Statement of

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HEARING ON

Turning Ideas into Action: Ensuring Effective Clean Up and Restoration in the Gulf

BEFORE THE

Subcommittee on Ocean, Atmosphere, Fisheries, and Coast Guard of the Committee on Commerce, Science, and Transportation

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Good morning Madam Chair, Ranking Member Snowe, and Members of the Committee. My name is Fritz Stahr. I am a physical oceanographer at the University of Washington's College of the Environment School of Oceanography. Presently I run the Seaglider Fabrication Center within the School, which makes, and helps owners' use, an autonomous underwater vehicle (AUV, or more simply, underwater robot) called a Seaglider™. Three Seagliders are presently deployed in the Gulf of Mexico around the DeepWater Horizon oil well observing various ocean properties, some which may show the presence of an underwater oil plume which comes from the seafloor oil well-head. Two of those units are owned and operated by the US Naval Oceanographic Office (NAVOCEANO), which purchased them from us about three years ago, and for which we provide maintenance. The third is owned and operated by iRobot Corporation, which has a sole-license from the UW to make, sell, and maintain Seagliders for all parties outside the UW. You may see the data from all these Seagliders, as well as other ocean gliders, at a webpage sponsored by NOAA's Integrated Ocean Observing System (IOOS): http://rucool.marine.rutgers.edu/deepwater/.

I am also a mechanical engineer, and Chair of the Puget Sound Section of the Marine Technology Society (MTS - https://www.mtsociety.org/home.aspx). MTS has many members in the business of designing, building, and operating a wide range of research and operational marine equipment and instruments, including for both the oil industry and basic ocean research. My testimony today will touch on aspects of this nation's capacity for better use of basic research-related technologies, and observations as an engineer of the series of equipment failures that gave us 80+ days of crude oil venting from the seafloor.

An oil "vent", not "spill", and the connection to an active ocean research community

To call this incident a spill implies the oil was in a container at one time, such as a ship or tank on land. But it actually comes directly from the earth at ~1500 meters below the ocean surface in a fashion analogous to deep-sea hydrothermal vents, often called "black-smokers" for their appearance of venting black smoke underwater (http://en.wikipedia.org/wiki/Hydrothermal_vent). Hydrothermal vents are found on or near mid-ocean ridges at depths from 700 to 3000+ meters beneath the ocean's surface. The terrestrial analogy to calling this a vent holds as well – oil "gushers" from uncontrolled well heads on land spew tall jets of oil into the air much like geysers at Yellowstone spew jets of water – both geysers and oil wells vent high-pressure, low-density fluids from the earth into either the atmosphere or ocean. I will continue to use the phrase "oil vent" throughout this testimony to distinguish this oil-generating seafloor feature from a spill (which is limited in scope to the size of the container) and emphasize its similarity to naturally occurring hydrothermal vents.

In considering a response to an accidental seafloor oil vent, particularly at this depth and of this strength, it seems natural to turn to one of the two communities used to working at there - ocean researchers and engineers who measure and explore hydrothermal vents. (The other community now accustomed to working at that depth are oil drilling and well-head engineers, but they are relative newcomers to this extremes of the environment). To work safely at the high pressures and extreme fluid temperatures and corrosive compositions found at seafloor vents one requires well designed, specialized equipment and instruments such as custom Remote Operated Vehicles (ROVs), high-pressure instrument housings, ultra-robust probes and tools - all things basic researchers have been inventing and using for decades. As a post-doctoral researcher, I measured hydrothermal-vent generated heat from groups of black-smokers in the northeastern Pacific with Dr. Russ McDuff (UW). There exists a very active community of vent researchers at universities and laboratories around the world, including UW, all of whom understand the technological and scientific demands of working at ultra-high pressure with fluids that are extremely acidic, toxic, hot, and volatile – very much like the oil from the DeepWater Horizon vent. Therefore it was reasonable that one of the first independent scientists to estimate the true flow rate of the oil vent based on the 30-second video clip BP finally released was a colleague who worked on exactly that problem with hydrothermal vents as part of his doctoral dissertation – Tim Crone, now at Columbia University's Lamont-Doherty Earth Observatory. His work, along with that of three colleagues of diverse expertise, on this flow-rate estimate was published in an Op-Ed piece in the *The New York Times* on May 21, 2010, (about a month after the original blow-out) titled "Measure of a Disaster," in which they conclude:

> Taking all this into account, our preliminary estimates indicate that the discharge is at least 40,000 barrels per day and could be as much as 100,000 barrels. Certainly, our assessments suggest that BP's stated worst-case estimate of 60,000 barrels has been occurring all along. What matters most is that we take the steps to find out if it has.

All the oceanographers I know, and much of the general public, agreed with the last statement – we wanted to determine what the ***real*** flow-rate was. But no one could do so for two reasons: First, access to the well-head for such a direct measurement was controlled entirely by BP and the US Coast Guard (USCG); and, second, neither BP nor the onsite incident commander (USCG) took steps to learn how much oil was actually entering the environment from this vent. This willful ignorance on BP's part is understandable as they have a pecuniary interest in that number. Current federal law will use that rate, and the time it flowed, to help determine how much oil was vented, and therefore what clean-up cost BP will incur. However, it is unclear why the USCG did not turn to natural partners in the ocean science community to gather that information and put it ahead of the containment and clean up efforts.

Frustration of research oceanographers at NOAA's public stance regarding flow-rate

BP, the USCG, and NOAA either were ignorant of, or missed entirely, an opportunity early on in this crisis to employ existing basic-research techniques, and scientists knowledgeable in them, to determine the flow rate from this oil vent. Knowing that number (or at least an accurate range for it) may have guided a more meaningful and focused containment and clean up effort. The fact that public statements by the USCG and NOAA indicated no real interest in knowing the flow rate for a long time into the disaster frustrated me and fellow oceanographers. We were deeply disappointed that the government agencies nominally responsible for protecting our oceans, shorelines, and fisheries took the same stance that BP did in this respect. Further, we were baffled by a failure to employ tools and techniques we already have to determine flow rate from deep-water hydrothermal vents, ***or*** to contact members of the ocean science and technology community who were speaking out on behalf of all the rest of us with estimates based on publicly available data. The situation left many of us wondering whether we were the only ones who cared or believed that knowing the oil vent flow-rate was important to the response.

As a bit of raw data on what people inside NOAA thought, or knew, I recently found and watched a 10-minute video clip created sometime on or shortly after April 22, 2010, taken in various rooms at NOAA's HazMat office in the Western Regional Center in Seattle. The video records people meeting in-person and by phone, with images of whiteboards, notepads, and audio, in which one can see and hear estimates for oil flow-rate from various sources. The numbers are the likes of "64k to 110k barrels a day", and "52-110,000 barrels a day". (Clip available at http://blog.al.com/live/2010/05/video_shows_federal_officials.html, published May 1, 2010 - NOAA credit slide at the end of clip.) Given that the NOAA HazMat group's job is to envision the worst case for a spill and help the affected area cope with it in a response they term "least regrets," I can understand why NOAA would not necessarily release those numbers to the public.

I believe that no oceanographer, however, would be surprised that the flow-rate estimates generated by Dr. Crone and his colleagues correlate well to those generated (or gathered) almost a month earlier by NOAA HazMat. But once this correlation was apparent, it became scientifically embarrassing that NOAA continued to maintain publicly the original extremely low flow-rate estimate of 5,000 bbls/day. As the op-ed piece authors said, "what matters most is that we take steps to find out" whether the flow rate has been higher all along.

Perhaps sensing that frustration, the Flow Rate Technical Group (FRTG) was finally formed by the Incident Commander and is led by an experienced and technically savvy ocean scientist, Dr. Marcia McNutt. Some had high hopes for a quality result from a 32-member strong team, many in academia and others from federal agencies such as the US Geological Survey, the Department of Energy, and Minerals Management Service. Divided along lines of different scientific approaches to the question, it appeared promising to those of us on the outside. On May 27th they published a "consensus" number of 12-19,000 bbls/day for flow rate. But the press release did not make it clear what subsequently was revealed - that those numbers really represented the low-end of the range as none of the groups could agree on the high-end of the range. Some of the FRTG groups estimated up to 40,000 bbls/day and others wouldn't say what the high-end could be, so no value for that was published and the press (and public) believed the high-end to be 19,000 bbls/day. In a later report FRTG released (June 10, 2010), the FRTG noted that a group led by scientists from the Woods Hole Oceanographic Institute with an ROV that was allowed access to the well-head estimated the flow rate after the top-kill attempt failed (May 29, 2010), but before the riser was cut, to be 65-125,000 bbls/day – certainly much higher than anything the FRTG published two days before or subsequently, but in line with NOAA HazMat's original estimates made in the days just after the rig sank. All of this just served to cause those of us on the outside further doubt of the Federal government's intent or ability to protect us, and the ocean environment, from the ravages of an out-of-control seafloor oil vent. Lack of knowledge means lack of control – clearly where the country has been put by this incident.

The underwater oil plume

Another parallel to hydrothermal vents exhibited by this oil vent is the creation of an underwater plume at a level of neutral density for some of the vented fluid. As they leave the seafloor, both types of vent fluids have momentum (from pressure) and buoyancy (from being lower density than the surrounding seawater). The momentum typically dissipates within a short distance by draining into turbulence all around the plume (typically seen as billows and vortices on the edges). But the buoyancy persists and drives the plume higher off the seafloor. In the case of a hydrothermal vent, this buoyancy is due to the high temperature of the venting water, often as much as 400º C. But it mixes with surrounding 2-4º C water and becomes neutrally buoyant a few hundred meters above the bottom, rarely rising all the way to the surface except in the case of an underwater magma eruption. From this oil vent, some fluid will be buoyant enough to rise all the way to the surface creating the large slicks being observed, mapped, skimmed, and washing ashore. But some of the oil will become so small as to become neutrally buoyant only part way to the surface. (A numerical and lab study of this process was conducted in May by professors at the University of North Carolina – video at http://www.youtube.com/watch?v=6Cp6fHINQ94.)

These subsurface plumes are then subject to the currents and microbial breakdown processes at depth, away from sunlight and surface wave effects. Such plumes were detected by Dr. Samantha Joye (University of Georgia) and Dr. Vernon Asper (University of Southern Mississippi) in their ship-board cruises during May and June. The plume(s) appear in a depth range of 800 to 1300 meters. Dr. Joye discussed this, and many other important effects on the natural environment and oil from DeepWater Horizon vent in her testimony on June 9th to the House of Representatives Committee on Science and Technology, Subcommittee on Energy and Environment. Dr. Asper was instrumental in getting iRobot Corporation to launch and fly their Seaglider on the west side of the oil vent to look for this plume.

Gliders, unfortunately, can only help track this neutrally buoyant plume down to 1000 meters, as none of those currently on the market are capable of diving deeper. Further, they do not as yet, carry any sensors that directly detect oil, only detecting parameters that are a proxy for oil, such as Colored Dissolved Organic Matter (CDOM) fluorescence and oxygen concentration. So, while gliders, and other AUVs, can currently help somewhat, there is significant room for improvement in that technology to monitor oil-vent plumes. Two developments are underway with promise. Professor Charlie Eriksen at the University of Washington's School of Oceanography is in the process of testing a Deepglider™ that has a dive depth and operational capacity to 6000 meters below the sea surface. This will cover to the deepest place an oil well has ever been drilled 9~3000 m) or is ever likely to be drilled. And secondly, a German company, Contros Systems and Solutions GmbH, makes a fluorometer-type sensor for polyaromatic hydrocarbons (oil) but it is too large and power-hungry to be integrated onto a glider. Pushing either of these technologies along will likely assist us in really measuring the next oil vent plume that occurs from deep-sea drilling incidents.

And lastly, in the "frustrated ocean scientist" arena again, I was outraged that both BP and NOAA denied the existence of these subsurface plumes long after conclusive physical evidence came aboard research vessels in the form of oil-coated filters from water collected at plume depths. Once more, it seemed that the agency charged with helping us measure and understand what was happening in the ocean due to this oil vent spent whatever potential it had for positive impact on obscuring the facts.

Ocean observing facilities unavailable due to lack of funds, but needed to understand fate of oil slick

NOAA has been slowly building an ocean observing system around the country known as the Integrated Ocean Observing System (IOOS). It is intended to benefit all sectors of our society – business, agencies, general public, and science - and is a system of systems building on many facilities and instruments already installed and taking data for other projects. We hope that someday it will help us observe the ocean like we do the atmosphere – continuously and everywhere along the coasts and Great Lakes. But at present it operates on a shoestring budget so in some cases is not sustainable on a full-time basis. (Legislation authorizing IOOS passed in early 2009, but a prototype system funded by a consortium of fisheries and academia in the Gulf of Maine was operational as early 2001.) When the White House asked for a list of ocean observing assets available in the Gulf of Mexico at the outset of this event, it was the Gulf of Mexico Coastal Ocean Observing System (GCOOS) of IOOS that responded. The list delivered contained some high-frequency radars (HFRs) that can track surface currents far out to sea. But those HFRs had been shut down months earlier due to lack of operational funding. They are running now thanks to funding from the Incident Command, and are critical to tracking the currents pushing the oil slick around. But knowing what the currents were before the disaster, and for years before that, could have helped greatly in understanding the system into which this oil vent erupted. (See http://www.cencoos.org/sections/news/Gulf_oil_spill_2010.shtml) for HRF data from the Gulf.) The general lack of funding for basic ocean observations and research in the Gulf was well covered in a *New York Times* article by Paul Voosen published June 3, 2010, titled "Federal Funding Cuts Leave Oceanographers, Spill Responders in Dark". What we need in terms of fund for IOOS and its regional associations pales in comparison with many other demands on tax dollars. Even the equivalent of one "inexpensive" NASA robotic mission of $200 million would make IOOS a functional reality.

Opportunities for action in measuring, monitoring, and evaluating accidental oil vents

What is clear from all this is that our country has put little effort into creating tools and instruments to measure, monitor, evaluate, and clean up a deep-sea oil vent caused by a well-head incident such as the DeepWater Horizon rig explosion and sinking. While oil company engineers do amazing work to create drills, rigs and methods to work in deep water, it is apparent from this event that no one can design, build, and operate a one-hundred-present fail-safe system for deep-water oil wells. A national effort, that includes work on both engineering and scientific challenges, is critical if we are to be truly prepared for another such event. We must take some action and several paths forward are offered in two bills proposed to this committee by members.

Senator Cantwell proposes the "Oil Spill Technology and Research Act of 2010" which creates a committee to oversee research and development spanning a wide range of concerns revealed by this disaster - from surface and sub-surface current prediction capability (typically a pure research endeavor), to containment and removal technology (typically done by agencies and oil companies), to rehabilitation methods (often handled by concerned citizen volunteers). The committee will act through NOAA and the National Academy of Sciences, which is important as it provides a balance necessary to make these efforts move forward with transparency and attention to impartiality. Though funded at a relatively small scale, the fact-finding part of this effort alone may be worth it – as Socrates pointed out, knowing what we do not know is the critical first step to true learning.

Senator Rockefeller proposes the “Securing Health for Ocean Resources and Environment Act”, or the “SHORE Act”, which invests in a variety of improvements to NOAA and the Coast Guard to better monitor and respond to oil spills, indentify aging oil infrastructure that puts us at risk, provides grants to states and other regional organizations to improve their readiness to respond, and establishes a long-term environmental monitoring system for the Gulf of Mexico where most deep offshore oil is being pursued. The funds for this are greater, but so is the scope and duration. And those funds come from industry-paid fees, which at present, are popular with the public given what has happened in the last 90 days.

Both of these bills are good steps forward in turning ideas into action and adding to our clearly weak arsenal of oil vent (and oil spill) response, monitoring, clean up, and restoration technologies. Even wider recognition of the important role basic oceanographic research plays in this field will be a welcome addition to the mandate of NOAA and the Coast Guard.

Thank you for inviting me to testify today.

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