EXPERT RESPONSE REPORT
U.S. v. BP Exploration & Production, Inc., et al.

Human Health Impact of the *Deepwater Horizon* Explosion, Oil Spill, and Response
Submitted on Behalf of the United States

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The following comments are in response to the expert reports prepared on behalf of BP Exploration and Production, Inc. by Dr. Robert Cox, M.D., Ph.D. and Captain Frank Paskewich dated August 15, 2014. I comment first on Dr. Cox, followed by a response to Capt. Paskewich's report.[1]

I. Response to Dr. Cox's Report

After describing his background and qualifications, Dr. Cox defines his scope of work on p. 3 of his report and offers an "executive summary" of his opinion beginning on p. 4. In that summary, he claims that he has found "no compelling evidence for significant adverse health effects to clean-up workers or to Gulf coast residents as a result of the DWH oil spill, and it is highly unlikely that any adverse health effects will become manifest in these populations in the future."

I disagree. As detailed further, below:

- Eleven people were killed and many others were injured in the explosion and fire that occurred on the DWH oil rig on April 20, 2010;
- Thousands of injuries and illnesses were documented amongst cleanup workers and volunteers during the response to the DWH oil spill;
- The oil spill had a documented impact on mental health;
- Ongoing work is being conducted to determine the long-term impact of the oil spill on human health and it is premature draw conclusions about the long-term impacts at this time.

In drawing his conclusions, Dr. Cox ignores or downplays the multitude of symptoms (including mental health symptoms) reported during the spill response; relies on faulty

[1] I incorporate by reference my resume and the information required by the Federal Rules of Civil Procedure that I submitted with my "Round 1" Expert Report entitled, "Human Health Impact of the Deepwater Horizon Explosion, Oil Spill, and Response, Submitted on Behalf of the United States," submitted on August 15, 2014.

assumptions and an outdated approach in his assessment of the human health risks associated with exposure to oil and/or dispersants; and ignores the historical literature regarding the health effects of oil spills and peer-reviewed literature regarding the health effects of dispersants.

A. Dr. Cox Fails to Analyze the Impact of Injuries Related to the Fire and Explosions and Ignores or Downplays the Multitude of Symptoms Reported after the Initial Explosion and Oil Spill

Dr. Cox indicates that "any assessment of the human health impact resulting from the explosion and fire on the DWH oil rig on April 20, 2010, and the rig resulting worker deaths and injuries" was not within the scope of his work. (Cox Round 1 Expert Report ("Cox"), p. 3.) Accordingly, Dr. Cox is ignoring the eleven deaths of workers directly affected by the DWH explosion, in addition to over two dozen non-fatal injuries on the rig and during the fire-fighting immediately afterwards. (Goldstein, et al., 2010, p. 1339.)

And while Dr. Cox does not state that the wide variety of injuries that occurred to clean-up workers subsequent to the oil spill were outside the scope of his report, he ignores or downplays those injuries. In his executive summary and throughout his report, Dr. Cox opines that there were no "significant adverse health effects" as a result of the DWH spill (without providing a definition of "significant adverse health effects"[2]), and yet there are numerous examples of clean-up workers who did suffer health effects requiring emergency medical care, lost work days, and personal distress and discomfort.

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[2] In my report, I rely on the following definition of adverse health effect proposed by Russell Sherwin:

> An adverse health effect is defined as the causation, promotion, facilitation and/or exacerbation of a structural and/or functional abnormality, with the implication that the abnormality produced has the potential of lowering the quality of life, contributing to a disabling illness, or leading to a premature death.

(Sherwin RP, 1983, p. 180.)

For instance, Dr. Cox himself references BP's Medical Encounters Database, which documented 20,032 visits between April 23, 2010 and March 31, 2011. Of these, 5,977 were for injuries and 14,155 were for illnesses. Furthermore, 3,936 incidents were "further evaluated," and eighteen clean-up workers were hospitalized. (Cox, pp. 63-64; *see also* BP Medical Encounters Database.) These latter cases were also summarized in a NIOSH's Final Health Hazard Evaluation (HHE). (NIOSH Final HHE, 2011, p. 2-3.)

Dr. Cox also references another summary of injuries and illnesses documented during the response, this one from a NIOSH report dated August 13, 2010, which indicated that 1,136 injuries and 994 illnesses recorded between April 23, 2010, and July 27, 2010. (Cox, p. 63 and NIOSH, 2010.) However, note that this report was not meant to be a final accounting of the recordable injuries and illnesses that occurred during the response. (NIOSH, 2010, p. 3.) And as I noted in my Round 1 report, the BP Deepwater Horizon Incident Response Recordable Injury and Illness Data Report for the period April 22, 2010 to December 3, 2010 summarized 5,986 reportable incidents of injuries and illnesses. (Clapp Round 1 Expert Report at 7 and Ex. 12020.)

Respiratory symptoms in other workers were consistent with an irritant effect from inhaled contaminants. Drs. Goldstein, Osofsky, and Lichtveld note that: "Chemical-induced symptoms in cleanup workers commonly include upper respiratory tract illnesses, throat and eye irritation, headaches, dizziness, nausea, and vomiting," (Goldstein, et al., 2010, p. 1338), and such symptoms were documented in clean-up workers during the response. (*Id.* at p. 1334.) Additionally, the excess prevalence of skin irritation, upper respiratory symptoms and headaches

in Coast Guard employees studied by NIOSH and reported in HHE 6 are consistent with exposure to weathered oil and dispersants in other clean-up workers. These may not be significant health effects to Dr. Cox, but they were important enough for NIOSH staff to investigate and report them in their HHE.

Epidemiologic analysis typically involves comparison of groups of people, some of whom are more exposed to potentially harmful substances than others. From an epidemiologic perspective, it is important to note that in some analyses conducted by NIOSH, symptoms occurred more frequently in those defined as exposed to oil than in those defined as unexposed. (*See, e.g.*, NIOSH HHE 6, 2010, p. 6A-2; NIOSH HHE 9, 2010, p. 9B-2.)

Finally, the most recent status report by the Medical Benefits Settlement Claims Administrator noted that the Medical Benefits Settlement ("Settlement") became effective on February 12, 2014. Rec. Doc. 13320. The Settlement specified physical conditions for which class members are eligible for compensation. (Rec. Doc. 6427-10 (Exhibit 8 to the Deepwater Horizon Medical Benefits Class Action Settlement Agreement, as Amended on May 1, 2012).) These included Upper Airway/Respiratory conditions such acute rhinosinusitis, acute tracheobronchitis, and acute bronchitis occurring within 72 hours of exposure; dermal conditions such as acute contact dermatitis, atopic dermatitis, irritant contact dermatitis occurring within 72 hours of exposures; neurophysiological/neurological/odor-related symptoms such as headache, dizziness, fainting and seizure occurring within 24 hours of exposure; and gastrointestinal distress manifested as nausea, diarrhea, vomiting, abdominal cramps and abdominal pain occurring within 24 hours of exposure. (Rec. Doc. 6427-10, p. 6-9.) Many of these conditions

and symptoms were documented in NIOSH Interim and Final HHEs and the Medical Encounters Database and summaries cited above. Through August 8, 2014 there were 79 claims paid and thousands more still under review in this detailed and lengthy process. (Rec. Doc. 13320, p. 7.)

In my opinion, there is evidence of numerous and significant adverse health effects from the DWH oil spill and clean-up activities. The evidence is contained in the medical encounters database, the NIOSH HHEs, and BP's own Injury and Illness summary. Some health effects were serious enough to require hospitalization.

B. Dr. Cox's Assessment of the Human Health Risks Associated with Inhalation of Oil and/or Dispersants Relies on Faulty Assumptions and an Outdated Approach

1. Dr. Cox's Conclusions Rely on the Incorrect Assumption That Potentially Hazardous Components of Oil and/or Dispersants Did Not Reach the Gulf's Surface and/or Shore

Dr. Cox cites Middlebrook, et al, at p. 20281 to support his contention that benzene, toluene, ethylbenzene and xylene dissolved in water and this reduced human exposure, and that other volatile organic compounds had little or no potential to reach clean-up workers or shore residents. Yet Middlebrook and colleagues, as well as other state and federal agencies, documented that such chemicals did reach shore and did in fact have the potential to reach clean-up workers and shoreline residents. (*See, e.g.*, Middlebrook et al, 2011, p. 20284, Figure 8; NIOSH FINAL HHE, 2011, p. 7; *see also* IGS173-000117, N1A001-003114.)

Additionally, I have reviewed section 5.4 of the Responses to BP Expert Reports prepared By Donald F. Boesch, Ph.D.and Stanley D. Rice, Ph.D. in which they respond to the statement that "fresh oil is more toxic than weathered oil," in the context of the environmental impact of the spill. While I am not a toxicologist, section 5.4 of Drs. Boesch and Rice's

Response Report is consistent with my opinion that weathered oil contains substances that are potentially hazardous to those exposed.

2. Dr. Cox's Reliance on Benchmark Doses to Conclude That There Is No Risk Is Inappropriate and Outdated

Dr. Cox describes his human health risk assessment methodology, citing a thirty year-old document, Risk Assessment in the Federal Government: Managing the Process, (Cox, p. 6), that is sometimes referred to as the Red Book. Dr. Cox does not acknowledge, however, that the National Academy of Sciences updated this document in 2009 to reflect current approaches not considered by Dr. Cox. (NAS, 2009.) In fact, the 2009 update has a section titled "Beyond the Red Book," (NAS, 2009, p. 241), and warns against uncritical use of "bright line" characterizations such as reference dose or reference concentration values. Dr. Cox uses such values repeatedly throughout his report.

After listing the four steps in this assessment process, Dr. Cox ends with the age-old adage that "the dose makes the toxin. Even essential substances, such as water and oxygen, can be toxic in large enough doses," to support his conclusion that the clean-up workers and Gulf residents were not exposed to components of oil, dispersants, or other substances associated with the spill at doses that would cause "significant adverse health effects." What Dr. Cox ignores in this section is the current understanding that some substances, including endocrine-disrupting substances such as the dioxins and furans created in the DWH oil spill burns, are exquisitely toxic at low doses. This current understanding was summarized by Dr. Linda Birnbaum, the Director of the National Institute of Environmental Health Sciences, who noted that as far back as 2002 "there was evidence for low-dose effects for a select number of well-studied endocrine

disruptors." (Birnbaum, 2012, p. a143.) She cites a review (Vandenberg, et al., 2012) that describes dioxin as the most potent endocrine disruptor that, among other effects, altered male reproductive development and sperm production at low dose in multiple laboratory experiments. (*Id.*)

Throughout his report, Dr. Cox relies upon current benchmark doses, which he defines as levels "below which no adverse health effects are expected." (Cox, p. 18.) Dr. Cox fails to provide context for these benchmarks. A more appropriate view was expressed many years ago by a Federal air pollution official:

> We...know that at a little lower level there are more subtle effects on the action of the lung, and that below that some enzyme system begins to fail or function improperly. The no-effect level would have to be below that. But as science progresses, it is very likely we are going to find still other body chemical systems that are being affected, so the no-effect level always corresponds, you might say, to the limitations of scientific knowledge in this area.... You can't classify even normal background (levels of air pollution) as a no-effect situation."

(Testimony of Dr. John Middleton, Commissioner National Air Pollution Control Administration, p. 1409 *in* Air pollution--1970. Hearings, Ninety-first Congress, second session, on S. 3229, S. 3466 [and] S. 3546, May 27, 1970.)

Furthermore, a recent review of adverse health effects of outdoor air pollutants found "increases in respiratory and cardiovascular problems at outdoor pollutant levels well below standards set by such agencies as the US EPA and WHO." (Curtis, et al., 2006.) These authors cite a study (Peters, et al., 2001) that found significantly increased hospital admissions for cardiac problems when median ten-micron particulate pollution levels were 19.4 micrograms per

cubic meter of air, the current EPA regulation to limit this type of air pollution is 150 micrograms per cubic meter. (*Id.* at p. 818, 821.)

Dr. Cox opines that: "For chemicals with different modes of action, there is no robust evidence that exposure to a mixture is of health concern if the individual chemicals are present below their zero-effect levels." (Cox, p. 21.) Yet the document he references in his footnote 57, ATSDR's Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures, does not support this opinion. Rather, the authors of the document note that: "A particular issue [in the health assessment of hazardous substances] is whether a mixture of components, each of which is present at less than guidance concentrations, may be hazardous due to additivity, interactions, or both." (ATSDR, 2004, p. 1.) Moreover, the authors also point out that: "EPA (2000) recommends the response addition model for independent action . . . for cancer risk, noting that when component risks are small, the formula collapses into the simple addition of component risks. . . the sum of the upper bound risks provides useful information regarding the overall risk from mixtures of carcinogens." (ATSDR, 2004, p. 22.) This is the opposite of the treatment of risks from mixtures implied by Dr. Cox. His opinion seems to be that there is no evidence that small exposures from different chemicals in a mixture add up; the ATSDR Guidance Manual, citing EPA, says that for mixtures of carcinogens, the small component risks do add up.

In analyzing potential inhalation exposure, Dr. Cox asserts that it is important "not to focus on a few high levels." (Cox, p. 27.) Interestingly, to illustrate his point, Dr. Cox gives the example of filling of gas tanks at gas stations of why high values can be misleading, but he fails

to mention that gas tank filler hoses now capture fumes to avoid just this type of short-term high exposure. If there was no potential risk to human health from short-term, intermittent exposure to these fumes it is unlikely the capturing of these fumes would be required.

Finally, Dr. Cox's conclusion that "toxicology benchmarks agree with the lack of positive health surveillance findings, which did not detect any significant adverse health effects," (Cox, p. 26), simply ignores the numerous examples of significant adverse health effects discussed above in Section I.A., including symptoms consistent with inhalation and dermal exposure to weathered oil and dispersants.

3. Dr. Cox's Comparisons of DWH Exposures to Seemingly Mundane Sources of Exposure Are Inapt Because There Is Risk Associated with Such Common Sources, And There Is a Significant Distinction between Voluntary and Involuntary Exposure

Throughout his report, Dr. Cox compares the exposures experienced by DWH responders and Gulf residents to seemingly mundane sources of exposure, ostensibly to imply that DWH exposure levels at or below these mundane sources could not pose a potential health risk. This approach ignores three fundamental points: 1) there is risk associated with exposure to seemingly mundane sources of exposure, 2) many of Dr. Cox's examples of seemingly mundane sources of exposure are sources that individuals voluntarily expose themselves to, whereas Gulf residents were involuntarily exposed to DWH sources (and to an extent, so were clean-up workers such as fishermen, whose livelihood was interrupted by the spill and who required an alternate source of income during the spill and response), and 3) Dr. Cox ignores any additive effects of exposure from both "mundane" sources and DWH-related sources.

For instance, Dr. Cox discusses the EPA finding that dioxins "were created from the controlled in-situ burning of oil" at levels "similar to emissions from residential woodstoves forest fires and two orders of magnitude lower than open burning of residential waste." (Cox, p. 32.) Dr. Cox does not, however, note that EPA has proposed new regulations to reduce emissions from woodstoves (EPA, 2014) because they contain substances that are harmful to human health. These emissions are not without risk, in other words, and are therefore the subject of on-going regulatory action. Moreover, Dr. Cox failed to distinguish between voluntary and involuntary exposures in making this comparison.

Similarly, Dr. Cox notes that during the burning of oil, dioxins and furans can form "from incomplete combustion of organic matter in the presence of chlorine. . . [and that h]umans are primarily exposed to dioxins through the diet, primarily in fish and fatty foods." (Cox, p. 16.) Again, this is an inappropriate juxtaposition of two unrelated sources of exposure to clean-up workers and shoreline residents. While it is true that the U.S. general population is primarily exposed to dioxins through the diet, such exposure does carry health risks. (*See* IARC vol. 69, 1997.) Moreover, this means that DWH clean-up workers and those exposed to burning spilled oil had an additional source of exposure that was directly related to the BP spill: they experienced exposure to a carcinogenic and endocrine-disrupting chemical independent of the normal exposure that occurs widely through the diet. For the same reasons, Dr. Cox's juxtaposition between exposure to PAHs and other less-volatile hydrocarbons due to in situ burning of oil during the DWH response and exposure to these compounds from chronic ingestion through food and chronic inhalation through smoking tobacco, (Cox, p. 9), is also inappropriate. Dioxins are acknowledged carcinogens and endocrine disrupting substances, so

the goal should be no additional exposure because any increased exposure confers increased adverse health risk.

While describing "exposure to PAHs for most of the United States population," (Cox, p. 10-11), Dr. Cox notes that PAHs are present in coal tar used in cosmetics and shampoos. He then expresses the opinion that "coal tar has not been shown to cause an increase in cancer." (*Id.* at p. 11.) But the International Agency for Research on Cancer classifies coal-tar pitch as "carcinogenic to humans (Group1)", and further that "There is strong evidence from experimental data that coal-tar pitch has a genotoxic mechanism of action." (IARC Monographs Vol. 100F, 2012, p. 165) This means that coal-tar pitch is capable of causing genetic damage to cells at any dose above zero. Later in his report, Dr. Cox similarly describes concentrations of PAHs in weathered oil as "far less than those in FDA-approved shampoos and skin medications." (Cox, p. 68.) The fact that a substance is found in an FDA-approved product does not mean that there is no risk associated with exposure to that product. The DWH exposures were not shampoo, and were not voluntary. This inappropriate comparison dismisses the importance of worker and community exposures caused by the DWH explosion, oil spill and subsequent clean-up activities.

Dr. Cox's comparisons of air concentrations of DWH-related oil and dispersant chemicals to other sources of pollution in U.S. cities and indoor air fare no better. Dr. Cox finds Gulf Coast air risk during the spill and response to be "less than the risk of breathing the air in our homes." (Cox, p. 67.) This is an inappropriate and falsely dismissive comparison; it is well-known that indoor air concentrations of volatile chemical compounds exceed ambient air

concentrations in most areas of the U.S. Similarly, Dr. Cox's comparison of DWH levels to polluted U.S. cities (Baton Rouge, Houston, Los Angeles), (Cox, p. 40-42), and his statement that "concentrations observed in the aftermath of the DWH spill were typical of atmospheric levels in U.S. cities," (*id.* at p. 41), was uninformative. Saying that Gulf Coast air is not worse than the air in cities such as Baton Rouge, Houston and Los Angeles does not resolve the question of whether the spill caused increased risk to human health in the Gulf Coast region, particularly, given that air pollution in Baton Rouge, Houston, and Los Angeles is widely recognized as a health risk.

Finally, Dr. Cox discusses the Air Quality Index (AQI), especially the ozone and fine particulate levels, for the Gulf states for several years. (Cox, p. 46.) He concludes that these "Air Quality Indices showed that the air along the Gulf Coast was overall healthier in 2010 than it was during the previous five years." (*Id.*) This fails to note the limited nature of the AQI county-level data compared to the more detailed and localized monitoring and modeling done in response to the DWH explosion and oil spill.

4. The Sampling Data Dr. Cox Relies on Has Its Limits

Dr. Cox refers to the air exposure data he relied on as "robust," (Cox, p. 24), but as he indicates in his Table 6, OSHA's sampling did not begin until May 27, 2010, and NIOSH's did not begin until June 4, 2010. Even BP's occupational sampling did not begin until April 27, 2010, a week after the explosion and fire. (Cox, p. 24.) Dr. Howard noted in his deposition that NIOSH did relatively little monitoring and did no collection of biological specimens

(biomonitoring). (Howard Deposition, pp. 259-265.) NIOSH further noted in its Lessons Learned document about the spill response that

> While NIOSH has the expertise to develop tools and plans, insufficient in-house capacity within NIOSH is available to conduct large-scale surveillance efforts, and the existing contract mechanisms impose time constraints that impede immediate implementation of large-scale surveillance during disasters.

(Ex. 12234, p. 4.) NIOSH noted that given staff limitations its investigators were typically able to visit each worksite for only one work shift and that: "Work conditions changed over time, likely leading to changing exposure to occupational hazards." (NIOSH HHE 7, 2010, p. 7-5.)

C. Dr. Cox's Analysis of the Human Health Risks Associated with Dermal Exposure to Oil and/or Dispersants Ignores the Fact that Dermal Exposure Was Not Measured and Relies on Faulty Assumptions Regarding Personal Protective Equipment (PPE)

1. Dr. Cox Fails To Address the Impact of the Lack of Biomonitoring in the Deepwater Horizon Spill

Dr. Cox focuses on the airborne testing that was performed during the response, opining that such airborne testing is sufficient to determine the impact of the spill on human health. Dr. Cox fails to acknowledge that such testing is in fact only one form of exposure testing that is in many instances – and should be – accompanied by biomonitoring to gain a full understanding of human exposure. Biomonitoring – the testing of blood and urine – can be an important complement to airborne monitoring, because exposures may appear in blood and urine testing that do not appear in airborne testing. As Dr. Howard testified during his deposition, it is possible to have dermal/ingestion exposure when air monitoring shows no exposure, (Howard

Deposition, p. 201); he also acknowledged that there can be exposure even if air monitoring results are all below OELs. (*Id.* at p. 239-40.)

Despite the importance of biomonitoring, neither any of the federal agencies nor BP conducted biomonitoring. As Dr. Howard explained in his deposition, NIOSH only performed "visual observations" of dermal exposure but in fact did not measure or monitor dermal exposure. (Howard Deposition, p. 271.) During the response, Dr. Howard articulated on multiple occasions that he was concerned about insufficient exposure monitoring without performing biomonitoring. Dr. Howard was not alone in his concern about the lack of biomonitoring. On June 25 for example, he wrote to several of his NIOSH colleagues that: "As a result of IOM and other conversations and reading, I am concerned that we may be not have a comprehensive approach to exposure monitoring for Gulf workers. DART has prepared their thoughts on the issue (see below) and I think HETAB needs to think about including Biomonitoring in the HHEs (or in a special focused HHE) so that we are not criticized for missing exposure through the dermal route." (Ex. 12026 at US_PP_HHS002809.) In another email, Dr. Howard noted the limitations of airborne sampling in an outdoor environment, focusing particularly on the fact that airborne monitoring may not capture longer term health effects and that in the absence of biomonitoring long-term health studies are impaired:

> Exposure monitoring by means of air sampling is subject to several limitations when used episodically in an outdoor, dynamic environment. Since air sampling does not reflect total exposure, and total exposure may be more associated with longer term health effects, the continuation of our approach without incorporating bio-monitoring (1) represents only a partial approach to determining exposure, (2) leaves us scientifically incomplete; (3) leaves us unable to address the concerns of those who are in the media now saying that harmful exposures are occurring despite negative air sampling results; and (4) impairs our ability to conduct long term health studies since we have little information on actual total exposure occurring now.

(Ex. 12025 at US_PP_HHS002807.) Dr. Howard confirmed these limitations in his deposition testimony. (Howard Deposition, pp. 286-87.) Dr. Howard indicated in his deposition that the conversations about biomonitoring only ceased because of the capping of the well, (*id.*at p. 96), and that in the future, NIOSH would recommend pre-work blood sampling and give serious consideration to biomonitoring. (*Id.* at p. 198.)

Despite the absence of biomonitoring by BP or NIOSH, there was some very limited biomonitoring conducted by a private employer, which indicated exposure of its workers to benzene: as described in an email about this sampling, Concateno is "the laboratory that has been doing some benzene biomonitoring in the Gulf. The ships they've received samples from are the Viking Poseidon and 5 others. They are the vessels operating some of the ROVs that are working down at the source. Jorunn reported that they are seeing slightly elevated levels (~25 ppm) of benzene metabolites in these workers, even correcting for smoking." (Ex. 12024 at US_PP_HHS002801.) The email goes on to note that there was increased exposure where individuals failed to comply with PPE requirements: "They were also able to figure out that the highest exposure they saw was due to improper doffing of PPE. The worker consistently removed things out of order and this led to his higher numbers. It was pointed out to him and they saw them fall back in line." (*Id.*) The limited biomonitoring that was performed thus indicated two problems: benzene metabolites were detected in even those wearing PPE, and there was a failure to comply with PPE (detected by a biomonitoring company) that led to an even greater concentration of benzene metabolites in workers.

The absence of adequate biomonitoring during the response has multiple implications: (1) exposure is not fully characterized and there may in particular be a lack of adequate characterization of exposures that could lead to long-term health effects and (2) long-term studies, such as the NIEHS study, will suffer from the absence of such information.

2. Dr. Cox Overstates the Use and Effectiveness of Personal Protective Equipment

The risks of dermal exposure to oil, dispersants, and chemicals used in response activities are not theoretical. There are numerous documented examples of clean-up workers with skin rashes consistent with contact with oil and dispersants during near shore clean-up activities and cleaning birds. (*See, e.g.*, NIOSH HHE 5, 2010, pp. 5-3, 5-7; NIOSH HHE 7, 2010, p. 7-9.)

However, in his executive summary, Dr. Cox opines that "dermal exposures … would be small … especially given requirements for use of appropriate PPE." (Cox, p. 4.) Here, and throughout his report, Dr. Cox stresses that personal protective equipment requirements should have been sufficient to prevent harm from skin contact with weathered oil and dispersant during cleanup activities. (*See, e.g.*, Cox, p. 48 ("Clean-up Workers, who were generally closer in proximity to oil and dispersants, were required to wear appropriate PPE, which should have prevented most, if not all, dermal exposures.").)

First, the fact that PPE was required for clean-up workers contradicts Dr. Cox's assumption that there's nothing harmful in weathered oil that could pose a potential risk to human health. Indeed, the NIOSH/OSHA Interim Guidance on PPE that Dr. Cox himself sites (*see* Cox, pp. 50, 73), indicates otherwise, noting that

> Although it generates less VOCs, weathered crude oil still contains harmful chemicals which can cause skin irritation and other irritant reactions. Thus, the use of gloves and protective clothing is recommended to minimize skin contact with weathered oil, including oil deposited on the shore ("tarballs" or "tarpatties").

(NIOSH/OSHA, 2010, p. 2.) Moreover, NIOSH found that even though the use of PPE exacerbated heat stress in response workers, use of PPE was necessary because although "air sampling did not identify airborne exposure levels above relevant OELs, the possibility of dermal exposures to oil and cleaning chemicals was observed to be considerable." (NIOSH HHE 8, 2010, p. 8A-5.)

Second, Dr. Cox overstates the proper use of PPE amongst cleanup workers, ignoring evidence of non-use and improper use of PPE. Dr. Cox cites Dr. John Howard, Director of NIOSH, as having stated that "PPE was generally effective at preventing health risks to DWH response workers, including by preventing and minimizing dermal contact with chemicals of concern," and as having "no knowledge … of any DWH workers being exposed to any chemicals of concern at levels that could potentially cause harm." (Cox, p. 49.) But in the same deposition testimony, Dr. Howard also noted that he had minimal direct observation of working conditions for clean-up workers and that he had visited the Gulf only a few times in 2010. (Howard Deposition, pp. 22-25.) Additionally, Dr. Howard said in his deposition that NIOSH did not conduct any PPE compliance monitoring[3] and never issued a Final Guidance on PPE (the Interim Guidance was issued July 26, 2010). (*Id.* at pp. 276-279.) Additionally, NIOSH found that:

[3] Additionally, BP Vice-President Dr. Heron said in his deposition that he didn't recall any formal PPE compliance monitoring. (Heron Deposition, pp. 141-42.)

> While the use of PPE (gloves, coveralls, face shields, goggles, etc.) was typically found to be matched to the level of expected potential dermal exposure at many sites, *PPE was not always used as directed.*

(NIOSH Final HHE, 2010, pp. 13-14 (emphasis added); *see also* Cox, p. 49 (emphasis added).) NIOSH went on to state that: "Proper training and consistent PPE use is an important component in preventing dermal exposures and injuries." (NIOSH Final HHE, 2010, p. 14.)

But a NIOSH qualitative assessment using focus groups and informant interviews showed that safety professionals were concerned about the degree of experience and training among response workers, noting that

> many of the workers did not come from safety or emergency response backgrounds and were unfamiliar with things such as PPE, safety terminology, marine operations, and emergency response. This lack of knowledge led to frustration over the need for on the job training, particularly for things with which they felt workers should have been trained on prior to arriving on the job site, such as proper PPE use.

(NIOSH HHE 9, 2010, at 9C-5.)

Anecdotal evidence indicates that appropriate PPE was not always provided, used properly, or used at all. For example, during decontamination operations:

> To apply patches, boom repair workers used a solvent-based (solvents included tetrohydrofuran and acetone) chemical adhesive (identified as a skin absorption/penetration hazard on the Material Safety Data Sheet) nearly continuously during the work shift. Skin exposures were identified as a potential health hazard by NIOSH investigators. Workers were not provided, or wearing, chemically-resistant gloves. They were provided and worked with either leather gloves or latex gloves. Several workers wore only medical latex gloves while manually applying and handling the solvent-based adhesive.

(NIOSH HHE 8, 2010, p. 8B-6.) Furthermore, there are photographs documenting individuals involved in bird rehabilitation efforts with minimal or no personal protective equipment, including gloves. (*See, e.g.*, US_PP_FWS_000262, US_PP_FWS_000263, Ex. 12621.) And as mentioned above, a response worker's improper removal of PPE reportedly led to elevated levels of benzene metabolites in that worker. (*See* Ex. 12204.)

Additionally, even correct use of PPE presents health risks. In their journal article, Drs. Michaels and Howard noted that "Perhaps the most serious health hazard faced by response and cleanup workers was heat. Many people, some wearing chemical resistant Tyvek coveralls, boots, and gloves. . ." required special heat/rest protocols. (Michaels, 2012, p. 4; *see also* Goldstein, et al., 2011, p. 1339 ("Vulnerability to heat stress, a major risk factor in the hot summer months in the Gulf, was compounded by the necessity of using personal protective equipment.").)

The reason these workers wore chemical resistant personal protection is because of the potential dermal exposure to weathered oil and dispersant. So this "serious health hazard" was necessitated by the conditions workers were exposed to in responding to the DWH oil spill and during subsequent clean-up activities. Several reports of injury and illness in spill responders and clean-up workers documented heat-related conditions. For example, Dr. Cox indicated that 2,109 visits out of the total 20,032 visits recorded in the BP Medical Encounters Database, or 10.5% of the recorded visits, were for heat-related illnesses; of these, 370 required further care or time off from work. (Cox, p. 63.)

Finally, Dr. Cox asserts that "intermittent or occasional skin contact with weathered oil or tar balls is not expected to have significant adverse health effects if good personal hygiene measures are followed (e.g., washing any contacted oil off of the skin)." (Cox p. 51.) This implies that the responsibility to avoid adverse health effects lies with the exposed person to wash off the contaminant, not with the party responsible for the contamination in the first place. This is inconsistent with traditional industrial hygiene principles and the hierarchy of exposure controls, which give first priority to preventing harmful exposure from happening at all.

While PPE may have prevented many dermal exposures in clean-up workers, given the evidence and examples provided above, it is inappropriate to say that PPE prevented "most, if not all, dermal exposures[.]" (Cox, p. 51.)

D. Dr. Cox Ignores the Historical Literature Regarding the Health Effects of Oil Spills

The National Academy of Sciences (IOM, 2010) workshop and other publications readily available to Dr. Cox (Goldstein, et al., 2011) provided numerous references to historical literature regarding health effects of oil spills. He provided little reference to this literature in his expert report. Two of the major oil spills, the Exxon Valdez spill in Alaska and the Prestige spill off the coast of Spain, have been studied extensively. Laffon summarized some of the genotoxic effects seen in those who cleaned oil-contaminated birds in the aftermath of the latter spill (IOM, 2010, pp. 22-24, *see also* Laffon, et al., 2006). She reported that there was "significant genotoxic damage in the exposed individuals, with genotoxicity being greater among individuals exposed for longer periods of time." (IOM, 2010, p. 23.) These effects did not persist, however.

In a second part of this study involving beach and rock cleanup workers, Laffon reported "significant DNA damage, with the most damage occurring in the volunteers." (IOM, 2010, p. 24.) When considering the results of three different assays of genetic damage, the "researchers concluded that the genotoxic effects of exposure change over time and vary depending on the type of cleanup work being done." *Id.* In any event, these findings clearly have relevance to potential future health effects in DWH clean-up workers that Dr. Cox apparently failed to recognize.

Sathiakumar summarized additional studies of oil spills on physical health, including the MV Braer community residents study which "found evidence of neurological, ocular and respiratory symptoms but no significant differences in lung, liver, or renal function between exposed and unexposed populations." (IOM, pp. 45-46.) She also noted studies health effects in communities affected by the Sea Empress (UK, 1996), Nakhodka (Japan, 1997), Erika (France, 1999), and Tasman Spirit (Pakistan, 2003) oil spills. All of the studies cited some symptoms in exposed populations that are relevant to those affected by DWH oil spill contaminants.

A similar summary of peer-reviewed published studies of health effects from previous oil spills was provided by Goldstein, et al, 2011. These authors noted, "Chemical-induced symptoms in cleanup workers commonly include upper respiratory tract illnesses, throat and eye irritation, headaches, dizziness, nausea and vomiting." (Goldstein, et al., 2011, p. 1338.) They also noted that, "There have been few studies of longer-term health consequences. Persistent abnormalities of pulmonary function have been reported, with improvement occurring over time." (*Id.* at p. 1339.)

E. Dr. Cox Has Not Conducted a Rigorous Analysis of the Impacts of Dispersants or Mixtures of Dispersants and Oil

NIOSH scientists and colleagues published a series of peer-reviewed articles on the effects of dispersants in experiments on laboratory animals. (Goldsmith, et al., 2011; Krajnak, et al., 2011; Sriram, et al., 2011; Anderson, et al., 2011; Roberts, et al., 2011.) These published studies examined the effects of COREXIT EC9500A on cardiovascular functions such as heart rate and blood pressure in rats, neurological toxicity in rats, and pulmonary effects in rats such as transient difficulty in breathing.

In a published study on effects of the dispersant COREXIT 9500A in mice (Anderson, et al., 2011), the authors say they undertook the work "due to increasing concerns of the public, speculative reported adverse health effects, large application volume, potential for worker exposure, and lack of definitive toxicity data . . . to evaluate the irritancy and immunotoxicity, including hypersensitivity and immune suppression, following dermal exposure to COREXIT 9500A and one of its main ingredients (DSS)." (Anderson, et al., 2011, p. 1420.) They summarize the results of their study saying that "COREXIT 9500A was identified as an irritant and tested positive for contact sensitization . . . The active ingredient in COREXIT 9500A, DSS, also tested positive for irritancy and sensitization potential, suggesting implications for workers and the general public beyond those involved in the Gulf oil spill." (*Id.* at p. 1429.)

F. Dr. Cox's Analysis of Mental Health Effects of the Spill is Inconsistent with the Evidence and, At Any Rate, Premature

Dr. Cox asserts that there is "[n]o direct causal relationship" "between chemical exposures following the DWH oil spill and mental health conditions" and further opines that "it is difficult to posit a direct and exclusive causal relationship between the socioeconomic conditions following the DWH oil spill and adverse public and mental health effects within a population of Gulf Coast Residents." (Cox, p. 4.) Dr. Cox imposes an inappropriately high and unreachable burden of proof – a direct and exclusive causal relationship between an event and its human health impact. He further separates out the potential "causal relationship" between "chemical exposures" and mental health conditions and "socioeconomic conditions" and mental health conditions, refining even further the standard to which he tries to hold mental health effects.

Dr. Cox himself acknowledges that the population at issue had been impacted by multiple events within the five-year period prior to the spill, noting that it occurred "only five years after Hurricanes Katrina and Rita and on the heels of the financial/housing crisis of 2008/2009." (Cox, p. 5.)

He uses one study with equivocal findings – the Substance Abuse and Mental Health Services Administration's Report on Behavioral Health in the Gulf Coast Region Following the *Deepwater Horizon* Oil Spill – to assert that mobilization of resources "may have resulted in a reduction in mental health problems relative to what would have occurred if those resources had not been mobilized." (Cox, p. 70.) This is circular reasoning, and it implies that there were mental health problems that needed to be reduced as a result of the DWH explosion and spill.

Dr. Cox simply ignores the findings of the SAMHSA Report with regard to impact on mental health and tries to focus on actions taken by BP and others to attempt to address recovery.

The evidence collected during and after the response, including BP's own injury and illness reports for the year 2010, indicate that in fact there were mental health impacts. NIOSH's Health Hazard Evaluation 7, which focused on shore-cleaning workers, contains the following finding on the impact of the spill on this set of response workers: "This evaluation found that 18% of participants reported one or more of five psychosocial symptoms." (NIOSH HHE 7, 2010, p. 7-5.) The evaluation goes on to note that psychosocial stressors were not unique to this group of workers:

> All Deepwater Horizon response workers may have experienced psychosocial stressors in the course of their response work. Those doing shore cleaning work may have been at risk of psychosocial stressors from specific aspects of their work or from other circumstances more generally related to the oil spill (such as the impact on the fishing communities and the environment in general). Long work hours (many times in conditions of high heat index as noted above) can be an important concern for shore response workers. Efforts to minimize exposure to heat, such as working night shifts, can contribute to fatigue and psychosocial stress. Other contributing factors for fatigue may have included working many days and long commuting distances."

(*Id.*) NIOSH's Health Hazard Evaluation 9 concluded without qualification that the spill had a serious impact on the stress and mental health of the Gulf Coast communities:

> The Deepwater Horizon oil spill has had a serious impact on the stress and mental health of the Gulf Coast communities. State mental health and substance abuse agencies and domestic violence hotlines have reported sharp increases in reports of distress and requests for assistance (Yun et al. 2010). Disasters such as this not only take a toll on the mental health of the communities impacted, but also on the individuals who are employed to assist with recovery and cleanup efforts. By their nature, disaster response efforts occur in a chaotic environment, with uncertainty, time pressure, and a myriad of complex challenges [SAMHSA 2000].

(NIOSH HHE 9, 2010, p. 9C-1.)

The SAMHSA Report concluded that there was a "mixed picture" that included "increases in past month marijuana and alcohol use among persons aged 12 or older and aged 26 or older; and increases in past year depression, serious suicide thoughts, and suicide plans, mostly among 18 to 25 year olds." (SAMHSA, 2013, p. 4). It noted that its analyses "focus on the population of the region as a whole and there may have been more marked increases in mental health problems among subpopulations within the GCDA[,]" (*id.*), and expressed a desire for future work more detailed mental health analyses:

> The feasibility of conducting additional focused analyses (e.g., analyses that might explore comparisons of demographic groups other than age groups, such as persons who work in specific industries most affected by the oil spill) is currently being explored. Future analyses of NSDUH data may also examine pre- and post-oil spill substance use and mental health for specific subgroups such as gender and racial/ethnic groups, as well as the longer-term impacts of the oil spill on behavioral health in the affected area. If feasible, NSDUH data will also be used to assess behavioral health in the GCDA during the period of the oil spill (spring and summer 2010).

(*Id.* at p. 4.) The SAMHSA Report, the HHEs, and the recorded injuries and illnesses all indicate that there is an impact to mental health as a result of the spill. None of these studies has a definitive conclusion, and it is premature to reach one. Future adverse health effects may be documented in the on-going Federal cohort study.

In my opinion, there is ample historical precedence and substantial evidence in Gulf Coast residents of adverse mental health impacts from the DWH explosion, oil spill and subsequent clean-up activities.

G. It Is Premature to Draw Conclusions about the Human Health Impacts of the Spill as There Are Ongoing Studies of Its Effects

Dr. Cox further opined that there is "no scientific evidence relevant to this oil spill to support concerns that either Clean-Up Workers or Gulf Coast Residents will suffer any future adverse health effects resulting from any exposures associated with the DWH oil spill." (Cox, p. 4.) However, the National Institute of Environmental Health Sciences has begun a long-term cohort study of approximately 30,000 individuals to examine this question. In my opinion, it is premature, at the least, to anticipate the results of this study as showing no future adverse health effects.

Dr. Cox does not discuss the NIEHS study in his report, except to quote John Howard's deposition testimony regarding NIOSH's lack of involvement in the study. However, Dr. Cox does not quote the portions of Dr. Howard's testimony in which he stated that NIOSH's point of view is not NIH's point of view, (Howard Deposition, p. 210), and that "NIEHS was the logical institute within NIH" to do a long-term study. (Howard Deposition, p. 214.)

Furthermore, when Dr. Cox quotes an article co-authored by Dr. David Michaels and Dr. John Howard in which these Federal officials say "[b]ecause protection efforts were so effective, few safety and health issues emerged as significant concerns in the media at the national level," (Cox, p. 57-58), he fails two quote the next two sentences of the article: "Although there is no evidence of significant short term health effects, there is a possibility of long term effects, even with the low exposure levels. This is the subject of a study being coordinated by NIEHS." (Michaels, 2012, p. 6.)

II. Comments on Expert Report of Capt. Frank Paskewich

Much of my critique of Dr. Cox's expert report is also applicable to Section V.C. of Captain Frank Paskewich's report ("BP's Response Efforts were Conducted Safely"). (Paskewich Round 1 Report ("Paskewich") p. 49-53.) Like Dr. Cox, Capt. Paskewich fails to consider the historical literature and lessons learned about health and mental health effects in those exposed in previous oil spills, nor does he refer to the IOM Workshop summary that assembled and summarized this literature or the medical settlement in this matter which indicated that there were specific health problems resulting from the DWH oil spill and response requiring relief.

Capt. Paskewich also notes the use of PPE during the response, but like Dr. Cox, he does not address issues of non-compliance with PPE requirements such as respirators and full-body suits. In 1996, the American Thoracic Society noted "Worker compliance with wearing required respirators has been studied based on direct observation of the amount of time of appropriate use. These studies show that acceptability to workers is a significant factor limiting the ability of respirators to provide protection against inhalation hazards. . . facial heat may add to the discomfort inherent in wearing other forms of protective equipment such as . . . the vapor barrier suits frequently used to protect the skin against exposure in hazardous waste cleanup." (ATS, 1996, p. 1162-63.) For these reasons, the American Thoracic Society warns that protective equipment is "not the method of choice for controlling exposures." (*Id.* at p. 1153.)

However, unlike Dr. Cox, in Capt. Paskewich's admits that: "Dermal exposure to some oil products and other chemicals posed a potential threat throughout the spill recovery

operation." (Paskewich, p. 51.) Unlike Dr. Cox, Capt. Paskewich discusses the problem of personal protection equipment and the risk of heat stress or stroke. (*Id.*) He notes that, in cooperation with OSHA and NIOSH, "BP developed a detailed matrix that specified what PPE was required for each task." (*Id.*) The citation listed in the footnote identifies a document dated August 14, 2010, nearly four months after the DWH explosion and after many days with high heat indices has already occurred.

Capt. Paskewich begins his safety section by noting the scale of the DWH oil spill response, and estimating that "47,000 people were working to respond to the spill." (Paskewich, p. 50.) He then lists the experts that BP hired and deployed, including those who "created a series of courses. . . delivered in a language and at a level appropriate to the responders being trained." Capt. Paskewich fails to mention that at least one trainer operating in the area, Connie M. Knight, was indicted for falsely claiming to be a government employee and sentenced to 57 months in prison in Mississippi. (Judgment in U.S. v. Connie M. Knight, 2:12-cr-00261-LMA-ALC (E.D.La. 2012) (U.S. v. Knight), Rec. Doc. 60, p. 2.) The indictment noted that over one thousand people attended Ms. Knight's training sessions in Louisiana and that many attendees "did not speak, read or comprehend the English language." (Indictment in U.S. v. Connie M. Knight, 2:12-cr-00261-LMA-ALC (E.D.La. 2012), Rec. Doc. 1, p. 4.) The plea agreement noted that: "a few individuals who had been given falsified HAZWOPER 40-hr certifications did gain employment through other employers and stated that their employer allowed them to work in direct contact with hazardous waste materials on *Deepwater Horizon* cleanup sites. (Factual Basis for Plea Agreement in U.S. v. Connie M. Knight, 2:12-cr-00261-LMA-ALC (E.D.La. 2012), Rec. Doc. 26, p. 4.) During the sentencing, the judge told the Defendant:

> You were responsible for a significant risk of physical injury or sickness because the victims weren't adequately trained to be exposed to what they need to do at these cleanup sites. You could have caused dangerous health and/or environemntal [sic] risks to these victims as well as others in the community.

(Sentencing Hearing Transcript in U.S. v. Connie M. Knight, 2:12-cr-00261-LMA-ALC (E.D.La. 2012), US_PP_RC007507-71, p. 58.)

Capt. Paskewich also describes the steps BP took to prevent and treat heat stress in responders and beach workers. He cites NIOSH Director John Howard as saying "no responders developed any 'serious heat illness.'" Nevertheless, according to the BP Medical Encounters Database cited by Dr. Cox, there were 2,109 visits for heat-related illnesses and 370 of these required further care or time off from work. (Cox, p. 63.)

Capt. Paskewich discusses seafood safety and notes that "as a precautionary measure during the spill, NOAA and the Food and Drug Administration closed many federal fisheries in the Gulf of Mexico." (Paskewich, p. 53.) The closed fisheries remained closed until May 2011, and in order to be reopened, "All specimens collected within the closed fishing areas had to pass both sensory and chemical analyses." *Id.* This means that for over a year, the fisheries may have contained specimens that were not safe to eat, and any individuals who ignored or did not understand the fish advisories between April 2010 and May 2011 were at risk of health effects from eating contaminated fish.

In his conclusion, Capt. Paskewich opines that the "safety measures employed during the *Deepwater Horizon* Response serve as a model for future spill responses." (Paskewich, p. 53.) But this conclusion ignores limitations acknowledged by NIOSH. With respect to NIOSH's effort to

roster response workers, NIOSH acknowledged that: "Given that rostering did not start until May, responders to the initial fire and sinking of the oil rig were likely missed." (NIOSH, 2001, p. 2.) NIOSH further noted that:

> Few health questions were included on the roster form. We intended to conduct a health survey of the rostered workers later and therefore asked only about health issues that were actionable during the event: smoking and tetanus vaccination status. Smoking status data aided interpretation of respiratory symptoms collected through injury and illness reporting during the event. Tetanus vaccination status was used to inform vaccine supply needs. On future roster forms, we intend to use the health questions identified in the predeployment health screening section of the Emergency Responder Health Monitoring and Surveillance document [NIOSH 2011].

(*Id.* at p. 23.) It appears that pre-placement screening of workers might have reduced the risk of injury for clean-up workers and volunteers. (*See, e.g.*, NIOSH HHE 7, 2010, p. 7-6 ("When response activities similar to the Deepwater Horizon response occur in the future, responsible parties should consider the need for pre-placement medical evaluations for workers participating in the response.").)

In my opinion, despite Captain Paskewich's claims that the DWH response was a model for safety, it is clear that there were adverse health impacts on response workers and volunteers and that future impacts may become evident in on-going studies being conducted by Federal and local public health researchers.

III. Conclusion

In sum, based on the substantial evidence of adverse health impacts from the DWH explosion, oil spill and clean-up activities, this unprecedented event has harmed the population of the Gulf Coast in myriad ways. These include injuries, illnesses, and psychosocial stress in response workers, volunteers and the general population. The full scope of health and mental

health impacts has not yet been documented, and on-going studies may shed additional light on these impacts in coming years. Dr. Cox and Captain Paskewich have misinterpreted the evidence of adverse health impacts already available, and Dr. Cox has dismissed the potential for further evidence resulting from on-going studies.

REFERENCES

Anderson SE, Franko J, Lukomska E, et al. Potential Immunotoxicological Health Effects Following Exposure to Corexit 9500A During Cleanup of the Deepwater Horizon Oil Spill. J. Toxicol. Environ. Health, Part A, 74:1419-1430, 2011 (Anderson, et al., 2011) (Ex. 12264).

ATS. American Thoracic Society Respiratory Protection Guidelines. Am J Resp Crit Care Med 154:1153-1165, 1996.

ATSDR. Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures. May 2004 (ATSDR, 2004).

Birnbaum, LS. Environmental Chemicals: Evaluating Low-Dose Effects. Environ Health Perspect 120(4):a143-a144, April 2012.

BP. Deepwater Horizon Incident Response Recordable Injury & Illness Data (April 22 – December 3, 2010) (Ex. 12020).

BP. Medical Encounters Database. (BP Medical Encounters Database) (BP-HZN-2179MDL08472030, BP-HZN-2179MDL08472031).

Curtis L, Rea W, Smith-Willis P, et al. Adverse health effects of outdoor air pollutants. Environment International 32:815-830, 2006 (Curtis, 2006).

Deposition of John Jackson Howard, M.D., In Re: Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico on April 20, 2010, June 26, 2014 (Howard Deposition).

Deposition of Richard Heron, In Re: Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico on April 20, 2010, June 20, 2014 (Heron Deposition).

EPA. EPA Proposes Updates to Air Standards for Newly Manufactured Woodstoves and Heaters. January 3, 2014 (http://yosemite.epa.gov/opa/admpress.nsf/0/e3175e041784cf6485257c550059ca4c?OpenDocument) (EPA, 20014).

Goldsmith WT, McKinney W, Jackson M, et al. A Computer-Controlled Whole-Body Inhalation Exposure System for the Oil Dispersant Corexit EC9500A. J. Tosicol. Environ. Health, Part A, 74:1368-1380, 2011 (Goldsmith et al., 2011) (Ex. 12261).

Goldstein BD, Osofsky HJ, and MY Lichtveld. The Gulf Oil Spill. N Engl J Med 364:1334-48, 2011. (Goldstein, et al., 2011) (Ex. 12259).

IARC. IARC Monographs on Carcinogenic Risks to Humans. Vol. 69. Polychlorinated Dibenzo-para-dioxins and Polychlorinated Dibenzofurans. WHO, 1997 (IARC Vol. 69, 1997).

IOM (Institute of Medicine). 2010. *Assessing the health effects of the Gulf of Mexico oil*

spill on human health: A summary of the June 2010 workshop. Washington, DC: The National Academies Press (IOM, 2010) (US_PP_RC005407-613).

Kawamoto M, King B, Bernard B, and J Gibbins. Health Hazard Evaluation of Deepwater Horizon Response Workers: Health Hazard Evaluation Interim Report 1, June 23, 2010 (NIOSH HHE 1, 2010) (Ex. 12231).

King B, Martinez K, and D Trout. Health Hazard Evaluation of Deepwater Horizon Response Workers: Health Hazard Evaluation Interim Report 8, October 25, 2010 (NIOSH HHE 8, 2010) (Ex. 12256).

King BS and JD Gibbons. Health Hazard Evaluation of Deepwater Horizon Response Workers: Health Hazard Evaluation Report. August 2011 (NIOSH Final HHE, 2011) (Ex. 12223).

King B, West C, Gibbins J, Wiegand D, and S Evans. Health Hazard Evaluation of Deepwater Horizon Response Workers: Health Hazard Evaluation Interim Report 9, December 7, 2010 (NIOSH HHE 7, 2010) (Ex. 12257).

Krajnak K, Kan H, Waugh S, et al. Acute Effects of Corexit EC9500A on Cardiovascular Functions in Rats. J. Toxicol. Environ. Health, Part A, 74:1397-14-4, 2011 (Krajnak, et al., 2011) (Ex. 12262).

Michaels D and J Howard. Review of the OSHA-NIOSH Response to the Deepwater Horizon Oil Spill: Protecting the Health and Safety of Cleanup Workers. PLOS Currents Disasters. 2012 Jul 18 (Edition 1). (Michaels, 2012) (Ex. 12221).

Middlebrook AM, Murphy DM, Ahmadov R, et al. Air quality implications of the Deepwater Horizon oil spill. PNAS Early Edition, December, 2011 (Middlebrook et al., 2011).

NAS. Science and Decisions: Advancing Risk Assessment. Washington, DC: National Academies Press, 2009 (NAS, 2009).

NIOSH. NIOSH Pocket Guide to Chemical Hazards. Accessed on August 31, 2014 (http://www.cdc.gov/niosh/npg/npgd0594.html)

NIOSH. NIOSH Report of Deepwater Horizon Response/Unified Area Command Illness and Injury Data (April 23-July 27, 2010), August 13, 2010 (NIOSH, 2010) (Ex. 12228).

NIOSH. NIOSH Deepwater Horizon Roster Summary Report. DHHS (NIOSH) Publication No. 2011-175 (NIOSH, 2011) (Ex. 12224).

Peters A, Dockery DD, Miller JF, et al. Increased particular matter and the triggering of myocardial infarction. Circulation 103:2810-15, 2001.

Roberts JR, Reynolds JS, Thompson JA, et al. Pulmonary Effects After Acute Inhalation of Oil Dispersant (Corexit EC9500A) in Rats. J. Toxicol. Environ. Health, Part A, 74:1381-1396, 2011 (Roberts, et al., 2011) (Ex. 12265).

Sherwin RP. What is an Adverse Health Effect? Environ Health Perspect, 52:177-82, 1983. (Sherwin, 1983).

Sriram K, Lin GX, Jefferson AM, et al. Neurotoxicity Following Acute Inhalation Exposure to the Oil Dispersant Corecit EC9500A. J. Toxicol. Environ Health, Part A, 74:1405-1418, 2011 (Sriram, et al., 2011) (Ex. 12263).

Substance Abuse and Mental Health Services Administration and Centers for Disease Control and Prevention (SAMHSA). Behavioral Health in the Gulf Coast Region Following the Deepwater Horizon Oil Spill, HHS Publication No. (SMA) 13-4737, 2013 (SAMHSA, 2013).

Trout D. Health Hazard Evaluation of Deepwater Horizon Response Workers: Health Hazard Interim Report 7, October 15, 2010 (NIOSH HHE 7, 2010) (Ex. 12255).

Trout D and C West. Health Hazard Evaluation of Deepwater Horizon Response Workers: Health Hazard Interim Report 5, August 26, 2010 (NIOSH HHE 5, 2010) (Ex. 12253).

Vandenberg LN, Colburn T, Hayes TB, et al. Hormones and Endocrine-Disrupting Chemicals: Low-Dose Effects and Nonmonotonic Dose Responses. Endocrine Reviews 33:1-78, 2012.

West C, Kawamoto M, and J Eisenberg, Health Hazard Evaluation of Deepwater Horizon Response Workers: Health Hazard Evaulation Interim Report 6, September 13, 2010 (NIOSH HHE 6, 2010) (Ex. 12254).

Expert Report of Dr. Richard Clapp: Appendix A

Consideration Materials

(In addition to the documents cited in my Round 1 report and this expert report, as well as the consideration materials identified in conjunction with my Round 1 expert report)

Bates, Exhibit, TREX, or Other Description
BP-HZN-2179MDL01891791-BP-HZN-2179MDL01891927
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Expert Report of Dr. Richard Clapp: Appendix A
Consideration Materials
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BP-HZN-2179MDL09235085-BP-HZN-2179MDL09235100
BP-HZN-2179MDL09235101-BP-HZN-2179MDL09235103
BP-HZN-2179MDL09235990-BP-HZN-2179MDL09235994
BP-HZN-2179MDL09236035-BP-HZN-2179MDL09236070
BP-HZN-2179MDL09236071-BP-HZN-2179MDL09236080
BP-HZN-2179MDL09236091-BP-HZN-2179MDL09236103
BP-HZN-2179MDL09236161-BP-HZN-2179MDL09236188
BP-HZN-2179MDL09236189-BP-HZN-2179MDL09236201
BP-HZN-2179MDL09236234-BP-HZN-2179MDL09236236
BP-HZN-2179MDL09236350-BP-HZN-2179MDL09236373
BP-HZN-2179MDL09236515-BP-HZN-2179MDL09236520
BP-HZN-2179MDL09237033-BP-HZN-2179MDL09237044
BP-HZN-2179MDL09237059-BP-HZN-2179MDL09237263
BP-HZN-2179MDL09237312-BP-HZN-2179MDL09237319
BP-HZN-2179MDL09237537-BP-HZN-2179MDL09237549
BP-HZN-2179MDL09237603-BP-HZN-2179MDL09237866
BP-HZN-2179MDL09237867-BP-HZN-2179MDL09237868
BP-HZN-2179MDL09237874-BP-HZN-2179MDL09237891
BP-HZN-2179MDL09238018-BP-HZN-2179MDL09238021
BP-HZN-2179MDL09238022-BP-HZN-2179MDL09238023
BP-HZN-2179MDL09238061-BP-HZN-2179MDL09238095

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Bates, Exhibit, TREX, or Other Description
BP-HZN-2179MDL09238347-BP-HZN-2179MDL09238518
BP-HZN-2179MDL09238519-BP-HZN-2179MDL09238521
BP-HZN-2179MDL09243426-BP-HZN-2179MDL09243428
BP-HZN-2179MDL09245593-BP-HZN-2179MDL09245595
BP-HZN-2179MDL09245612-BP-HZN-2179MDL09245647
BPNRD0002109-BPNRD0002149
BPNRD0002153-BPNRD0002182
C1T002-001549-C1T002-002035
DEFEXP001461-DEFEXP001468
DEFEXP001472-DEFEXP001474
DEFEXP001479-DEFEXP001608
DEFEXP001670-DEFEXP001670
DEFEXP001675-DEFEXP001692
DEFEXP001834-DEFEXP001835
DEFEXP001854-DEFEXP001856
DEFEXP001857-DEFEXP001859
DEFEXP001863-DEFEXP001875
DEFEXP001890-DEFEXP001892
DEFEXP001893-DEFEXP001894
DEFEXP001901-DEFEXP001902
DEFEXP001943-DEFEXP001943
DEFEXP001955-DEFEXP001956
DEFEXP001957-DEFEXP001959
DEFEXP002405-DEFEXP002648
DEFEXP002649-DEFEXP002658
DEFEXP002842-DEFEXP002849
DEFEXP002865-DEFEXP002865
DEFEXP002866-DEFEXP002867
DEFEXP002870-DEFEXP002885
DEFEXP002886-DEFEXP002909
DEFEXP002910-DEFEXP002912
DEFEXP002913-DEFEXP002914
DEFEXP002915-DEFEXP002916
DEFEXP002917-DEFEXP002918
DEFEXP002919-DEFEXP002920
DEFEXP002921-DEFEXP002921
DEFEXP002926-DEFEXP002943
DEFEXP003102-DEFEXP003105
DEFEXP003133-DEFEXP003139
DEFEXP003302-DEFEXP003305
DEFEXP003306-DEFEXP003310

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Bates, Exhibit, TREX, or Other Description
DEFEXP003322-DEFEXP003331
DEFEXP003332-DEFEXP003341
DEFEXP003351-DEFEXP003353
DEFEXP003362-DEFEXP003363
DEFEXP003364-DEFEXP003365
DEFEXP003654-DEFEXP003655
DEFEXP003656-DEFEXP003657
DEFEXP003658-DEFEXP003658
DEFEXP003659-DEFEXP003661
DEFEXP003797-DEFEXP003797
DEFEXP003877-DEFEXP003882
DEFEXP004118-DEFEXP004120
DEFEXP004122-DEFEXP004123
DEFEXP004132-DEFEXP004132
DEFEXP004133-DEFEXP004171
DEFEXP004172-DEFEXP004175
DEFEXP004176-DEFEXP004177
DEFEXP004383-DEFEXP004401
DEFEXP004806-DEFEXP005243
DEFEXP005244-DEFEXP005964
DEFEXP007409-DEFEXP007584
DEFEXP007942-DEFEXP008256
DEFEXP008852-DEFEXP008853
DEFEXP008855-DEFEXP008855
DEFEXP008861-DEFEXP008874
DEFEXP009061-DEFEXP009063
DEFEXP009064-DEFEXP009065
DEFEXP009066-DEFEXP009067
DEFEXP009068-DEFEXP009499
DEFEXP016113-DEFEXP016124
Deposition Exhibit 12036
Deposition Exhibit 12222
Deposition Exhibit 12500
Deposition Exhibit 12512
Deposition Exhibit 12527
Deposition Exhibit 12533
Deposition Exhibit 12619
Deposition Exhibit 12621
Deposition Exhibit 13026
Deposition Exhibit 9124
Deposition of Austin, RADM Meredith (July 17, 2014)

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Bates, Exhibit, TREX, or Other Description
Deposition of Hein, CAPT Julia (July 9, 2014)
Deposition of Heron, Dr. Richard (June 20, 2014)
Deposition of Howard, Dr. John (June 26, 2014)
Deposition of Kulesa, Frank (July 15, 2014)
Deposition of Lubchenco, Jane (July 10, 2014)
Deposition of McCleary, CAPT Stephen (July 18, 2014)
Deposition of Utsler, Mike (June 27, 2014)
HCG866-000315-HCG866-000316
IGS173-000117
N1A001-003114
N5G074-000124
OSE209-022006
PPDEPODOC005129-PPDEPODOC005130
Expert Report: Responses to BP Expert Reports by Donald F. Boesch and Stanley D. Rice, § 5.4
US_PP_DBO005158-US_PP_DBO005163
US_PP_FWS000262-US_PP_FWS000262
US_PP_FWS000263-US_PP_FWS000263
US_PP_HHS000001-US_PP_HHS000070
US_PP_RC000024-US_PP_RC000427
US_PP_RC000428-US_PP_RC000603
US_PP_RC000604-US_PP_RC001041
US_PP_RC001042-US_PP_RC001382
US_PP_RC001636-US_PP_RC001992
US_PP_RC001993-US_PP_RC002377
US_PP_RC002378-US_PP_RC002692
US_PP_RC002770-US_PP_RC002772
US_PP_RC003584-US_PP_RC003586
US_PP_RC004990-US_PP_RC004999
US_PP_RC005648-US_PP_RC005652
US_PP_RC005653-US_PP_RC005662
US_PP_RC005663-US_PP_RC005667
US_PP_RC005668-US_PP_RC005672
US_PP_RC005673-US_PP_RC005685
US_PP_RC005686-US_PP_RC005687
US_PP_RC005688-US_PP_RC005703
US_PP_RC005704-US_PP_RC006390
US_PP_RC006391-US_PP_RC007018
US_PP_RC007019-US_PP_RC007023
US_PP_RC007024-US_PP_RC007030
US_PP_RC007031-US_PP_RC007453
US_PP_RC007454-US_PP_RC007459

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Bates, Exhibit, TREX, or Other Description
US_PP_RC007460-US_PP_RC007506
US_PP_RC007507-US_PP_RC007571
US_PP_RC007572-US_PP_RC007596
US_PP_USCG2_1573596-US_PP_USCG2_1573603