OBJECTIVE: Develop external means to provide real-time externally mounted communications through the hull of a distressed submarine (DISSUB) to provide digital communications and/or external measurement of internal DISSUB conditions.

DESCRIPTION: To successfully rescue a DISSUB, and minimize risks to rescue forces, it is necessary to quickly and efficiently determine the status of the DISSUB survivors. Current procedures utilize available onboard communications, such as underwater telephones and globally recognized tap codes, to assist rescue forces in determining status and risk. However, in the event the DISSUB is unresponsive, no method exists to determine the status of the survivors in real time. U.S. Navy rescue protocols dictate that in this instance, rescue will not be attempted because of the unknown risks to rescue forces.

While an unresponsive DISSUB may be because there are no survivors, there are other reasons why the DISSUB survivors may not be able to effectively communicate with rescue forces: loss of underwater telephone capability, location of survivors within the DISSUB, and atmospheric conditions that limit and/or prevent consciousness – such as high internal pressures or higher than normal atmospheric contaminants. In these instances, it is necessary for rescue forces to be capable of externally determining the status of survivors in real time to effectively determine the risks associated with a rescue attempt prior to the rescue vehicle mating with the DISSUB. Current technology using external communications equipment requires the transmission to be recorded and then the equipment to be removed for future download. Due to the necessity for rapid assimilation of all available information to support rescue of a submarine, the ability to receive and transmit DISSUB information in situ is paramount.

To provide all necessary information to rescue forces to be able to accurately determine risks associated with a rescue attempt, the Program Office desires communications that are capable of providing digital transmission and receipt, determining the internal pressure of the submarine compartments, and determining the levels of atmospheric contaminants within the compartments. These communications should not rely on DISSUB survivor inputs, should not require permanent onboard installation of equipment, and should minimize power requirements as much as practical. The proposed solutions should be capable of the following: (1) Externally mountable to a submarine hull via Remotely Operated Vehicle (ROV) or Unmanned Undersea Vehicle (UUV); (2) Implosion- and explosion-proof to a minimum of 3000 feet of sea water (fsw); (3) Transmit and receipt of digital data to the surface via relay station onboard an ROV or UUV; (External measurement of internal submarine pressure up to 6 atmospheres absolute (ATA) [Note that the use of available thru-hull penetrators is acceptable, but establishing new penetrators is not desired]); and (4) External measurement of internal atmospheric contaminant levels up to 8 ATA. It is well known that the accuracy of currently available technology to assess atmospheric contaminants under pressure is widely disparate. The solution proposed should take this into account and either provide a scalable correlation or a means of determining tolerances of data provided. At a minimum the solution should be capable of measuring the following contaminants: Carbon Dioxide (CO2) up to 5 parts per million (ppm), Oxygen (O2) 13 to 30 %, Carbon Monoxide (CO) up to 50 ppm, Hydrogen Cyanide (HCN) up to 50 ppm, Ammonia (NH3) up to 300 ppm, Chlorine (Cl2) up to 10 ppm, Hydrogen Chloride (HCl) up to 50 ppm, and Sulfur Dioxide (SO2) up to 100 ppm. In terms of technology development effort priority, the proposed solution threshold is the development of digital communications and the objective is the ability to measure atmospheric contaminants.

In addition to being a safety and duty of care issue, continued advancement and modernization of the USN Submarine Escape and Rescue Program is considered an Assistant Secretary of the Navy core field in support of the larger Undersea Warfare effort and directly aligns to both the National Defense Strategy and the Submarine Commander’s Intent by defending the homeland, enabling interagency counterparts to advance U.S. influence and national security interests, ensuring USN submarine warfighting readiness and survivability, strengthening alliances, and attracting new partners. The latter was highlighted in the geopolitical outcome following the USN Submarine Escape and Rescue response to the ARA SAN JUAN incident in November 2017.

PHASE I: Develop a conceptual solution that defines the methods and identify the major components required to meet the Navy needs. Determine feasibility by using modeling and simulation to demonstrate the proposed solution. The Phase I Option, if exercised, will
include refinement of the proposed solution to support Phase II breadboard and prototype development.

PHASE II: Develop a breadboard design based upon the conceptual solution, including the major components identified, to provide a representative simulation of the proposed solution. Following breadboard testing, refine, as necessary, the design to build and deliver a reduced scale prototype for testing. Depending on schedule and asset availability, test the reduced scale prototype at sea on a submarine platform, but at a minimum via bench-testing in a simulated environment comparable to the anticipated operational environment at NSWC Philadelphia and/or NUWC Rhode Island. Include, in testing, verification of the ability to meet implodability and explodability in accordance with SS800-AG-MAN-010/P-9290 Revision A. Develop the concept of operations for utilizing ROV and/or UUV to support delivery and attachment of the equipment. Develop a Phase III plan.

PHASE III DUAL-USE APPLICATIONS: Assist the Government in transitioning the technology for Navy use. Develop, build, and deliver a full-scale through-hull communications system based on the proposed design for use in the support of the USN submarine rescue mission. Test the system(s) at sea in a representative operating environment before transition to a program of record and procurement to support submarine rescue mission needs. Support the development of any required training manuals, technology refresh considerations, and other applicable lifecycle sustainment requirements.

The ability to provide real-time digital communications through various obstructions and monitor and/or externally measure atmospheric conditions of confined spaces is a technology requirement that extends beyond the submarine rescue mission, both in other military and commercial applications. Confined space rescue and the ability to assess the risks associated with that rescue are also mission needs within organizations such as the National Aeronautics and Space Administration (NASA), Mine Safety and Health Administration (MSHA), and National Institute for Occupational Health and Safety. While the program office’s intent is to develop technology that addresses the unique needs associated with a submarine rescue event, potential exists to leverage that technology to address similar needs across these other organizations.

REFERENCES:


4. “Immediately Dangerous to Life or Health (IDLH) Values: Table of IDLH Values.” Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (NIOSH). cdc.gov/niosh/idlh/intridl4.html

KEYWORDS: Underwater Communications; Atmosphere Control; Atmosphere Monitoring; Submarine Rescue; Digital Communications; Disabled Submarine Assessment; DISSUB