Public Executive Summary

Title: Enumerating Bacteria in Deepwater Pipelines in Real-Time and at a Negligible Marginal Cost per Analysis: A Proof of Concept Study

Name of Offeror: Livermore Instruments Inc.
Project Director/Principal Investigator: Dr. David P. Fergenson

Additional participants: Phage Biocontrol, LLC; Texas A&M University; ConocoPhillips Company; Shell International Exploration & Production; Petrobras America, Inc.; Halliburton; Nalco Company; Multi-Chem Corporation; BJ Services Company; Champion Technologies, Inc.; Intertek Group plc; INTECSEA.

Solicitation Number: RFP2008DW2902 (08121-2902-06)

Project Start Date: January 25, 2010
Project End Date: July 31, 2011

Total Estimated Cost:	$	170,203.00
RPSEA Maximum Share:	$	118,014.00
Livermore Instruments Cost Share:	$	50,487.00

Bacterial fouling leads to inefficiencies and health, safety and environmental hazards across the oil and gas recovery industry. Microbially-influenced corrosion attacks the whole system from production wellhead to refinery. Bacterially-evolved hydrogen sulfide sours the reservoir, devaluating the product and corroding extraction pipes. Bacterial iron sulfide production creates black powder accumulation, blocking pipelines. Bacteria present in the flood water are injected down hole during water flooding and become entrenched in the reservoir. Long deepwater pipelines are particularly at risk to microbial attack due to their physical size, the pressures that they bear, and the high costs of inspection, maintenance, repair and replacement.

To control microorganism contamination, the petroleum industry currently uses chemical biocides which are expensive and harmful to humans and the environment. The number and types of bacteria present have a profound impact on the biocide regimen that is advised in any given scenario but bacterial identification is a slow, laborious and expensive process that cannot be used to direct, optimize or even verify the effectiveness of biocide applications. The risk of an ineffective biocide regimen drives the over application of the biocides to ensure adequate bacterial control. The emerging issue of biocide resistance is further complicating these matters. An alternative technology for the identification and enumeration of bacteria, pre- and post-treatment that would return an answer within the decision cycle of the biocide application would allow far lower concentrations of biocides to be used when appropriate while warning that higher concentrations are needed in isolated cases. Such a technology would provide the added advantage of enabling emerging strategies such as targeted bacteriophage application.

We propose to utilize BioAerosol Mass Spectrometry (BAMS) technology, originally developed for biodefense, to provide real time bioassays for flood water. BAMS is the only technology capable of

identifying and enumerating bacteria sampled directly from the environment in real-time. BAMS operates by collecting individual mass spectra of all particles present in a sample, bacterial or otherwise, and analyzing the spectra automatically to determine the number and types of bacteria present in real-time. Assay development and modification is far simpler for BAMS than for other “wet” microbial enumeration techniques such as PCR or immunoassays, taking only hours for nonpathogenic organisms and the theoretical precision of BAMS in bacterial enumeration is significantly higher.

The successful completion of this project will result in a laboratory demonstration of the enumeration and quantification of sulfate-reducing bacteria (SRB) in real time and the determination of threshold application of sodium hypochlorite required to neutralize SRB *in vitro*.

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