

## Naval Special Warfare Support With REMUS

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### LONG-TERM GOAL

The Naval Special Warfare (NSW) concept of operation, which REMUS supports, is based on the use of small autonomous underwater vehicles to perform shallow water reconnaissance in support of amphibious landing and hydrographic mapping operations. Missions of this type require the vehicle to be launched and recovered from small craft, to operate in water depths from three to six meters in the open coastal ocean, to navigate in a geographic coordinate system, and to support sensors that can detect and locate moored or bottom laid mines as well as other obstacles. To successfully complete shallow water reconnaissance missions, the data collected by the vehicle must be compiled, forwarded, and made available to the task force commander and the fleet. To be useful, this information must be forwarded in a timely manner in a format that supports decision-making.



*Figure 1. SAHRV Advanced Development Model*

## OBJECTIVES

The objective of this program is to develop and demonstrate a small affordable autonomous underwater vehicle that can be used by Special Forces teams to perform shallow water minefield and hydrographic reconnaissance missions. The vehicle will utilize low cost commercially available sensors. The project will focus on technological advancements that will permit the system to meet the requirements set forth in the NSW Very Shallow Water (VSW) Mine Counter Measures (MCM) mission needs statement, which was approved on March 26, 1992. These advances will also address requirements established in the Semi Autonomous Hydrographic Reconnaissance Vehicle (SAHRV) Operational Requirements Document (ORD) approved August 21, 1998.

## APPROACH

The objectives of this program have been met by developing two Advanced Development Models (ADMs) during FY99. These new vehicles are based on the existing REMUS design that has undergone extensive evaluations by the VSW MCM Detachment and PMS 325J over the past two years. The new design addresses the specific needs of special warfare and EOD teams. To meet these needs, the REMUS vehicle had to be modified to meet certain requirements of MIL-STD-810E. In addition, new, commercially available, higher energy battery packs were required which would permit the vehicle's batteries to be recharged with the housing closed. To further extend mission time, vehicle drag was also reduced, and a new more efficient propeller was developed for the system. A set of smaller, ruggedized transponders was also required, along with the development of a prototype transit container. The vehicles were also equipped with a new side scan sonar, a new down-looking only DVL, and conductivity/ temperature and optical back scatter sensors. New vehicles were evaluated by PMS 325J under realistic field conditions in the open ocean, from October 12-22, 1999. The NAVSEA evaluation concluded that significant advancements had been made which will permit the vehicle system to meet or exceed all established operational requirements. This evaluation provided demonstrated proof of the system's capabilities. This proof was used to obtain a Justification and Approval (J&A), which authorized the Program Executive Officer, Expeditionary Warfare (PEO EXW) (PMS325J) to award a sole source services contract to WHOI for the execution of the Engineering and Manufacturing Development (EDM) Phase of the SAHRV program; SAHRV is an acquisition category IVT program.

## WORK COMPLETED

The majority of work sponsored under this grant was completed during FY99. Work of note, completed during this fiscal year, involved the following:

1. *Initial temperature testing of the ADM vehicle.* The ADM vehicle was subjected to hot and cold temperature tests during the period of January 20-24. The tests were conducted in the environmental chamber in the Smith Building at WHOI. In addition to providing an initial evaluation of the vehicle, this testing allowed the determination of the achievable extremes within this chamber. The maximum and minimum chamber temperatures were 45 °C and -32 °C, respectively.
2. *Support of the ONR/NAVOCEANO FY99 AUV Fest.* Under this grant, the Oceanographic Systems Laboratory (OSL) participated in the third annual ONR/NAVOCEAN UUV Fest that was held in Gulf Port, Mississippi. OSL's involvement included chartering the R/V Gyre and operating three different REMUS vehicles during the tests.

3. *A Review of the SAHRV program.* The review was conducted in DC on December 7<sup>th</sup> and 8<sup>th</sup>, 1999 by NAVSEA. The plan of action developed from this review included the transfer of \$100K via ONR to cover the short-term needs of the program. These needs included environmental testing, transit container development, Li Ion battery pack development, and evaluation of 900 & 1200 kHz side scan sonar units, as well as a number of engineering tasks required to upgrade the ADM vehicles to EDM vehicles. All of these tasks were completed during this year,

## RESULTS

1. *Environmental Tests.* The cold testing identified a potential problem with the side scan at temperatures below -25 °C. Additional testing is necessary to verify that the hard drive is the problem and to develop a better understanding of the cold temperature performance. No problems occurred during hot temperature tests. *ONR/NAVOCEANO UUV Fest.* During the fest, surveys were performed with three vehicles, an ADM vehicle equipped with standard sensors, an older REMUS vehicle equipped with a WHOI acoustic communication system, and an older REMUS vehicle equipped with a Bio-luminescence sensor. One hundred twenty-seven nautical miles were surveyed in 33.3 hours over a six-day period during the fest. Each vehicle performed flawlessly. A comprehensive report, including fully processed field data was provided on a CD-ROM to ONR and NAVOCEANO before the team left the ship. Some results of the fest are provided below.
3. *Justification and Approval.* A J&A document was approved, which authorizes the award of a sole source services contract to WHOI for the execution of the Engineering and Manufacturing Development Phase. This phase includes development, fabrication, assembly, testing, refinement and delivery of four SAHRV Engineering Development Models to support EMD Phase requirements; performance of associated engineering services and test support; and development of a supporting technical data package. The entire EMD procurement will be funded under Research, Development, Test and Evaluation (RDT&E) funds. The NAVSEA PMS 325J Acquisition Program, which was awarded in March 00, represents a transition of technology from basic research to the fleet.

## IMPACT/APPLICATION

The United States Special Operations Command in Tampa, FL has approved an Operational Requirements Document that describes a very shallow water mine countermeasures and a semi-autonomous hydrographic reconnaissance system. This document details a system which is essentially identical to the technology which has been developed at WHOI and states that no change in the Naval Special Warfare force structure will be required to support this technology. The ORD also establishes that a full operational capability will be achieved when a complete inventory of 28 vehicles with full logistic support and training is in place. Currently, full operational capability is called for in FY01.

On June 8, 1999, in the Commerce Business Daily, NAVSEA posted their intent to issue a request for proposal to WHOI for the design, fabrication, and testing of two SAHRVs engineering development models, and the subsequent delivery of 14 production units in FY01.

The Program Executive Office, Mine Warfare, has established a study team to perform an analysis of alternatives for an FY01 acquisition program. The SAHRV vehicle will serve as the benchmark against which all other alternatives will be evaluated.

## **TRANSITIONS**

The demonstrated improvements developed under this grant have resulted in approval of a Justification and Approval by the Program Executive Officer, Mine Warfare that authorized the Program Executive Officer, Expeditionary Warfare PMS325 to a sole source services contract to WHOI for the execution of the Engineering and Manufacturing Development Phase of the development of the SAHRV system. This is an acquisition category IVT program.

## **RELATED PROJECTS**

ONR BAA 98-008 Diver and UUV Systems and Technologies for VSW/MCM Missions

## **REFERENCES**

Semi Autonomous Hydrographic Reconnaissance Vehicle (SAHRV) Field Evaluation One Report, Program Executive Officer, Expeditionary Warfare (PMS 325); May 1998

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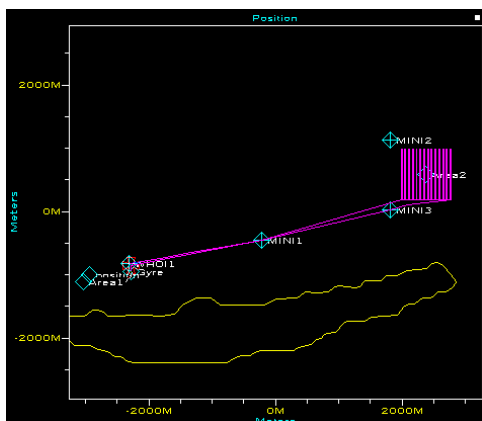
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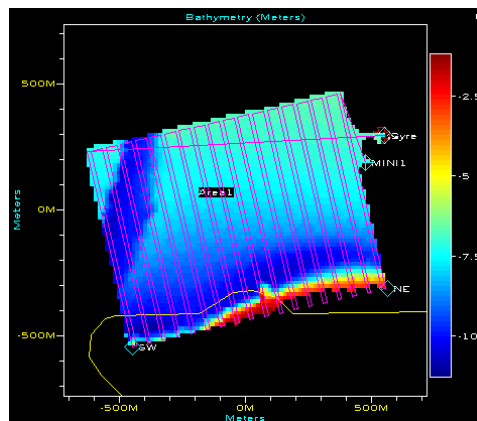
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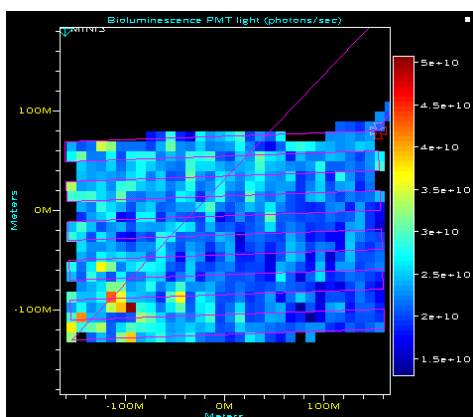
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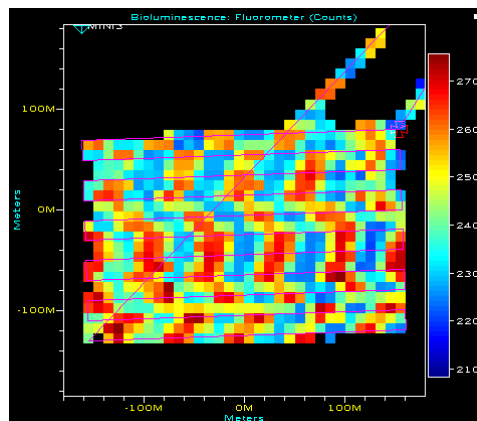
*Figure 2 Mission 12, 17.8 nm, Time 4:54*



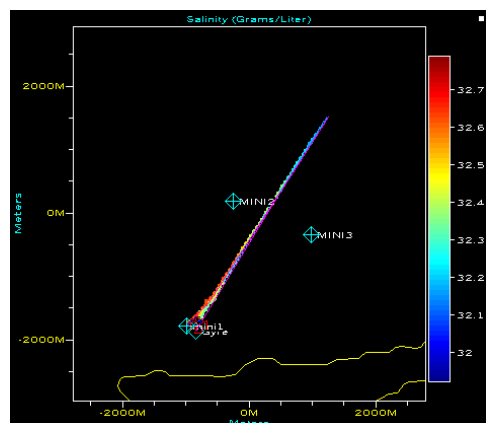
*Figure 3 Mission 14, 16.9 nm, Time 4:34*



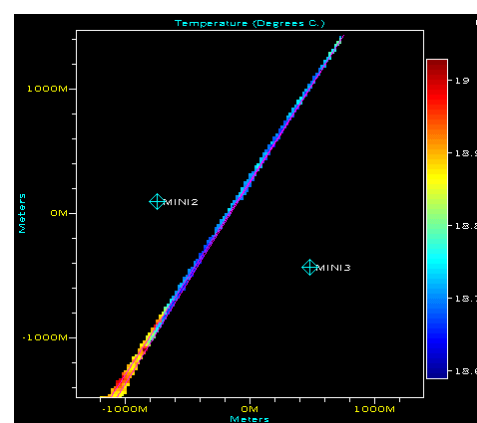
*Figure 4 Bioluminescence Data Mission 16*



*Figure 5 Fluorometer Data Mission 16*



*Figure 6 Salinity data transmitted from vehicle over acoustic communication system*



*Figure 7 Temperature data transmitted from vehicle over acoustic communication system*