In re: Oil Spill by the Oil Rig "*Deepwater Horizon*" in the Gulf of Mexico, on April 20, 2010

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF LOUISIANA
MDL NO. 2179, SECTION J
JUDGE BARBIER; MAGISTRATE JUDGE SHUSHAN

Expert Report of Mark G. VanHaverbeke

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August 15, 2014

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I. Professional Background

I am Captain Mark G. VanHaverbeke, United States Coast Guard (USCG). Retired. I currently am employed as a research engineer at the USCG Research and Development Center ("RDC"). With the exception of short period in 2005 when I retired from active duty, I have been employed by the USCG since 1975. The majority of my active duty career was spent in the Marine Safety, Security, and Environmental Protection program. Within that program, I held both field positions, in which I planned for and directly responded to spills, and District (regional) supervisory positions, in which I coordinated other assets and federal agencies in support of the field responders. I was second-in-command to the Coast Guard's pre-designated Federal On-Scene Coordinator ("FOSC") in Buffalo, NY, when the USCG revitalized its contingency planning efforts to include state and local officials, as directed by the Oil Pollution Act of 1990,[1] and implemented NIMS[2]/ICS as our response organizational model after assuming the command a few years later, including the role of FOSC. In a later tour, as the pre-designated FOSC in Providence, I took response planning to a higher level by developing guidelines for specific locations based on geography or threat, planning that proved invaluable to my successor following a major oil spill. As a research engineer at the RDC, I conducted a systems analysis of spill response and developed a multi-year plan for USCG response research investments. I have participated in a number of response research projects, mainly focused on detections and recovery of sunken oil.

My formal training is as a naval architect and marine engineer (having earned both bachelors and masters of science degrees in the field, plus a masters in mechanical engineering and spending several tours in technical billets while on active duty). My expertise is based on that science-based knowledge, combined with almost 40 years of experience (including front line spill response, two tours as the USCG pre-designated FOSC, discussions over the years with my compatriots, attending or reviewing papers from major conference such as the International Oil Spill Conference and Clean Gulf, study of FOSC reports and Incident Specific Preparedness Reviews to glean lessons learned from significant spills, and conduct of a systems analysis of spill response as a research project).

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[1] Oil Pollution Act of 1990 (OPA 90), Public Law 101-380 (104 Stat. 484), Title IV, Section 4202(a)

This report mentions both NIIMS (National Interagency Incident Management System) and NIMS (National Incident Management System). The National fire Service developed NIIMS (two I's) in the 1980's to address coordination issues at multi-agency fire responses and the USCG began using the process after Exxon Valdez. The Department of Homeland Security implemented its own variation for federal agency response as NIMS (one I). Both systems have the Incident Command System (ICS) as a core component. [2]

II. Involvement in the Deepwater Horizon Response

During the Deepwater Horizon spill response, I spent over 50 days in the Gulf of Mexico region, either at the Incident Command Post in Houma supporting the FOSC through the Alternatives Response Tool Evaluation System ("ARTES") (an established process for evaluating alternative countermeasures), in the field evaluating technologies, or in meetings with citizenry and vendors listening to their concerns and proposals, and explaining the ARTES process. As lead for the ARTES team under the Environmental Unit in the Houma, in addition to reviewing concepts submitted to BP's Alternative Response Technology ("ART") system, I attended operational planning meetings to identify capability gaps that ART might address, and provided an interface with the Critical Resources Unit of the Unified Command's Planning Section. While at the RDC between Gulf tours, I supported the Government's Interagency Alternative Technology Assessment Program ("IATAP").

III. Executive Summary

This report summarizes the ongoing process of research and development ("R&D") related to oil spill response techniques and technology in the United States, as well as current oil spill response doctrine in the United States. In reaching my conclusions, I have relied upon my own experience in the areas of oil spill response and oil spill response R&D. I have also reviewed and considered the documents cited throughout this report and those listed in Appendix C. I conducted interviews of David Moore (Chief of the Oil Spill Response Division, BSEE) and Lori Medley (Chief of the OSRD Response Research Unit, BSEE).

It is my understanding that BP intends to seek a reduction of its civil penalty in recognition of its "technological achievements and industry leading safety enhancements from the response," including purported advancements in Collaboration, Organizational Capabilities, Information-Sharing, Containment and Collection Technologies, Response Technologies, and Safety Advancement.[3] I offer my opinions in response to this contention.

I offer three opinions concerning the R&D process generally, the application of doctrine, technology, and technique to the Deepwater Horizon response in particular, and need for adaptation among responders to spills of any type:

A. Oil spill response research and development is an ongoing process with participation from across the public and private sectors. This process did not begin with the Deepwater Horizon response.

[3] Exhibit 12288 at 29-34.

B. If any of the response technologies or techniques employed during the Deepwater Horizon response can be considered new or innovative, they were developed not by BP acting on its own, but by the Unified Command and the Incident Management Team as a whole through collaboration between government entities, contractors, members of the oil industry, academia, and others. This collaboration was not new or unique to the Deepwater Horizon response.

C. Every oil spill is unique and adaptation in response to the particularities of the spill is common and expected. Experiences drawn from one oil spill response may not be directly transferable to future spill responses.

IV. Discussion

A. Oil spill response research and development is an ongoing process with participation from across the public and private sectors. This process did not begin with the Deepwater Horizon response.

A variety of organizations have devoted funding and effort to spill response R&D over the last several decades. R&D activity and the rate of publication on topics related to spill response increased after the Torrey Canyon spill in 1967, Santa Barbara Spill in 1969, the IXTOC spill in 1979, and the Exxon Valdez spill in 1989[4]. This work continues today. Major events tend to precipitate interest. As has been the case after other major oil spills, a variety of parties have either begun investing, or increased their level of investment, in R&D since the spill.

The federal government has long played a central role in both the conduct and coordination of oil spill response related R&D. The Oil Pollution Act of 1990 established an Interagency Coordinating Committee on Oil Pollution Research ("ICCOPR") that it directed to coordinate a comprehensive program of oil pollution research, technology development, and demonstration among the federal agencies, in coordination with industry, universities, research institutes, State government, and other nations.[5] The ICCOPR currently has 15 members representing independent agencies, departments, and department components from across the federal government and is chaired by the United States Coast Guard ("USCG").[6]

Every two years, the chair of the ICCOPR sends a report to Congress describing its activities in the two preceding fiscal years.[7] Over the last two decades these reports have highlighted a range of activities including regular committee meetings, the drafting and revision of research and technology plans, participation in international oil spill R&D forums, the institution of grant programs, model development, demonstration projects, cooperative efforts

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[4] R&D activity and the rate of publication on topics related to spill response increased after the Torrey Canyon spill in 1967, Santa Barbara Spill in 1969, the IXTOC spill in 1979, and the Exxon Valdez spill in 1989. *See e.g* Peter H. Albers, An Annotated Bibliography on Petroleum Pollution, USGS Patuxent Wildlife Research Center, US_PP_MVH002471 (noting increased interest after the Torrey Canyon and Exxon Valdez spills and compiling more than 2000 citations related to petroleum pollution). Also see "*U.S. Coast Guard Oil Spill Research & Development Program: A Decade of Achievement*," Report No. CG-D-07-03, Bates US_PP_USCG551986 - US_PP_USCG552064

[5] 33 U.S.C. 2761(a)

[6] ICCOPR "Meet the Members" page. Members include: USCG, EPA, NOAA, BSEE, US Army, PHMSA, USFWS, US Navy, NASA, DOE, USFA, MARAD, NIST, BOEM, and USARC.

[7] 33 U.S.C. 2761(e)

with states and industry, the creation of an International Oil Pollution R&D abstract database, and descriptions of various research projects and publications, among other things.[8]

In 1992 the ICCOPR developed and published an Oil Spill Research and Technology Plan ("1992 R&T Plan").[9] The 1992 R&T Plan identified federal agencies and described their role with respect to environmental protection and oil spill response research.[10] The plan outlined a research and development program that would reduce the probability of spills through vessel design, facility design and pipeline design, as well as improvements in operation and inspection.[11] The plan also outlined a research and development program for spill response planning and management that focused on risk assessment, spill response readiness, spill management, communications, and health and safety of responders.[12] The 1992 R&T Plan also described a grant subcommittee established to develop an implementation program and plan to carry out the OPA-directed regional grant program.[13] The ICCOPR exhausted all funds under the regional grant program in fiscal year 1996.[14]

The ICCOPR contracted with the National Research Council of The National Academy of Sciences to analyze the adequacy of the 1992 R&T Plan.[15] The National Research Council suggested augmenting the plan based on a systems analysis of oil production and transportation.[16] A second plan was published in 1997 ("1997 R&T Plan").[17] The 1997 R&T Plan analyzed the state of oil production and transportation systems, and based on this analysis prioritized spill prevention research by category: spill response planning, training and management, spill countermeasures and cleanup, fate, transport and effects, and monitoring and restoration.[18] In biennial reports to Congress since 1997, ICCOPR has detailed interagency efforts to communicate and coordinate research efforts both within and external to the ICCOPR

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[8] *See* ICCOPR biennual reports, available at http://www.iccopr.uscg.gov/apex/f?p=118:331.

[9] ICCOPR, *2010-2011 Research Report: 2012 Biennial Report to Congress*, at 5 (June 04, 2012).

[10] ICCOPR, *Oil Pollution Research and Technology Plan*, at 1-5 through 1-26 (April 24, 1992).

[11] *Id.* at 3-1.

[12] *Id.* at 3-7,3-8.

[13] *Id.* at 4-1,4-2,4-3,4-4.

[14] ICCOPR, *2012-2013 Research Report: 2014 Biennial Report to Congress*, at 6 (June 25, 2014)

[15] ICCOPR, *Oil Pollution Research and Technology Plan*, at 1 (April 1997).

[16] *Id.*

[17] ICCOPR, *2010-2011 Research Report: 2012 Biennial Report to Congress*, at 5 (June 04, 2012).

[18] ICCOPR, *Oil Pollution Research and Technology Plan*, at iii (April 1997).

membership. While ICCOPR has not formally updated the Oil Pollution Research and technology Plan since 1997, the member agencies have continued to assess research priorities (e.g., workshop held in 2004 as reported in the FY2003-2004 biennial report) and ICCOPR has a revised plan under development.[19]

In June of 1992, the first International Oil Spill R&D forum was held in McClean, VA. The forum was co-sponsored by the USCG and International Maritime Organization. Representatives from 19 countries, 13 U.S. States, over 15 U.S. federal agencies, 39 foreign organizations, 20 universities, and 18 international research institutes attended. The purpose of the forum was to give effect to Article 8 of the International Convention on Oil Pollution Preparedness, Response and Cooperation of 1990 which mandates international cooperation in oil spill R&D.[20] A second convention was held in London, England in 1995 and a third in Brest, France in 2002.[21]

A variety of individual federal agencies undertake and/or fund R&D related to oil spill response. Here, I highlight some of the work of the Department of the Interior ("DOI") as but one example.[22]

Since 2001, DOI has funded 112 projects related to oil spill response. These range from research on improving methods for recovering residues from in-situ burning of marine oil spills to work on cold water dispersant effectiveness testing.[23] Many of these are joint industry projects done in partnership with other stakeholders. DOI selects research projects for funding after soliciting proposals through Broad Agency Announcements ("BAA") published on the Federal Business Opportunities Website.[24] These are competitively selected projects with

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[19] ICCOPR, *2012-2013 Research Report: 2014 Biennial Report to Congress*, at 20 (June 25, 2014)

[20] See US_PP_MVH002131.

[21] A brief description of the conferences as well as a link to proceedings from the third conference are available on the IMO website at http://www.imo.org/blast/mainframe.asp?topic_id=225

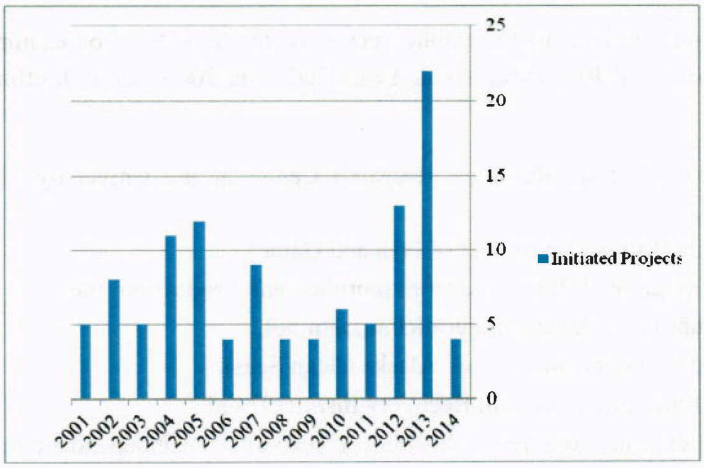
[22] DOI efforts were formally consolidated within the Mineral Management Service ("MMS"), later reorganized as the Bureau of Ocean Energy Management, Regulation and Enforcement ("BOEMRE"), and are now organized under the Bureau of Safety and Environmental Enforcement ("BSEE") in the Oil Spill Response Research ("OSRR") program.

[23] OSRR project numbers 647 and 1016, abstracts available at http://www.bsee.gov/Research-and-Training/Oil-Spill-Response-Research/Master-List-of-Oil-Spill-Response-Research/

[24] For a description of the program, see OSSR's wed page, available at http://www.bsee.gov/Research-and-Training/Oil-Spill-Response-Research/index/ . Federal Business Opportunities web page may be found at https://www.fbo.gov/.

concrete deliverables.[25] Figure 1 tracks the number of project initiations each year from 2001 to present.

Figure 1: Oil Spill Response R&D Projects Initiated by DOI, 2001-Present[26]



DOI also maintains the National Oil Spill Response Test Facility, known as Ohmsett, in coastal New Jersey. Ohmsett houses a 203 meter long saltwater wave/tow test tank, that largest in North America, that allows for testing of full-scale equipment. This facility is available on a reimbursable basis to both the public and private sectors as a research center to test oil containment and cleanup equipment, techniques, remote sensing devises, sorbents, or conduct training.[27]

However, limited funding, in turn, limits the amount of research that can be conducted. For example, the need for research on dispersant application at the subsea discharge source was identified in a 1999 MMS paper[28] but not undertaken. While the technology was deployed during the response, it was done on a trial and error basis. We are only now studying issues like the efficient nozzle design, droplet size, subsea sensing and monitoring of application, dispersant ratios, and other relevant issue.[29]

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[25] Interview with David Moore and Lori Medley.

[26] Master List of OSRR Project abstracts available at http://www.bsee.gov/Research-and-Training/Oil-Spill-Response-Research/Master-List-of-Oil-Spill-Response-Research/

[27] ICCOPR, *1993-1994 Research Report: 1996 Biennial Report to Congress*, at 9 (September 1996).

[28] See Exhibit 2297.

[29] Interview David Moore and Lori Medley.

For its part, the USCG began an oil spill R&D effort in 1969 that continues today.[30] Recent research efforts focused on issues that have been periodic problems but receive little funding (detection and recovery of sinking oils) or are projected to be significant in the near future (spill response in ice covered waters).

Oil spill R&D is not confined to the public sector, or to the U.S. For example, as presented in the ICCOPR Biennial Report for Fiscal Years 2008 and 2009, research efforts are undertaken by:

- academia (e.g., Coastal Response Research Center at the University of New Hampshire),
- states (e.g., California Department of Fish and Game),
- corporations (e.g., Shell International Exploration and Production, Inc)
- industry groups (e.g., American Petroleum Institute),
- oil spill response cooperatives (e.g., Alaska Clean Seas),
- research institutes (e.g., Oil Spill Recovery Institute), and
- international organizations (e.g., SINTEF, a Scandinavian independent research organization).

High visibility events tend to precipitate a renewed focus among the public, government, industry, and academia. The ICCOPR 1997 Oil Pollution Research and Technology Plan stated, "The Marine Spill Response Corporation (MSRC), the oil industry supported oil spill response organization formed after the string of oil spills that resulted in the passage of OPA 90, funded approximately $30 million dollars of oil spill R&D through 1995. It terminated this program as of January 1, 1996. Meanwhile individual oil companies are funding only minimal oil spill R&D, with much of the work again being conducted through the American Petroleum Institute's (API) ongoing programs."[31]

This pattern holds true with respect to the years following the Deepwater Horizon spill. A variety of public and private organizations have contributed to a marked acceleration in the rate of R&D related to oil spill response since mid-2010.[32] For example, BP is funding the Gulf of Mexico Research Initiative ("GoMRI") to investigate the impacts of the Deepwater Horizon oil, dispersed oil, and dispersant on the ecosystems of the Gulf of Mexico and affected coastal states.

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[30] "*U.S. Coast Guard Oil Spill Research & Development Program: A Decade of Achievement*," Report No. CG-D-07-03, Bates US_PP_USCG551986 - US_PP_USCG552064, and personal knowledge.

[31] ICCOPR, *Oil Pollution Research and Technology Plan*, at 1 (April 1997).

[32] *See e.g.* GAO-12-585, Oil Dispersants: Additional Research Needed, Particularly on Subsurface and Arctic Applications, May 2012, US_PP_MVH001307 (Reporting that, with respect to106 dispersant related research projects funded by federal agencies since fiscal year 2000, more than half of the funding occurred after the Deepwater Horizon incident, including three projects related to the subsurface application of dispersants).

GoMRI makes research grants to independent academic and research institutions using National Science Board protocols and researchers must comply with professional standards as defined by the National Academies of Science.[33] Although research publications to date have largely focused on dispersion and effects of the spill, GoMRI research themes include technology developments for improved response, mitigation, detection, characterization, and remediation associated with oil spills and gas releases.[34]

What I have described here is only a narrow sample of the broad universe of relevant research undertaken throughout the public and private sectors in the United States. Some have argued that the level on investment in oil spill response technology by public and private actors was to low prior to the spill. I do not offer an opinion on this point. Whether the level of pre-spill investment was appropriate or not, the research that was done was conducted across a wide variety of industry and government entities and in many cases was done in a collaborative and transparent fashion. This work directly contributed to actions taken in the Deepwater Horizon response. This body of research, both pre- and post-spill, conducted across industry, government and academia, has dramatically improved our collective understanding of the most effective means to respond to oil spills in a wide variety of environments.[35]

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[33] See GoMRI web site, Scientific Integrity, at http://gulfresearchinitiative.org/about-gomri/scientific-integrity/.

[34] See GoMRI web site, RFP-IV, at http://gulfresearchinitiative.org/request-for-proposals/rfp-iv/.

[35] See e.g. US_PP_MVH000477 (American Petroleum Institute finding that in situ burning would not have been possible without the research and regulatory changes of the past 20 years).

B. If any of the response technologies or techniques employed during the Deepwater Horizon response can be considered new or innovative, they were developed not by BP acting on its own, but by the Unified Command and the Incident Management Team as a whole through collaboration between government entities, contractors, members of the oil industry, and others. This collaboration was not new or unique to the Deepwater Horizon response.

The response to the Deepwater Horizon explosion and oil spill was conducted by a Unified Command using the Incident Command System ("ICS"). It is not my intent to offer an exhaustive description of the Deepwater Horizon response organization in this report. As explained below, the ICS framework for the management of oil spill response was in place long before the Deepwater Horizon incident. This system is intended to provide for a unity of effort across all response activities. At least with respect to the development and implementation of any new or innovative response techniques or technologies, unity of effort was achieved to such an extent that it is unlikely that BP can claim sole credit for the creation of any advances that may have resulted from this response. BP Exploration & Production Inc.'s First Supplemental Responses to the Unites States' First Set of Discovery requests in the Penalty Phase states, "BPXP, *together with the Unified Command*, [emphasis added] developed several innovative advancements in spill-response technologies, tools, equipment and processes."[36]

The National Oil and Hazardous Substance Contingency Plan ("NCP")[37] is the basic framework for responding to pollution incidents, both large and small. Incidents are typically managed using the National Incident Management System ("NIMS") with command and control organized according to the ICS. Of particular relevance to the Deepwater Horizon incident, the USCG, acting on lessons learned from the March 1989 Exxon Valdez oil spill and the October 1994 San Jacinto River flooding that ruptured or damaged eight oil pipelines, mandated NIIMS ICS be used for all USCG hazardous material and oil spill response actions, and then expanded this to all response organization and management procedures in 1998.[38] Since then, through exercises and responses to actual in incidents, ICS has become standard operating practice within

[36] Ex 12288 at 32

[37] 40 CFR Part 300.

[38] Commandant Instruction 3120.14, Incident Command System, Sep 28 1998, available at https://www.uscg.mil/directives/ci/3000-3999/CI_3120_14.pdf

the U.S. spill response community, enabling a myriad of agencies, organizations, and the private sector to work together to respond to spills, regardless of cause, size, location, or complexity.[39]

When multiple agencies, jurisdictions, or authorities must be coordinated, the ICS may be implemented through a Unified Command.[40] The Unified Command links the organizations responding to the incident and provides a forum for these entities to make consensual decisions. For an oil spill, the Unified Command consists of the Federal On-Scene Coordinator ("FOSC," generally a USCG officer for coastal oil spills[41]), the State On-Scene Coordinator ("SOSC"), and the responsible party ("RP"). Each representative brings to the Unified Command resources, responsibilities and authorities. For example, the RP has the legal requirement to remove the oil and pay claims. Members of the Unified Command work together to develop a common set of incident objectives and strategies, share information, maximize the use of available resources, and enhance the efficiency of the individual response organizations.[42] Because of the size, complexity, and number of jurisdictions involved in the Deepwater Horizon response, a Unified Area Command ("UAC") was established with several subordinate Incident Command Posts ("ICPs") in Houston, Houma, Mobile, and Tampa. The UAC and the ICPs each had a Unified Command composed of representatives of the RP, of the relevant States, and a USCG FOSC (at the UAC) or Federal On-Scene Coordinator's Representative ("FOSC-R"). At each level, the Unified Command established objectives and the supporting ICS-based structure developed plans and took action to meet those objectives.

The implementation of ICS in the Deepwater Horizon response illustrates how the response to the nation's first Spill of National Significance under the NCP involved a united effort from the federal to the local level and from the identification of overall objectives to the implementation of those objectives. To the extent that any technologies or techniques used in the DWH responses were new or innovative (rather than just done on a scale commensurate with the spill), they were done under the auspices of the Unified Command and cannot be attributed solely to efforts by BP.

A unity of effort was evident in the way the organization solicited, analyzed and implemented technological solutions proposed by outside actors and the general public. BP did

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[39] *See* Department of Homeland Security, National Incident Management System, December 2008, available at http://www.fema.gov/national-incident-management-system/nims-doctrine-supporting-guides-tools, HCE937-003905.

[40] USCG Incident Management Handbook, at 5-1.

[41] *See* National Contingency Plan, 40 CFR Part 300.120(a)(1); 2014 USCG Incident Management Handbook, US_PP_MVH00091; Coast Guard Marine Safety Manual Volume I, HCF049-011944.

[42] National Response Team Unified Command Technical Assistance Document, Section 1.1, available at http://www.nrt.org/Production/NRT/NRTWeb.nsf/AllAttachmentsByTitle/A-820PubUCTAD/$File/UC%20TAD%201-26-07%20FINAL.pdf?OpenElement.

not create a system for evaluating alternative oil spill response tools during the Deepwater Horizon response from scratch or without significant involvement from federal and state agencies. Rather, a structure was created within the Unified Command that reflected best practices and lessons learned from previous responses across the nation. At the turn of the 21st century, response agencies recognized the need to assess proposals concerning alternative oil spill response tools.[43] Consequently, Regional Response Teams consisting of federal and state representatives designed the Alternative Response Tool Evaluation System ("ARTES").[44] The National Oceanic and Atmospheric Administration hosted ARTES on its website starting in 2002.[45] Prior to the Deepwater Horizon incident, the system had been used by a Response Technologies Specialist from within the Environmental Unit.[46] The system was never embedded into the Incident Command System given its limited use during active responses.[47]

Following the DWH explosion and spill, the government received tens of thousands of proposals for technologies related to spill control and response.[48] Rapid assessment of these ideas was required, and the NOAA Scientific Support Coordinator ("SSC") filled the ARTES role on the FOSC's behalf.[49] Vendor, operational and media demands triggered an increase of staffing and the activation of personnel from the USCG's Research and Development Center ("RDC") and the Office of Spill Prevention and Response from the State of California.[50] As the effort continued to grow, other Coast Guard personnel, a responder from the State of Washington, and a contractor were added. The need for real-time technology review, evaluation and testing

[43] AMERICAN PETROLEUM INSTITUTE, AN EVALUATION OF THE ALTERNATIVE RESPONSE TECHNOLOGY EVALUATION SYSTEM (ARTES) iii, 1, July 2013, *available at* http://www.oilspillprevention.org/~/media/Oil-Spill-Prevention/spillprevention/r-and-d/alternative-response-technologies/1142.pdf.

[44] *Id.*

[45] *Id.*

[46] *Id.*

[47] *Id*

[48] MICHELE FITZPATRICK & SCOTT FIELDS, INSTITUTIONALIZING EMERGING TECHNOLOGY ASSESSMENT PROCESS INTO NATIONAL INCIDENT RESPONSE 1, May 2012, *available at* http://www.iccopr.uscg.gov/iccopr/i/files/Institutionalizing%20Emerging%20Technology%20Assessment%20into%20National%20Incident....pdf.

[49] AMERICAN PETROLEUM INSTITUTE, AN EVALUATION OF THE ALTERNATIVE RESPONSE TECHNOLOGY EVALUATION SYSTEM (ARTES) 2, July 2013, *available at* http://www.oilspillprevention.org/~/media/Oil-Spill-Prevention/spillprevention/r-and-d/alternative-response-technologies/1142.pdf.

[50] *Id.*

prompted the creation of two groups with assessment processes consistent with the ARTES design.[51]

The first group formed was the Alternative Response Technologies ("ART") organization. ART was formed in May 2010 as part of the UAC and was organized and coordinated out of the Houston ICP.[52] The group included individuals from a variety of organizations, including the Coast Guard RDC staff, individuals hired by NOAA, California Fish and Game, and BP.[53] Its purpose was to evaluate and test new and improved response technologies to make response and cleanup operations more efficient and effective.[54] Of the many ideas submitted, roughly 100 were evaluated and/or tested, approximately 25 of which were used during the response.[55] Due to the overwhelming volume of ideas received by ART, as well as the public's negative perception of the RP's role in ART, a second group was formed, the Interagency Alternative Technology Assessment Program ("IATAP").[56]

The IATAP was formed in June 2010 by the National Incident Command Interagency Solutions Group.[57] It offered an independent, government-lead interagency perspective on technology ideas.[58] IATAP included personnel from many federal agencies including the Coast Guard, NOAA, EPA, the Minerals Management Service, Fish and Wildlife, and the U.S. Navy Supervisor of Diving and Salvage, but none from BP. Its purpose was to relieve the overwhelmed ART and to ensure a fair and systematic evaluation process.[59] IATAP issued a

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[51] MICHELE FITZPATRICK & SCOTT FIELDS, INSTITUTIONALIZING EMERGING TECHNOLOGY ASSESSMENT PROCESS INTO NATIONAL INCIDENT RESPONSE 1, May 2012, *available at* http://www.iccopr.uscg.gov/iccopr/i/files/Institutionalizing%20Emerging%20Technology%20Assessment%20into%20National%20Incident....pdf.

[52] *Id* at 1-3; Deposition Exhibit 12284, BP-HZN-2179MDL01885329

[53] *Id;* Deposition of Mike Utsler 142:20-143:14.

[54] *Id.*

[55] *Id.*

[56] *Id* at 4.

[57] AMERICAN PETROLEUM INSTITUTE, AN EVALUATION OF THE ALTERNATIVE RESPONSE TECHNOLOGY EVALUATION SYSTEM (ARTES) 13, July 2013, *available at* http://www.oilspillprevention.org/~/media/Oil-Spill-Prevention/spillprevention/r-and-d/alternative-response-technologies/1142.pdf.

[58] MICHELE FITZPATRICK & SCOTT FIELDS, INSTITUTIONALIZING EMERGING TECHNOLOGY ASSESSMENT PROCESS INTO NATIONAL INCIDENT RESPONSE 1, May 2012, *available at* http://www.iccopr.uscg.gov/iccopr/i/files/Institutionalizing%20Emerging%20Technology%20Assessment%20into%20National%20Incident....pdf.

BAA to solicit ideas from outside the response organization and ultimately received and analyzed thousands of recommendations from a variety of sources. [60] Review and comment concerning BAA submittals was managed through the USCG's secure collaborative website "Homeport". Homeport was chosen because it allowed people from outside the USCG to use it (other agency and contractor reviewers), while maintaining the appropriate security for the procurement process. Meritorious proposals were field tested through the ART.

This process of seeking and evaluating potential technical solutions from the public is one key example of how the process of innovation was handled collaboratively within the Deepwater Horizon response. A government employee fulfilling a role in the ICS structure (the NOAA SSC) identified an existing response tool (ARTES created by the federal government and hosted on a federal website) which might assist in the response. At the direction of the Unified Command, federal, state and RP employees began using the tool. Because of the massive size of the spill, the public response overwhelmed the Unified Command's capability so the federal government modified the existing process and provided additional resources. Ultimately some ideas were adopted for use in the response. This process of solicitation, evaluation, testing, and implementation was imbedded in the Unified Command structure and cannot be solely attributed to the efforts of BP.

BP has pointed to several management and response tools developed outside of the ART process that it claims were new or innovative. Here again, the development of these interventions was managed within the Unified Command. BP was one member of a team drawn from across industry and government that worked collaboratively under the direction of the Unified Command.[61] For example, in-situ burning operations were managed collaboratively and, according to Richard Morrison, BP Deputy Area Commander during the response, "it's hard to say was it exactly BP or exactly Coast Guard."[62] Similarly, BP and the federal government responders worked collaboratively to adapt an existing federal government information system know as ERMA to build a common operating picture that could be used by responders across the organization.[63]

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[59] AMERICAN PETROLEUM INSTITUTE, AN EVALUATION OF THE ALTERNATIVE RESPONSE TECHNOLOGY EVALUATION SYSTEM (ARTES) 13, July 2013, *available at* http://www.oilspillprevention.org/~/media/Oil-Spill-Prevention/spillprevention/r-and-d/alternative-response-technologies/1142.pdf.

[60] MICHELE FITZPATRICK & SCOTT FIELDS, INSTITUTIONALIZING EMERGING TECHNOLOGY ASSESSMENT PROCESS INTO NATIONAL INCIDENT RESPONSE 4, May 2012, *available at* http://www.iccopr.uscg.gov/iccopr/i/files/Institutionalizing%20Emerging%20Technology%20Assessment%20into%20National%20Incident....pdf.

[61] Deposition of Richard Morrison 188:7-17; 189:22-190:3; 194:21-195:15; 196:11-197:14.

[62] Deposition of Richard Morrison 202:11-204:10.

[63] Deposition of Richard Morrison 198:15-199:5.

The response to the Deepwater Horizon spill, including both cleanup and source control efforts, drew upon resources from across industry and government, including the Department of Energy, the Department of the Interior, the U.S. Geological Survey, the USCG, BP, Shell, Exxon-Mobile, ConocoPhillips, Chevron, Louisiana State University, the Massachusetts Institute of Technology, and wide variety of other federal and state agencies, outside experts and contractors.[64] This is consistent with established NIMS doctrine. In my opinion, any particular response technique or technology employed during the course of the response, whether conventional or innovative, and the development of any new response technique or technology during the response, resulted from collaboration among the multitude of participants in the response and cannot be attributed solely to the efforts of BP.

[64] *See* HCP008-002191 (TREX-009105.0042); TREX 6113.0081; Deposition of Richard Morrison 207:9-210:2; Deposition of Suttles 252:08-253:3.

C. Every oil spill is unique and adaptation in response to the particularities of the spill is common and expected. Experiences drawn from one oil spill response may not be directly transferable to future spill responses.

Every oil spill is unique, which means that every spill response is unique.[65] Experiences drawn from one oil spill response may not be directly transferable to future spill responses.[66] The USCG, the various OSROs, and industry actors must be flexible in both their capabilities and planning. As the needs of a particular response become clear, it is expected that responders will adapt to them.[67] The process of adapting the available resources to address the needs of a particular response is common and expected. This process is so integral to oil pollution response that the USCG Incident Management discusses the need to make appropriate adjustments to ensure maximum potential[68] for success by achieving key success factors.

While most response operations share common principles and procedures, some elements of a response will be unique to the circumstances confronted in the field.[69] Because of this, flexibility and scalability are core components of NIMS.[70] For example, during an oil spill response that involves the loss of well control, Coast Guard guidance calls for the employment of both a Scientific Support Coordinator and a Source Control Support Coordinator to help address the unique issues presented by the event.[71] As described in BP's Incident Management Handbook, "[a]s incidents change in size, scope, and complexity, the response must adapt to meet requirements."[72] This is consistent with my experience in and understanding of oil spill response.

[65] *See* Dispersant Studies of the Deepwater Horizon Oil Spill Response, Vol.1 at 17-18, BP-HZN-2179MDL01454315-BP-HZN-2179MDL01454413

[66] *See Id.*

[67] *See* BP Incident Management Handbook at 2-7, BP-HZN-2179MDL01093604-BP-HZN-2179MDL01093604

[68] See USCG Incident Management Handbook at 19-3, 19-4.

[69] *See Id.*

[70] Department of Homeland Security, National Incident Management System, December 2008, available at http://www.fema.gov/national-incident-management-system/nims-doctrine-supporting-guides-tools, HCE937-003905.

[71] *See* USCG Iincident Management Handbook at 19-17, 19-19.

[72] BP Incident Management Handbook at 2-7, BP-HZN-2179MDL01093604-BP-HZN-2179MDL01093604

The experience of the Deepwater Horizon response and the events that followed are consistent with this general principal. For example, during his deposition in his corporate representative capacity on behalf of BP in this litigation, Richard Morrison explained that after the response BP shared the Riser Insertion Tube Tool ("RITT") used to gather hydrocarbons during the response with the Marine Well Containments Company, a consortium of operators in the Gulf of Mexico. The decision was made that the technology was so unique to the circumstances of the Deepwater Horizon response that it would not be added to that company's response inventory.[73] This is not surprising given the specialized adaptation of this tool to the unique circumstances of the Deepwater Horizon response. It is likely that any future response involving subsea flow from a severed riser will involve different depths, geometries, surface vessels, and other variables that will make the specific adaptation used in the Deepwater Horizon response inappropriate for deployment. Responders to a future spill involving this type of discharge will be called upon to adapt this concept, or some other appropriate concept, to the unique circumstances of that spill.

Similarly, responders during the Deepwater Horizon incident, including the USCG, BP, and many others, looked to a number of techniques and technologies that had been used in the past but which had to be adapted to the specific requirements of the incident. These include, among others, the use of dispersants, in-situ burning, containments domes, junk shots, and capping stacks.[74] As would be expected in any oil spill response, these existing concepts were evaluated in light of the unique circumstances of the spill and adapted accordingly.

The characteristics of the oil we were recovering on the surface and how it changed as it weathered are examples of the challenges we faced. The vessel of opportunity ("VOO") fleet used sorbent boom to recover surface oil and deposited the "saturated" boom into plastic bags for disposal. Noting that the bags seemed light, we cut open samples of the boom and found that the waxy oil covered the surface but did not penetrate below the immediate surface and that the interior sorbent was still snow white.[75]

No two oil spills, or oil spill responses, are the same. For this reason, it is difficult to generalize about the contribution that any particular intervention used in the context of a specific response makes to the ability of future responders to work effectively. Responders to the Deepwater Horizon spill acted appropriately in seeking response techniques tailored to the unique circumstances they confronted. Responders to future oil spill will be called upon to undertake the same type of incident specific analysis. It can be expected that future responders will look to the experiences of the Deepwater Horizon response, and many other responses, in

[73] Deposition of Richard Morrison 190:20-191:8

[74] See Deposition of Suttles 255:05-256:19.

[75] Personal observation of the author.

evaluating their own needs, but will ultimately be left to fashion the interventions uniquely suited to the circumstances before them.

V. Conclusion

The Deepwater Horizon spill response was the largest ever in the US, challenging both the technology respond to a spill and the organizational means to manage such a large and complex event. Our response leaned heavily on capabilities, technology, systems and processes developed over decades of research, smaller responses, and exercises. Significant research efforts encouraged by previous, the research following the Exxon Valdez being the latest example, positioned the spill response community for the best chance for success. The success of in situ burning (collecting and oil on the water) was due to the equipment and techniques developed by the combined efforts of government and the response industry, both nationally and internationally, following the Exxon Valdez.

The adoption of NIMS/ICS by the "response community" was central to the successful management success of the response, and a community effort it was. No single entity is capable of handling a response of the Deepwater Horizon's magnitude. It took the combined efforts of numerous government agencies (federal, state, and local), the RP, academia, and an army of contractors (on both the source control and spill response sides) to even attempt provide the best outcome, given that the event occurred. USCG FOSCs have used ICS since the mid-1990's and frequent drills and exercises have inculcated its coordination and decision-making processes into the regular members of the response community. Recognizing the frequency of proposal to use alternative technology at significant spills, the ARTES process was developed and published. The adaptation of the process to meet the thousand of alternatives suggested for the response, and the evaluation and adaptation of those ides was, like the response itself, a community effort. Future use of new techniques or technologies should be credited to the community as a whole.

But, every oil spill response is unique and requires the appropriate techniques and technologies in the so-called "tool box" to be adapted to the unique characteristics of that response. There's a saying in the response community, "if you've seen one spill, you've seen one spill," that reflects the recognition that every response requires thoughtful application and adaptation of the tactics and techniques that have been used before. It is expected that the specific circumstance of the spill, whether it be environmental conditions, geographic or hydrodynamic constraints, critical habitat, etc., will dictate what tactics and techniques will be adopted and adapted to produce the "best response".

Over the past decades, my experience and study has led me to one unalterable conclusion with respect to an oil spill "best response:" while we have made tremendous strides in organizational effectiveness by adoption of the National Incident Management System, we cannot overcome the laws of physics or chemistry, or mother nature itself; if an oil spill occurs, we have failed and the best we can do is limit the damage. Time, gravity, dispersion, weather, tides, and currents all conspire against the responder in a race to stem the tide of oil.

Information Required by the Federal Rules of Civil Procedure

1. This report contains my opinions, conclusions, and reasons therefore.

2. A general statement of my qualifications is contained in Section I, Professional Background, and in my resume, included as Appendix A

3. A list of all of my publications is provided in Appendix B.

4. I have received no compensation for my expert work in this case aside from my regular salary from the United States Coast Guard.

5. I have not previously testified as an expert witness.

6. The facts and data I considered in forming my opinions are listed in the citations to this report and in Appendix C.

The opinions expressed in this report are my own and are based on the data and facts available to me at the time of writing. Should additional relevant or pertinent information become available, I reserve the right to supplement the discussion and findings in this report.

Appendix A: Resume

Mark G. VanHaverbeke

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PROFESSIONAL SUMMARY

- Research and development in support of Coast Guard operational programs.
- Thirty years of commissioned service in the U.S. Coast Guard in positions of ever-increasing responsibility in marine safety, security, and environmental protection programs.
- Senior leadership and management positions in port, regional, and national settings.
- Engineering experience in field inspections, technical plan review, and program management.

EXPERIENCE HIGHLIGHTS

Research Engineer, Coast Guard Research & Development Center, New London, CT – October 2005 to present

- Developed a strategic plan for Coast Guard oil and hazardous material spill response R&D based on a systems analysis augmented by consideration of external factors such as funding availability, research by other organizations, and political considerations.
- Completed test and evaluation of sonar to detect heavy (sunken) oils and supported effort to develop a complete detection and recovery system.
- Conducted evaluation of oil dispersant effectiveness monitoring technology.
- Led or supported mission analysis and requirements development for the offshore patrol cutter, maritime security operations, and polar icebreaker.
- Spent over 50 days in the Gulf of Mexico region, primarily at at the Incident Command Post in Houma supporting the Federal On-Scene Coordinator by evaluating thousands of ideas submitted to BP's Alternative Response Technology ("ART") system, attending operational planning meetings to identify capability gaps that ART might address, and interfacing with vendors and the public.

Chief, Marine Safety Division, First Coast Guard District, Boston, MA – June 2002 to June 2005

- Directed programs for maritime safety, security, and environmental protection and provid oversight to district staff and field offices from Maine to New Jersey.
    - Managed implementation of Maritime Transportation Security Act, including creation of five Area Maritime Security Committees, development of vessels and facility security plans for 350 facilities and vessels, and the distribution of $67 million in port security grants.
- Identified need for and restructured district staff to provide critical focus on port, waterways, and coastal security.
    - Ensured a cadre of Cost Guard operational experts integrated port security concerns with "normal" Coast Guard operations during a critical period of the reinvigoration of the Coast Guard Ports, Waterways, and Coastal security mission.
- Led formal, multi-agency and multi-national teams to ensure coordinated response to pollution incidents, including aspects of weapons of mass destruction.
    - Chaired Regional Response Team 1 in support of the response to the tank barge B-120 grounding and oil spill in 2003, the largest spill to occur in Buzzards Bay, Ma.
    - Directed the highly successful maritime security planning effort for the 2004 Republican and Democratic National Conventions in an interagency effort that included 2,000 Coast Guard personnel, 17 cutters, and 45 small boats.
    - Coordinated Coast Guard District preparations, support, and exercise actions for TOPOFF 3, the National Exercise Program Top Official full-scale exercise in 2005 which the Commander, First Coast Guard District was the Principal Federal Official for the New London venue.

Commanding Officer, Marine Safety Office Providence – July 2000 to June 2002

- Field level implementation of marine safety, security, and environmental regulatory programs as designated Captain of the Port; Officer-in-Charge, Marine Inspection; Federal On-Scene Coordinator, and Federal Maritime Security Coordinator.
- Emphasized pre-event planning to ensure coordinated pollution response.
    - Improved pollution response planning by regionalizing effort, resulting in greater participation by state and local partners.
    - Emphasized roll of Environmental Section under Incident Command System: conducted a table top exercise structured to focus on environmental risks. Exercise identified criticality of Buzzard Bay breeding grounds for the endangered Roseate Tern. Subsequently collaboratively developed an oil spill protection plan that was used in the B-120 grounding and oil spill in 2003 to protect this critical habitat.
    - As Federal On-scene Coordinator, established Unified Command with State of Rhode Island and responsible party to respond to tug capsizing off Rhode Island beach.

- Responded immediately to events of 9/11, monitoring and controlling shipping to ensure ports secure while allowing legitimate operations to continue; received positive comments from industry for balanced/practical approach.
    - Organized efforts of multiple agencies and industry into a Unified Command to plan, coordinate, and protect deliveries of liquefied petroleum gas into the Port of Providence.
    - Leveraged existing Port Safety Committee to communicate and coordinate "new normalcy" security effort.
- Implemented Baldrige National Quality Program-based planning and measurement system to advance unit operational effectiveness.

Chief, Office of Design and Engineering Standards, Office of Marine Safety, Security, and Environmental Protection, U.S. Coast Guard Headquarters – May 1997 to July 2000

- Led office of 40 engineers and technical experts responsible for developing national and international standards for safety systems and ship design.
    - Shifted commercial vessel and port safety stance from reactive to proactive by propelling risk management into a place of prominence in the Coast Guard's marine safety and environmental protection business plan, as well as efficient resource usage and organizational focus.
    - Institutionalized the Prevention Through People concept, an effort to address the human element in marine safety and environmental protection missions, by developing sustaining, executable processes both nationally and internationally through the International Maritime Organization.
- Ensured best use of scarce R&D funds; drove restructure of 50-year old, multi-agency committee to maximize return on investment by cutting overhead by 75%.

Chief, Human Element and Ship Design Division, Office of Marine Safety, Security, and Environmental Protection, U.S. Coast Guard Headquarters – July 1995 to May 1997

- Took Coast Guard effort to address human aspects of safety and environmental protection, Prevention Through People, from concept to reality.
    - Developed long-term strategy to implement program through the International Maritime Organization, national steering groups, Coast Guard program direction, and R&D efforts.
    - Pushed message to industry through broad forums, workshops, and individual discussions to emphasize the need for action by the boardroom, not just at the deck plate level.
- Placed special emphasis on risk-based decision making in marine safety and environmental protection, expanding the concept to include recommended process adaptable to policy and operational decisions.

Commanding Officer, Marine Safety Office Buffalo – June 1993 to June 1995

- Field level implementation of marine safety, security, and environmental regulatory programs as designated Captain of the Port; Officer-in-Charge, Marine Inspection; and Federal On-Scene Coordinator for oil and hazardous material spill planning and response.
- Extremely successful in developing broad-based, multi-agency spill response planning team.
    - Developed scenario-based "action annexes" to the Area Contingency Plan to provide first line field responders with critical guidance and information.
    - Incorporated the National Interagency Incident Command System, Unified Command (UC), and the Incident Command System (ICS) into the Area Contingency Plan.
    - Implemented the National Preparedness Response Exercise Program, exercising the ICS/UC concepts and convincingly demonstrating to government and industry the strength of the UC approach.
- Implemented highly successful program to screen ships entering the Great Lakes from sea, gaining cooperation of quasi-governmental organizations on both sides of the international boarder.
    - Vigorously enforced new ballast water regulations, ensuring that foreign ballast was retained on board while facilitating research into alternative treatment methods.
    - Unit received Vice Presidential "Hammer Award" for developing cooperative safety and environmental protection enforcement program with other agencies (U.S. and Canadian) and industry.

Executive Officer, Marine Safety Office Buffalo – July 1991 to June 1993

- Executed the orders and policies of the Commanding Officer; responsible for unit personnel, administration and supply functions.
- Alternate Captain of the Port; Officer-in-Charge, Marine Inspection; designated Federal On-Scene Coordinator for oil and hazardous material spill planning and response in absence of Command Officer.
    - Developed plan and facilitated execution to implement new Area Committee and Area Contingency Plan requirements established by the Oil Pollution Act of 1990.
    - Planned and oversaw execution of initiatives in support of new ballast water regulations and enhanced program to ensure foreign ships met safety standards.
    - Brought operational and technical skills to bear in successfully responding to several marine casualties and pollution incidents.

Staff Naval Architect, Standards Development Branch, Office of Marine Safety, Security, and Environmental Protection, U.S. Coast Guard Headquarters – August 1987 to July 1991

- Developed policy, standards, and regulations in support of the Coast Guard's Marine Inspection Program

- Conducted a regulatory impact analysis and provided technical input into the small passenger vessel regulatory rewrite, one of the largest and broadest regulatory projects undertaken by the Coast Guard in years.
- Coordinated the Marine Inspection Program safety and occupational health effort, planning and implementing a program to acquire and nationally deploy resources, including billets, to protect the safety of marine inspectors and pollution responders.
- Developed Coast Guard position and initiated action for regulation of asbestos in the marine industry.
- Provided technical analysis on aspects of the Oil Pollution Act of 1990 while still under development, including evaluation of various implementation schemes or double hulls, leading to the schedule incorporated in the final Act.

Staff Engineer, Hull Division, Marine Safety Center, Washington, DC – July 1986 to August 1987

- Reviewed plans for merchant vessel designs to ensure compliance with federal regulations and associated standards.
- Provided guidance for corrective action and supported field units in ensuring ships were safe for operations.
- As one of the original members of the new unit, formed when three regional offices were merged, provided internal unit guidance and recommendations and helped meld the policies of three units into one national position.

Staff Engineer, Merchant Marine Technical Branch, Third Coast Guard District, New York, NY – June 1984 to July 1986

- Reviewed plans for merchant vessel designs to ensure compliance with federal regulations and associated standards.
- Provided guidance for corrective action and supported field units in ensuring ships were safe for operations.
- Provided technical evaluation of damage and salvage plans for Captain of the Port and Officer in Charge, Marine Inspection overseeing responses.

Various Positions, Marine Safety Office Chicago – July 1979 to June 1982

- In first marine safety/environmental protection field assignment, rotated through all major branches within the office, including inspections, investigations, merchant mariner licensing, and port operations.
- As Port Safety Officer, oversaw unit's prevention activities and preparation for pollution response.
    - Coordinated response by multiple agencies dealing with open hopper barge illegally used to store 100,000 gallons of hazardous material.

- Coordinated response to tallow globules appearing on South Chicago beaches, tracing source to manufacturer of soap products.
- Oversaw response to a warehouse fire that resulted in 2300 drums of over 75 different chemicals mixing with water to create a soup of over 500,000 gallons of chemically contaminated water in the warehouse basement, located next to a commercial waterway.
- Developed realistic response exercise scenarios and oversaw or provided advice on response methods, enhancing unit and regional preparedness.

Staff Officer, Marine Environmental and Port Safety Branch, Eleventh Coast Guard District, Long Beach, CA – July 1976 to June 1979

- Supported field commands in their execution of the marine environmental protection and port safety programs,
- Attended various pollution responses to gain "hands-on" experience.
- Coordinated notification and communication efforts with the Regional Response Team immediately following the tanker SANSINENA explosion and fire.

Operations Officer, United States Coast Guard Cutter COMANCHE, Eureka, CA – June 1975 to July 1976

- Deck watch officer and department head.

ACQUISITION CERTIFICATION

Systems Engineering Level I
DHS Certified Contracting Officer's Representative (COR) Level III

EDUCATION

University of Michigan, MS, Mechanical Engineering , 1984
University of Michigan, MS, Naval Architecture/Marine Engineering, 1984
U.S. Coast Guard Academy, BS, Marine Engineering, 1975

AWARDS AND RECOGNITION

- Coast Guard Legion of Merit Medal
- Coast Guard Meritorious Service Medal with Gold Star and "O" Device
- Coast Guard Commendation Medal with Gold Star and "O" Device
- Transportation 9-11 Medal
- Coast Guard Achievement Medal with Gold Star
- Secretary's Outstanding Unit Award

- Coast Guard Meritorious Unit Commendation
- Coast Guard Meritorious Team Commendation with Three Gold Stars
- National Defense Service Medal with Two Bronze Stars
- Coast Guard Bicentennial Unit Commendation
- Humanitarian Service Medal
- Vice Presidential Hammer Award

AFFILIATIONS

- Propeller Club of the United States

Appendix B: Publications

VanHaverbeke, Mark. 2007. "Oil and Hazardous Materials Spill Response Technology Development, Strategic Plan." (internal USCG working document)

VanHaverbeke, Mark G. and B. Cotton Jr. 2008. "Systems Analysis of Oil Spill Response" *Proceedings, 2008 International Oil Spill Conference*. Savannah, GA. Pp 357-364

Trudel, Ken; R. Belore, M. VanHaverbeke, and J. Mullin. 2009. "Updating the U.S. SMART Dispersant Efficacy Monitoring Protocol." *Proceedings of the 32nd Arctic and Marine Oil Spill Program (AMOP) Technical Seminar*. Ottawa, ON, Canada. Pp 397-404.

Hansen Kurt, M. Fitzpatrick, P. R. Herring and M. VanHaverbeke. 2009. "Heavy Oil Detection (Prototypes) — Final Report." CG-D-08-09, U.S. Department of Homeland Security, United States Coast Guard.

VanHaverbeke, Mark, V. Guthrie, L. Dew, J. Kallmeyer, B. Barr, S. Tauber, D. Tisera, H. Woo Park. 2009. "Inland Waterways Maritime Security System Market Research & Analysis Report." (Distribution limited; Sensitive Security Information)

VanHaverbeke, Mark, V. Guthrie, L. Dew, J. Kallmeyer, B. Barr, S. Tauber, D. Tisera, H. Woo Park. 2009. "Inland Waterways Maritime Security System Technology Development and Demonstration Plan." (Distribution limited; Sensitive Security Information)

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Macesker, Bert, M. VanHaverbeke, K. Shea Kettle. 2010. "US Coast Guard Methodologies and Tools for Developing an Affordable and Effective Fleet." *Proceedings, 10th International Naval Engineering Conference and Exhibition*. Portsmouth, UK. Pp 121-130.

Addassi, Yvonne, E. Faurot-Daniels, K. Hansen, M. Van Haverbeke, M. Wilcox, and C. Hall. 2011. The Deepwater Horizon Spill Response: Standing-up a Large-scale Alternative Response Technologies Review, Testing, and Evaluation Program within the Incident Command Structure. *Proceedings, 2011 International Oil Spill Conference*. 2011-373.

Krempley, Mark, A. Barrett, S. Marlay, and M. VanHaverbeke. 2012. "Technical Report on DOMICE Simulation Model."

Krempley, Mark, A. Barrett, S. Marlay, and M. VanHaverbeke. 2012. "DOMICE Simulation Model User Guide."

Garrett, Gordy, M. VanHaverbeke. B. Eiserike, K. Puzder, T. Meyers. 2012. "Maritime Security Operations Mission Analysis Study Plan." (Distribution limited)

Mowrer, Matt, J. Fuller, M. Sculley, M. Michaelis, M. Thibault, M. VanHaverbeke. 2013. "Maritime Security Operations Mission Analysis Report." (Distribution limited; Sensitive Security Information; annexes classified)

Appendix C: List of Acronyms

ART - Alternative Response Technologies
ARTES - Alternation Response Tool Evaluation System
BAA - Broad Agency Announcement
BOEMRE - Bureau of Ocean Energy Management, Regulation and Enforcement
BSEE - Bureau of Safety and Environment Enforcement
DOI - Department of Interior
DWH - Deepwater Horizon
EPA - Environmental Protection Agency
FOSC - Federal On-Scene Coordinator
FOSC-R - Federal On-Screen Coordinator's Representative
GoMRI - Gulf of Mexico Research Initiative
HSPD - Homeland Security Presidential Directive
IATAP - Interagency Alternative Technology Assessment Program
ICP - Incident Command Post
ICCOPR - Interagency Coordinating Committee on Oil Pollution Research
ICS - Incident Command System
NCP - National Contingency Plan
NIC - National Incident Commander
NIIMS - National Interagency Incident Management System
NIMS - National Incident Management System
NOAA - National Oceanic and Atmospheric Administration
OSRD - Oil Spill Response Division
OSRO - Oil Spill Response Organization
R&D - Research and Development
RDC - Research and Development Center
RP - Responsible Party
RRTs - Regional Response Teams
SONS - Spill of National Significance
SOSC - State On-Screen Coordinator
SSC - Scientific Support Coordinator
UAC - Unified Area Command
USCG - United States Coast Guard

Appendix D: Sources Considered

The sources considered in preparation of this report include the citations in the report footnotes, as well as those listed in this appendix.

Expert Report of Mark VanHaverbeke
Consideration Materials
(Documents Cited in Report are Consideration Materials even if Not Listed Below)

Attachment Range
33 U.S.C. 2761
BP-HZN-2179MDL01093604-BP-HZN-2179MDL01093776
BP-HZN-2179MDL01426137
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Deposition Exhibit 11981
Deposition Exhibit 11987
Deposition Transcript Hollek, Darrell
Deposition Transcript Morrisohn, Richard
Deposition Transcript Suttles, Doug (2 vol.)
Deposition Transcript Utsler, Mike
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HCG388-013677-HCG388-014284
HCP008-002191-HCP008-002434

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Consideration Materials
(Documents Cited in Report are Consideration Materials even if Not Listed Below)

http://www.iccopr.uscg.gov/apex/f?p=118:331
PCG072-024036-PCG072-024118
TREX-12288
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Consideration Materials
(Documents Cited in Report are Consideration Materials even if Not Listed Below)

US_PP_MVH002835-US_PP_MVH002931
US_PP_MVH002932-US_PP_MVH002940
US_PP_MVH002941-US_PP_MVH002943
US_PP_MVH002944-US_PP_MVH002984
US_PP_MVH002985-US_PP_MVH003059
US_PP_MVH003060-US_PP_MVH003102
US_PP_MVH003103-US_PP_MVH003161
US_PP_MVH003103-US_PP_MVH003161
US_PP_MVH003162-US_PP_MVH003368
US_PP_MVH003162-US_PP_MVH003368
US_PP_MVH003369-US_PP_MVH003376
US_PP_MVH003377-US_PP_MVH003460
US_PP_MVH003377-US_PP_MVH003460
US_PP_MVH003461-US_PP_MVH003470
US_PP_MVH003471-US_PP_MVH003670
US_PP_MVH003671-US_PP_MVH003676
US_PP_MVH003677-US_PP_MVH003680
US_PP_MVH003681-US_PP_MVH003776
US_PP_MVH003777-US_PP_MVH003855
US_PP_MVH003856-US_PP_MVH003859
US_PP_MVH003860-US_PP_MVH003864
US_PP_MVH003865-US_PP_MVH003956
US_PP_MVH003957-US_PP_MVH004008
US_PP_MVH004009-US_PP_MVH004037
US_PP_MVH004038-US_PP_MVH004045
US_PP_MVH004046-US_PP_MVH004047
US_PP_MVH004048-US_PP_MVH004049
US_PP_MVH004050-US_PP_MVH004053
US_PP_MVH004054-US_PP_MVH004054
US_PP_MVH004055-US_PP_MVH004056
US_PP_USCG330336-US_PP_USCG330610
US_PP_USCG551986-US_PP_USCG552064