Public Executive Summary

Title: Ultra-High Conductivity Umbilicals

Name of Offeror: NanoRidge Materials, Inc.

Project Manager: James Pappas
Principal Investigator: Dean Hulsey

Additional participants: Technip USA, Inc.; DUCO, Inc.; Rice University

Solicitation Number: RFP2007DW1302 (07121-1302)

Project Start Date: December 5, 2008
Project End Date: May 30, 2010

Total Estimated Cost:	$	560,000.00
RPSEA Maximum Share:	$	448,000.00
NanoRidge Materials Cost Share:	$	112,000.00

Goal

The goal of this project is to develop an ultra-high conductivity power cable suitable for use in undersea umbilicals. The overall objective is to design, build, and test an engineering prototype of a working ultra-high conductivity cable that could in later stages be incorporated into an umbilical exceeding 100 miles in length and called upon to deliver up to 10 MW at up to 36 kV with operating temperatures up to 250 °F and pressures up to 4500 psi.

Background

When considering high power requirements and long umbilical tie-back distances, there is a need for new technologies to enable power delivery to the seafloor. Carbon nanotechnology is one such new technology that could enable efficient power transfer over long tie-back distances where light weight yet durable cable is required. One concept for a new high current density electrical wire is a polymer-nanotube umbilical (PNU) based on single walled carbon nanotubes (SWCNTs) dispersed in a polymer binder. Such a wire would have the ability to be produced in long segments with connections that could be made at numerous points along the length. An SWCNT typically has a diameter that is close to 1 nanometer, and a length that may be many thousand times longer. The way the carbon material is wrapped to form the cylindrical tube can vary.

A low current loss wire could be bundled into an umbilical to provide power for communication lines and to operate pumps and other subsea equipment. The umbilical might include hydraulic lines, communication electrical wiring, and power lines for pump operation.

There are three main deliverables for the project: 1) produce a one foot long conductor that works at room temperature and can carry at least 500 amps while being one half the diameter of a pure copper conductor carrying the same current at the same voltage; 2) deliver a final report that documents the results of the demonstration as well as a wide range of physical properties associated with the conductor (weight, flexibility, conductivity, etc.); and 3) conduct a workshop in Houston, Texas to present and discuss results.

Potential Impacts

The envisioned cable will have an electrical conductivity that will be about four times that of copper in the same cross-sectional area, allowing for power transmission for much greater distances than is currently possible. The cable will also be much lighter and will be close to neutral buoyancy, thus allowing for easier installation. Also, polymer cables will be more fatigue resistant than any metallic conductor. While the purchase cost of the cable could initially be higher than copper, the projected future cost of nanotubes is expected to decrease to the point where in just a few years a nano-polymer cable will be less than copper. A low cost, high capacity, durable electrical cable will enable more robust subsea development in deeper water, enabling the economic development of portions of the ultra-deepwater resource that would otherwise remain inaccessible.

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