are deeper than 15,000 feet.

This mission of technology development encompasses:

- Extending basic scientific understanding of the various processes and phenomena that directly impact the design and reliable operation of an ultra-deepwater production system.
- Developing "enabling" technologies that facilitate the development of additional technical advances.
- Enhancing existing technologies to help lower overall cost and risks.
- Pursuing "Grand Challenges" (long-term, high-risk research on applied science and on key leveraging and transformational technologies capable of "leapfrogging" over conventional pathways).
- Accomplishing ultra-deepwater resource development in a safe and environmentally responsible manner.
- The goals of the UDW are to develop the ultra-deepwater resource base and to convert currently identified (discovered) resources into economic recoverable (proven) reserves, while protecting the environment.

These goals will be achieved by:

- Reducing the costs to find, develop, and produce such resources.
- Increasing the efficiency of exploration for such resources.
- Increasing production volumes, production efficiency, and ultimate recovery of such resources.
- Improving safety and environmental performance, by minimizing environmental impacts associated with exploration and production in ultra-deepwater.

Since the inception of the program both the Bush and Obama administrations have sought to repeal funding of the Section 999 program. However, Congress has kept the funding mechanism and the program in place. RPSEA currently has approximately 170 members, with representation from across industry, academia, NGOs, and government laboratories and programs. In the wake of the Deepwater Horizon tragedy, questions have arisen as to how this program, in conjunction with a more robust program in DOE Fossil Energy, could better serve the nation's needs for development of advanced environmental and worker safety technologies and practices while providing a federal resource for technical expertise on deepwater and ultra-deepwater drilling technologies.

Industry Standards and Best Practices

The Department of the Interior's Minerals and Management Service (MMS) is responsible for the promulgation of the nation's offshore operating regulations. According to MMS, the regulations are written to ensure "safe operations and preservation of the environment, while balancing the Nation's needs for energy development." These regulations are often informed by industry standards developed by the industry through the American Petroleum Institute (API). API is the main U.S. trade association for the oil and natural gas industry and is also the main body responsible for the establishment of industry standards. API issues standards that fall into two categories: manufacturing specifications and recommended practices. API's standard-making procedure is approved by the American National Standards Institute (ANSI) and convenes experts from manufacturers, drilling companies, operators, service providers, government regulators, and academia. Standards are also developed by other organizations such as the International Association of Drilling Contractors (IADC). MMS rules and regulations often incorporate these third-party organizations' standards which, when published in the Federal Register, have the "force and effect" of law. There is growing support for MMS to transition from broader, industry-written performance goals to narrower, more prescriptive regulations.