July 11, 2010

Governor Bobby Jindal
PO Box 94004
Baton Rouge, LA 70804-9004

Dear Governor Jindal,

The BP oil spill is exerting a devastating effect on the Louisiana coastal wetland ecosystems as the oil originating from the wellhead physically coats and smothers vegetation and wildlife. In response, the USCG has requested EPA assistance in organizing our federal and state partners in pursing innovative technologies to remediate the Gulf of Mexico region and to provide opportunities to use them in accordance with appropriate laws (e.g., CWA) and procedures (e.g., NCP) in an expedited manner. Among the technologies being evaluated is bioremediation, and the guidance in this letter results from the joint collaboration of scientists from EPA and NOAA along with scientists that participate in the Deepwater Horizon Science and Engineering Review Team (H-SERT), which was organized by the Louisiana office of Coastal Protection and Restoration (CPRA) and consists of scientists from Louisiana State University, University of Louisiana at Lafayette, University of New Orleans, Tulane University, and Southern University.

Bioremediation is defined as the exploitation of living microorganisms to significantly enhance the rates of biodegradation of oil constituents to innocuous end products such as carbon dioxide, water, biomass, and incompletely oxidized yet benign substances. Bioremediation is a technology that offers great promise in transforming oil into nontoxic products with little disruption to the local environment. The success of oil-spill bioremediation depends on the ability to establish conditions appropriate for effective treatment of the contaminated environment. The rates of growth of oil degraders can be maximized by ensuring that adequate concentrations of nutrients (specifically nitrogen and phosphorus) and oxygen are present. Bioremediation is the technology that implements the principles of biodegradation. To quote a 2003 National Academy of Sciences report titled *Oil in the Sea III: Inputs, Fates and Effects*, "Biodegradation of hydrocarbons has been considered one of the principal removal mechanisms in the aquatic environment."

The two main approaches that have been used in bioremediation are (1) *bioaugmentation*, in which oil-degrading bacteria are added to supplement the existing microbial communities, and (2) *biostimulation*, in which nutrients are added to stimulate growth and biodegradation of indigenous oil degraders. However, since hydrocarbon degraders have been found to be ubiquitous, it is seldom if ever necessary to augment the natural populations with lab-grown cultures. During an oil spill, the size of the hydrocarbon-degrading bacterial population usually increases rapidly in response to oil contamination, and it is very difficult, if not impossible, to increase the microbial population over that which can be achieved by biostimulation alone. Added bacteria have been observed to compete poorly with indigenous populations, and the scientific literature has demonstrated repeatedly that bioaugmentation has no long-term benefits in shoreline cleanup operations.

Both the government and the H-SERT scientists recognize that biodegradation of oil already occurs in marshes and is an important part of recovery. EPA's research demonstrated this effectively in 1999 when oil-contaminated wetland plots recovered much more rapidly when nutrients were added compared to plots receiving no nutrients. However, these scientists also recognize that, in general, significant levels of nutrients in the form of nitrogen and phosphorus are likely to be present in the soils of Louisiana wetlands, and adding additional nutrients might offer little or no benefit to the ecosystem. Therefore, we believe it is critical to quantify the background nutrients of a site being considered for bioremediation to determine if biostimulation is appropriate (i.e., if current nutrient levels are insufficient to support rapid biodegradation). This conclusion is consistent with EPA's bioremediation guidelines documents, http://www.epa.gov/emergencies/publications.htm#bio.

EPA, NOAA, and H-SERT scientists identified other areas of concern. We agreed that any approach must have a well-thought out monitoring program to be technically defensible, and that implementing an approach must be weighed against the additional harm to the wetlands that could be caused from physical intrusion during application and monitoring. Attention should also be given to bioremediation products having additives that may make the oil more bioavailable to sensitive aquatic life stages, thereby posing a greater risk.

Oil spills result in a huge influx of carbon into the impacted environment. In oil-contaminated coastal areas that do not have sufficient nutrients, the main challenge associated with biostimulation is maintaining optimal nutrient concentrations in contact with the oil at all times. Oleophilic and slow-release formulations have been developed to achieve this, but most of these rely on dissolution of the nutrients into the aqueous phase before they can be used by hydrocarbon degraders. Therefore, design of effective oil bioremediation strategies and nutrient delivery systems requires an understanding of the transport of dissolved nutrients in the intertidal zone.

Another important aspect of the BP spill is the fact that much of the oil reaching the shoreline is a stable water-in-oil emulsion that behaves quite differently from non-emulsified oil that has not undergone the same type of weathering. Stable water-in-oil emulsions may be less amenable to bioremediation since the lighter fractions of the crude oil have already evaporated, leaving heavier fractions such as the asphaltenes behind. This represents a new challenge to scientists and responders. Therefore further evaluation is needed from laboratory studies regarding the inherent biodegradation of stable water-in-oil emulsions that reflect the conditions in the wetlands and marshes before biostimulation in the field is considered a treatment option for the sensitive Louisiana wetlands and marshes. Oil type, physical characteristics, and chemical composition should be evaluated as part of any bioremediation consideration.

These conclusions are based on deliberations of scientists from H-SERT and EPA, NOAA, and USCG. In addition, on June 5, 2010, scientific experts across the federal government and academia, including key emergency response and local ecosystem technical experts, participated in the Technical Forum on Alternative Coastal Protection and Cleanup, convened at the University of New Orleans. The bioremediation breakout group unanimously agreed that bioaugmentation (the addition of microbes alone) would provide no appreciable added benefit to oil spill cleanup on Louisiana wetlands. The group further agreed that biostimulation should be used only in areas where nutrient concentrations are too low to support effective and rapid biodegradation. So, the government and H-SERT scientists reached a consensus that bioremediation would provide limited value for oil discharges in general. There may be specific situations where bioremediation might be considered after a thorough evaluation of the site-specific conditions (including oil composition and concentrations and an assessment of nutrient and oxygen limitations) and limited testing to ensure that the benefits outweigh any risks before a decision to implement such course of action is made. Such testing should include ecotoxicological analyses to further assess relative trade-offs to natural biodegradation.

James A. Watson
Rear Admiral, USCG
Federal On-Scene Coordinator

Date: 7-12-10

for Sam Coleman

Al Armendariz
Regional Administrator
U.S. EPA
Region 6

Date: 7/11/10