

harm but does not unambiguously demonstrate it. In some cases, the available scientific literature allowed me to draw confident conclusions as to actual or potential harm. However, in many others definitive conclusions cannot yet be drawn, particularly considering that research is ongoing and that effects may be delayed. Thus, I have been cautious in my approach in not prejudging harm except where it can be demonstrated or dismissed with a high level of certainty, particularly in the distinction between "actual" and "potential" harm.

3. HYDROCARBONS AND THEIR TOXICITY

Dr. Stanley Rice's expert report, "Toxicological Impact of the MC252 Blowout, Oil Spill, and Response," includes a primer on the chemistry of oil, chemical dispersants and their toxicity. It reviews how the paradigm of oil spill effects has evolved from learning during the study of earlier oil spills, particularly the Exxon Valdez spill in Alaska in 1989. And, it evaluates the potential for toxicity damage as a result of the Macoedo well blowout based on available literature and data. Here, I will just touch on a few salient points in this report that set the stage for my assessment. I have independently reviewed Dr. Rice's cited materials related to the Macoedo well blowout and concur with his summary of them.

organisms. A chemical dispersant injected where oil gushed from the wellhead or marine riser or sprayed onto surface oil slicks had little toxicity in itself, but increased the amount of oil dissolved or dispersed in the water column and thus the toxic exposure to aquatic organism.

Alaska North Slope oil that spilled from the Exxon Valdez.

The hydrocarbon mixtures change as they are released into the environment as a result of differences in the solubility and volatility of different compounds as well as their susceptibility to degradation by microorganisms and sunlight. PAHs are more resistant to degradation and, thus, can persist in the environment as long-term constituents and accumulate in lipid-rich tissues of organisms. A chemical dispersant injected where oil gushed from the wellhead or marine riser or sprayed onto surface oil slicks had little toxicity in itself, but increased the amount of oil dissolved or dispersed in the water column and thus the toxic exposure to aquatic organisms.

Scientific understanding of the effects of oil in the marine environment has shifted the paradigm that earlier focused on obvious and lethal effects on birds and shoreline organisms to the realization that even very low concentrations of PAHs below the water's surface in dissolved or

³ Rice, S.D. (2014) Toxicological Impact of the MC252 Blowout, Oil Spill, and Response. Expert Report submitted on behalf of the United States, U.S. v. BP Exploration & Production et al.