TESTIMONY OF:
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Chairman Bishop, Ranking Member Grijalva, and Committee members, thank you for the opportunity to again provide testimony to this Committee on issues important to management of the nation's natural resources. Today I appear before you to summarize some of the environmental consequences and propose some steps to be taken to address the ongoing challenges we face resulting from the *Deepwater Horizon* oil spill, and in enabling safer drilling in the future.

My perspectives in providing this testimony are two-fold. During the *Deepwater Horizon* (DWH) oil spill I served as a senior science advisor to the Under Secretary for Oceans and Atmosphere at the Commerce Department for issues related to the oil spill. I did so from my position as the Director of Scientific Programs and Chief Science Advisor at the National Marine Fisheries Service. I saw first-hand the difficulties in responding to the unprecedented volume of oil released continuously over an 84 day period in the deep, cold recesses of the Gulf of Mexico.

Subsequent to the spill, I retired after 34 years of service from NOAA to become a Professor of Biological Oceanography at the University of South Florida, in St. Petersburg Florida. In my current capacity I direct a large, multifaceted and multi-institutional research program concerned with understanding oil spill impacts and increasing preparedness to deal with deep spills of the future. The work of my colleagues and me is funded through a grant from the Gulf of Mexico Research Initiative (GoMRI), which was in-turn funded via $500 million from BP in the early days following the spill. The goals of our Center for Integrated Modeling and Analysis of Gulf Ecosystems (C-IMAGE; http://www.marine.usf.edu/c-image/) are to address fundamental questions of science with respect to response procedures and to help understand the long-term consequences to natural resources and people of toxic chemicals in environment.

An Unanticipated and Unprecedented Spill

"*We are fighting an omnidirectional, almost indeterminate threat here. We are trying to protect the entire Gulf Coast at the same time*."

Coast Guard Commandant Thad Allen, May 18, 2010 before the
Senate Committee on Commerce, Science, and Transportation.

In the years prior to the *Deepwater Horizon* incident, the offshore oil and gas industry had progressively migrated offshore into the deeper parts of the Gulf of Mexico, and elsewhere around the world, as easier to obtain formations were explored and subsequently played-out. The advent of "ultra-deep" drilling (>5,000 feet water depth) has accounted for an increasing and

now significant portion of production in the last decade, despite the relatively high costs of production there. While *Deepwater Horizon* was located in over a mile of water depth, it is by no means the deepest well drilled in the Gulf. As the quote above from former USCG Commandant Admiral Thad Allen (cited in Lubchenco et al. 2012) indicates, despite the practice of drilling in such extreme depths, the industry and government regulators were unprepared for the advent of a massive spill occurring at the water-geological interface. Even now there is considerable dispute as to the specific conditions that conspired to cause the accident, the efficacy of response measures - many of which were essentially made up on the spot - and the full set of environmental effects of DWH.

In the intervening years since the spill, government regulators and the industry have become more safety conscious regarding deep drilling, as attested to by the witnesses in today's hearing. However, as with the *Deepwater Horizon* incident, we must ask the question – are we preparing for the circumstances for the *last* spill or anticipating the conditions that will occur during the *next* major spill? Remember that five years ago a mile deep well was a novelty, now the industry is drilling in two miles water depth and even deeper.

The volume of oil and gas released during *Deepwater Horizon* into the environment and the conditions under which that release happened by were unprecedented at the time. Although deep blowouts and their characteristics were previously and presciently considered (Ross 1997; NRC 2003), practical spill response measures for such a unique scenario, such as sub-surface containment, dispersant use in the deep sea, and prediction of fate and effects, were not brought into operational spill response planning prior to DWH (McNutt et al. 2012; Lubchenco et al. 2012).

Should a deep blowout occur at two miles water depth, many of the conditions extant during the DWH spill will be fundamentally different, resulting in yet a different spill scenario. Hydrate formation conditions will be altered and more critical in determining the utility of containment technology and the rise rate of oil droplets. Different gas/oil ratios (GORs) will result in altered turbulent mixing of multi-phase jets of oil, gas and water. As well, the "family" of oil composition will likely differ resulting in a heavier/lighter or sweeter/more sour crude being released. All of these differences need to be carefully be considered as to impacts and efficacy before, or if, the *Deepwater Horizon* "play book" is used once again.

What people Ask Scientists in the Gulf about DWH

In order to design a hydrocarbon extraction policy that is safer for the workers and the environment, it is contingent on us to carefully assess the risks of accidents of various types and volumes. Risk is a combination of the probability of a particular accident or phenomenon happening and the significance of the consequences should that particular event occur. In the case of DWH, the frequency of a deep spill may be low (as compared to accidental low level releases associated with surface operations), but the sheer volume and extent of the spill may have consequences that last for decades or that result in threshold-level changes to the ecosystem that are unrecoverable. Understanding the totality of these risks requires that we evaluate spill effects from many perspectives. State and federal regulators, representatives of various use sectors and the public all consider the spill from a variety of different lenses. Gulf scientists are

often asked about many aspects of the spill that reflect these multiple perspectives of risk. The questions that most often recur include:

- Where is the Oil Now? When will it be Gone?
- How Toxic is (was) the oil?
- What about dispersants?
- Is the seafood safe to eat?
- What are the short- and long term impacts on biota (fish, birds, marine mammals)?
- What will be the human health impacts?
- Are we (as a society) better prepared now to respond to a spill of the magnitude of DWH?
- Is such a spill less likely to occur now than it (apparently) was in 2005?

Designing an acceptable oil spill risk policy for the nation requires that we understand better the answers to these and other questions so that we can improve the system to minimize the frequency and mitigate the impacts of future spills along these and other dimensions. Improvements to the current system for risk reduction have real costs to the industry and society, and balancing those costs with the goal of minimizing the risk to levels well below those that existed in 2005 should be our ultimate goal. In order to do so, we need more and better science to address the tradeoffs of risk to cost. Thus, in the wake of the DWH incident it is critical that we carefully evaluate the questions above, and others, as we plan for the next disaster response and build more risk aversion into the current regulatory system

What do we know now that we did not know then?

Because of the generous funding of organizations such as GoMRI, the National Science Foundation, various state and federal agencies, and other sources, we now have partial answers so some of the key questions vexing responders during the DWH spill. For example, we now know the following:

- Oil and gas from ruptured well will create dense clouds of fine, almost neutrally-buoyant plumes in 900-1200 meters of water and never surface – even without the addition of chemical dispersants. The key – and yet unresolved – aspect of this problem is the role, if any, the addition of dispersants injected at the well head played in keeping oil volume from surfacing. This is a fundamental problem of enormous practical importance that can only be answered through carefully controlled high pressure experimentation and modeling (e.g., Paris et al. 2014). These studies are ongoing (funded by API, GoMRI and others) but have yet to be concluded and independently peer reviewed.
- Oil does not, in all circumstances, float, and large quantities of the DWH oil remain trapped in sediments of the deep Gulf. Estimates range from 4-30% of the volume exiting the well currently residing in deep water. Additional DWH oil can be found near beaches in the form of tar patties and tar balls, and in some of the coastal marsh habitats.
- A combination of oil, dispersants, dead plankton and fine clay from river inputs conspired to form a "dirty blizzard" which coats the bottom of the Gulf in a >1,000 square mile area (Valentine et al. 2014; Schwing et al. 2015), and which also occurs in the deep waters off Mexico following the IXTOC-I blowout in 1979-1980.

- High resolution satellite and aircraft imagery and airborne sampling can be used both to track surface oil and to measure its thickness and therefore quantity, as well as the chemical composition of oil.
- The composition of oil residues in fishes can closely resemble that of the crude oil that taints them (Murawski et al. 2014)
- Different species can exhibit vastly different contamination levels, even if taken in the same location, due to differences in contamination vector and physiology
- Due to a combination of aggressive fishery closures and intensive seafood inspections (Ylitalo et al. 2012) no tainted seafood apparently reached the market following DWH.

The over 400 scientific papers published in the wake of the DWH disaster have done much to close the knowledge gap, and the lessons from these studies need to be folded into disaster response strategies. Impressive as the pace of scientific understanding of spill dynamics has been in the past five years, there remain a number of key scientific uncertainties that are critical to resolve prior to the next deep spill:

What do we Need to Know (that we do not know now)?

- What are the Baselines of contamination in sediments, water and biota associated with the ~4,000 oil and gas facilities in the Gulf (and pipeline fields as well)?
- How do the depth of the water and specific oil composition affect the efficacy of response measures?
- What resources are at risk from a potential oil spill at any location in the Gulf?
- How would surface and sub-surface oil spills move, at what rates, and in response to what factors?
- What are the environmental consequences of oil spill response measures (burning, dispersants, sand berms, water releases)?
- Will deep plumes form without the addition of any dispersants at all? What value is added by the use of deep dispersants (if any), what is their environmental consequence?
- Can ultra-deep drilling and production be accomplished with greatly reduced risks of environmental damage?

Resolving these and other issues should be viewed as critical "known unknowns" in oil spill response. Below I focus on a few approaches that Congress and the Administration could collaborate on in addressing them.

Steps we can Take to be Better Prepared for Future Spills

(1) Address the Lack of adequate Environmental Baselines:

Currently there are literally hundreds of environmental scientists, students and citizens conducting studies to determine the impacts of the DWH spill on the environment and biota of various types. These studies are use both to assess penalties in the litigation phase of the accident, but also to understand the spill's implications for public safety and long-term environmental sustainability in the Gulf. We can discover much about these impacts by evaluating contaminants locked in the sedimentary record before, during, and after the spill

(Stanschi et al. 2001; Schwing et al. 2015), monitoring the recovery process (Murawski et al. 2014) and by comparing resources in the spill zone to control areas far from the spill. However, literally every environmental scientists that I have spoken with has lamented the lack of comprehensive pre-spill environmental baselines as making the job of assessing DWH effects needlessly complicated and expensive. For example, one of the only baseline studies of hydrocarbon residues in sediments, water and fish comes from a study (funded by MMS) conducted in the early 1990s, over 300 miles west of the DWH accident (McDonald et al. 1996). Had the record of PAH contamination of the environment surrounding DWH been periodically monitored, the process of disentangling DWH effects from background contamination would be much more straightforward than it is today.

Maintaining adequate baseline studies and periodically assessing changes due to energy exploration and development activities is clearly within the purview of DOI/BOEM, as specified in the Outer Continental Shelf Lands Act (OCS) of 1973:

"The Environmental Studies Program[1] now managed by BOEM was first established in 1973 by the OCS Lands Act, which directed the Secretary of the Interior to –

• Establish information needed for the assessment and management of impacts on the human, marine, and coastal environments of the OCS and potentially affected coastal areas.

• Predict impacts on marine organisms resulting from a variety of factors: chronic low level pollution or large spills associated with OCS production; discharge of drilling muds and cuttings, as well as pipeline emplacement; and onshore development.

• Monitor human, marine, and coastal environments to provide time-series and data trend information for identification of significant changes in the quality and productivity of these environments."

Clearly, despite these stated mission goals for DOI, gathering the "*information needed for the assessment and management of impacts on the human, marine, and coastal environments of the OCS…"* is a priority not currently being met. Given the continuing development of ever deeper petroleum reservoirs in the Gulf of Mexico, as well as the schedule for expanded leasing activities along the Atlantic Seaboard and off Alaska, there is an increasing need for these environmental baselines and associated studies. The budget within the Department of the Interior is inadequate to meet these responsibilities and has been stagnant for years.

One way to assure adequate baseline data are obtained is to require such data be collected periodically. Congress and the Administration could stipulate that:

> *The Bureau of Ocean Energy Management shall require (at the expense of the operator) that all existing and planned marine oil and gas production facilities be monitored at no*

[1] This section quoted directly from: 2015. BUDGET JUSTIFICATIONS and performance information for 2016, The United States Department of the Interior, BUREAU OF OCEAN ENERGY MANAGEMENT: http://www.doi.gov/budget/appropriations/2016/upload/FY2016_BOEM_Greenbook.pdf

more than five year intervals to provide baseline and ongoing contamination assessments of sediments, the water column, and marine life (e.g., invertebrate and fishes) in the vicinity of these facilities. The Department shall develop scientific protocols for such activities and make the data publically available on a continuing basis.

Such a requirement not only would make assessing the impacts of any new spill much more direct, but would potentially help the industry demonstrate the facts about environmental pollution associated with its routine operations and if a company was responsible for environmental damage from an accident. For example, in the case of the *Hercules #265* gas rig explosion in July, 2013 off the Louisiana coast, baseline information on fish contamination was available for the vicinity from post-DWH studies. Sampling in the aftermath of the *Hercules* event showed no increase over the baselines in the concentration of low molecular weight polycyclic aromatic hydrocarbon (PAH) metabolites in red snapper bile, although high molecular weight PAHs, resulting from burning hydrocarbons, did increase.

(2) Invest in Independent Science through Environmental Studies and Oil Spill Preparedness Programs

The Bureau of Ocean Energy Management (BOEM, representing parts of the former Minerals Management Service), maintains its Environmental Studies Program (ESP) to conduct research and provide critical information on a wide variety of subjects ranging from the impacts of seismic exploration on marine mammals, deep coral and chemosynthetic community mapping, alternative energy development, archeological relic preservation and contamination studies. The spatial domain of study has increased to include the Arctic and, with impending lease sales in the Atlantic, to that region as well. The budget to cover the wide scope of issues and increasing spatial domain of development is only about $35 million per year – far too little to make effective progress and support national policy initiatives. I recommend that Congress and the Administration consider a significant and commensurate increase in the Environmental Studies Program budget at BOEM.

(3) Invest in Interagency Oil Spill Research

One of the important, but often overlooked, lessons of DWH is the key roles that coordinated actions among the relevant federal agencies play in addressing the "omnidirectional" threats resulting from massive and unique oil spills (Lubchenco et al. 2012; McNutt et al. 2012). Congress anticipated the importance of the synergy among agencies in writing OPA-90 by establishing the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR). Housed within the US Coast Guard, ICCOPR has membership including all agencies dealing with aspects of oil spill response. However, while OPA was authorized in 1990, there has been no recent funding directed to ICCOPR to address the long list of interagency research priorities identified by that group. Other that some federal funding spent under very restrictive stipulations of the Oil Spill Trust Fund, there is no funding to coordinate disaster response strategies among agencies, and to close critical research gaps identified by them. I recommend that Congress and the Administration collaborate on funding directed specifically to address the research priorities identified by ICCOPR.

This research potentially bears not only on the response measures to a spill but can help identify (through resource mapping studies combined with four-dimensional hydrodynamic modeling) drilling locations that may present an inordinate risk should a large accidental spill occur. In this case, regulators may deem drilling in these locations unacceptable. While these and other research projects are clearly worthy of priority they remain essentially unfunded.

(4) Increase Transparency and Collaboration among Industry, Government and Academic Scientists

"*The worst time to be exchanging business cards is during a crisis"*.

Quoted by Dr. Marsha McNutt, former Director of the US Geological Survey and current editor, Science Magazine (McNutt 2015).

In responding to the unprecedented nature of the DWH spill, a number of *ad hoc* committees were formed to help answer thorny technical problems, devise new solutions and to review data and analyses to be made public. While initially made up of government and industry scientists, all of these committees eventually entrained independent academic scientists. This is because the expertise necessary to solve the problems resided outside pre-arranged communication channels, and because the scale and scope demanded high levels of transparency in decision making and in the conclusions being reached. The inclusion of academic scientists was not without controversy or problems, but on balance better decisions were ultimately made because of it (McNutt et al. 2012; Lubchenco et al. 2012; McNutt 2015). Problems in using independent scientists in this role were exacerbated by the lack of organization of the large, diverse community with specialized expertise, and the unprecedented nature of the interagency working groups as established. Since the DWH spill the academic community in the Gulf has formed the Gulf of Mexico University Research Collaborative (http://gomurc.usf.edu/) with the goal of establishing a clearing house to rapidly identify pertinent expertise in the event of a large-scale spill. As well, the US Coast Guard has formed partnerships with the academic community, including establishing new memoranda of understanding to enhance such collaborations.

A number of key scientists and policy advisors, both within and outside agencies, have also been working to better define the roles and advantages of enhanced collaborations among responders and academic scientists through the *Science Partnerships Enabling Rapid Response* project at the Center for Ocean Solutions[2], at Stanford University. Rather than being seen as antagonistic, such collaborations among industry, government and academia are a positive development and such collaborations should therefore be nurtured and supported.

(5) Re-Authorize OPA-90

[2] www.centerforoceansolutions.org/project-science-partnerships-enabling-rapid-response

It has been nearly 25 years since the Oil Pollution Act of 1990 was passed by Congress and signed into law. The industry has evolved considerably, and drilling and production have become much more complex, especially with the advent of ultra-deep drilling. While the current law is a vast improvement over what existed when the *Exxon Valdez* spill occurred, like most legislation, it needs to be updated and expanded as circumstances have changed. A vigorous, open and collaborative debate on provisions of a re-authorized law can carefully consider provisions to reduce or eliminate inordinate risks in hydrocarbon production while carefully considering the costs of various proposals to the industry and the public. As an example, the process of such an open and transparent debate preceded the 2007 reauthorization of the federal Magnuson Stevens Fishery Conservation and Management Act, resulting in near unanimous passage of landmark legislation that sets the global standard for fishery conservation and sustainability. We should have no less comprehensive model legislation regulating oil pollution for the United States. I will not discuss specific proposals for new provisions of a reauthorized OPA but suggest the process of considering reauthorization will result in a thorough debate on the merits of various regulatory approaches.

(6) Improve International Aspects of Oil Spill Preparedness and Response

As the oil and gas industry in the Gulf expands to ever deeper waters of the Gulf it has edged closer to the boundaries of the US Exclusive Economic Zones (EEZ) with Mexico and Cuba. Likewise, the Mexican state oil company PEMEX has initiated ultra-deep drilling near the US EEX, and Cuba has been conducting exploratory drilling in its waters. A large spill near the boundaries of EEZs in the Gulf will likely affect all. The next deep spill in the Gulf will thus likely have a more international component to both oil spill effects (distribution across international boundaries) and in coordinated oil spill response. To its credit, the US Coast Guard has been reaching out to these nations to coordinate response activities in the advent of a spill impacting multiple jurisdictions. More needs to be done, however, in harmonizing safety standards, collaborating on international response, joint clean up and training and exercises and in setting of mutually beneficial extraction policies. The international aspects will be evident as well in the Arctic as exploration and production activities are expanded there as well. There is much to be gained from more direct engagement on such international collaborations, and Congress and the administration can set the tone for positive engagement with international partners.

Summary

Increased government oversight, better equipment, higher regulatory standards determining when and how to drill, and heightened awareness on the part of the industry are important factors in assuring that deep drilling becomes safer for workers, the public and for the environment. However, while these steps are necessary they are not, in and of themselves, sufficient to reduce risk of harmful spills to a negligible degree, as was the operating assumption prior to *Deepwater Horizon*. The marine environment is a publically owned resource. All operations conducted on public lands need to be carefully monitored, in an open and transparent way, to assure the public that oil and gas operations do not harm the asset value of the full portfolio of ecosystem goods and services (Ocean Studies Board 2013) owned by all of us. Likewise, in the advent of another

deep oil spill, measures used by the industry to clean the environment and mitigate damage should not compound the toxic effects of the spill itself. More research on innovative methods to interdict spills and clean them up are urgently required. As we remember the legacy of DWH we should redouble our efforts to anticipate, prepare and train for the next disaster. The events earlier this month when workers were killed and injured aboard a Mexican production platform in the Gulf of Mexico should remind us of the dangers of complacency. Guarding against such complacency by doing more to make ocean drilling safer for people and the environment honors the legacies of the 11 workers killed as a result of the *Deepwater Horizon* disaster.

Thank you for your attention, and I will answer your questions to the best of my ability.

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