

Coast Guard's Underwater Port Security R&T

Ric Walker
U.S. Coast Guard Research and Development Center
1082 Shennecossett Rd
Groton, CT 06340-6096
860.441.2782 (Phone)
860.441.2792 (Fax)
rwalker@rdc.uscg.mil
www.rdc.uscg.gov

INTRODUCTION

The Coast Guard's homeland security mission includes providing security for 361 ports and 95,000 miles of US coastline. This role has been increasingly visible since the Coast Guard became part of the Department of Homeland Security. One of the cornerstones of the Coast Guard's security strategy is to establish Maritime Domain Awareness, or MDA. This is the effective knowledge of all activities and elements in the maritime domain so that anything that threatens the safety, security or environment of our country or its people can be identified and addressed. In order to ensure safe and efficient commerce, maritime security is an increasingly critical component of the MTS. Robust port security measures will constitute a key aspect of defending the MTS and preserving its vital economic role.

As part of the MDA picture, the Coast Guard has recognized the need to include an underwater component to address criminal and terrorist threats from that sector. Specifically, we need to be able to detect and respond to potentially hostile swimmers and divers in the port environment; we need to be able to inspect ship hulls, piers and bulkheads to detect suspicious objects for further investigation; and we need to enhance our awareness of port channels and bottom characteristics to minimize the threat of harbor mining or obstructing.

In order to enhance the ability to execute the port security mission, the Coast Guard established a number of Maritime Safety and Security Teams or MSSTs. These 100-member units are rapid response forces assigned to vital ports and capable of nationwide deployment by air, land or sea to meet emerging threats. MSSTs are multi-mission: they protect military load-outs, enforce security zones, defend critical waterside facilities, interdict illegal activities and assist with shore-side force protection. They provide enhanced port safety and security and law enforcement capabilities in their homeport and wherever they are deployed. They can be deployed in support of national special security events (NSSE) requiring Coast Guard presence, such as political conventions, major political summit meetings, tall ship festivals, Olympic events, major disasters or storm recovery operations. MSSTs are one of the Coast Guard's front lines in port security. Underwater port security is a critical part of this mission.

In order to foster timely development of underwater port security mission requirements, and identify performance gaps and possible solutions, the Coast Guard established the Underwater Port Security Working Group (UPSWG). The group was chartered to address underwater security issues relevant to MSSTs, local Coast Guard forces, Captains of the Port, and other port security partners. The members include representatives from Coast Guard Program offices, Area Command representatives, the Coast Guard Research and Development Center, the

Transportation Security Administration and various Navy laboratories and program offices as appropriate.

One of the UPSWG activities was to conduct a risk assessment workshop to better define the nature of underwater threats and possible mitigation strategies. Threats were prioritized and a range of solutions based on policy, doctrine, education, public relations, training and technology were identified. The Coast Guard has since made several programmatic decisions based on this work designed to enhance underwater port security. The results were also used to identify and prioritize technology developments for enhanced underwater port security.

The Coast Guard R&D Center addressed the technology solutions through the Underwater Port Security (UPSec) Program. Due to the urgency of getting enhanced capabilities to the field quickly, a rapid spiral development process was used where possible. In order to leverage the expertise resulting from years of research and development of underwater technologies, the Coast Guard has partnered with the Navy. An example of this partnering is that the Coast Guard Research & Development Center (R & D Center) entered into a Memorandum of Understanding with the Naval Undersea Warfare Center, Division Newport (NUWC-NPT) to facilitate collaborative efforts. The large number of entities with an interest in furthering security technology has fostered additional coordination efforts and working groups such as the Technical Support Working Group (TSWG) and the Joint Non-lethal Weapons Directorate (JNLWD). The Coast Guard is leveraging by participating in these groups to share information, results and development costs, and expedite the development and evaluation process.

TECHNOLOGY DEVELOPMENT

Integrated Anti-swimmer System

In an effort to enhance the Coast Guard's ability to provide underwater port security, anti-swimmer technology was one of the areas slated for improvement. The goal was to realize improvements in both detection and response systems. After an extensive market survey of both commercial and government-developed swimmer detection systems, the R&D Center identified the underwater component of the Navy's Waterside Security System as the best available system for our needs. This system was based on the Navy's AN/WQX-2 sonar combined with an advanced sonar processor. We partnered with the system developers at the Navy's Space and Naval Warfare Systems Center San Diego (SSC -SD) and the Applied Research Laboratory at the University of Texas in Austin (ARL:UT) to develop a swimmer detection system to meet specific Coast Guard mission requirements.

For the highly mobile MSST application, portability was a key requirement. SSC-SD had already developed a "lightweight" version of the detection system by coupling the existing processor with a commercial soundhead. This reduced the soundhead weight from approximately 1100 pounds to less than 200 pounds. In order to enhance the overall functionality, we integrated a number of additional subsystems to form the Integrated Anti-swimmer System (IAS). The IAS consists of an active, commercially available sound head for detection, a software processor to provide classification and tracking, a tactical display for the Command & Control operator, an automated guidance system to direct the response boat to the sonar contact, an underwater high-frequency acoustic imaging system for positive identification and localization of the contact, a commercially available diver recall system (underwater speaker) to issue warnings and commands to underwater intruders, and interdiction capabilities.

The IAS was subjected to an extensive test and evaluation program at NUWC-NPT during the summer of 2003. The test program was highly successful and included an assessment of the effectiveness, suitability and deployability of the system for the MSST port security mission. The test program also provided critical input to the system concept of operations. Based on the successful results of this work, the Coast Guard has bought these systems and deployed them for operational use.

Underwater Loudhailer

The IAS uses a diver recall device for notification. However, commercially available systems do not have proven intelligible communication distances necessary to meet Coast Guard requirements. The UPSec Program brought this unanswered need to the TSWG. The ability to broadcast intelligible warnings and commands to an underwater intruder was a high priority among the TSWG members. As a result, this working group issued a Broad Agency Announcement (BAA) soliciting proposals for an extended-range underwater loudhailer. The relatively shallow waters of most ports can cause reverberation of the sound in this environment, which makes long-range transmission of an intelligible message difficult. A development effort for a long range underwater loudhailer is currently underway. Results of this work should be available in the summer of 2005.

Non-lethal Weapons

Another major area of anti-swimmer technology development was to enhance our response systems. The Coast Guard response tactics are guided by the Commandant's Use of Force Policy. Simply put, this means that as the tactical situation allows, Coast Guard units must enter the use of force continuum at the lowest level possible to compel compliance. This is similar to law enforcement policies ashore, where police must first yell at someone and identify themselves as law enforcement officials, before firing warning shots, before applying deadly force. The underwater loudhailer provides the means to yell at a potential intruder and warn them that they are violating a security zone. The Coast Guard also is working with the Joint Non-lethal Weapons Directorate to develop additional response tools to "encourage" compliance while using less-than-lethal force measures.

Interestingly, one approach taken in the development of response tools emulates a natural phenomenon used by a certain species of snapping shrimp. *Alpheus heterochaelis* is a small finger-sized shrimp with an oversized claw. The two parts of the claw are normally cocked open, but when a muscle contracts, they close with lightening speed ejecting a jet of water. The water comes from between the claw-halves, and is squeezed out with great speed (30 meters per second), which is fast enough for the pressure within the liquid to drop and generate a cavitation bubble. When the pressure builds back up, the bubble implodes and makes a popping noise. The popping noise is actually an acoustic impulse produced when the bubble collapses. The shrimp use this impulse effect to stun their prey, such as small crabs, fish and worms, and then capture them for consumption with no resistance.

Acoustic impulses are known to have negative effects on humans in the water as well. One of the most reliable sources for acoustic impulse comes from the seismic survey industry. Water guns use high-pressure air to create a large-scale version of the shrimp "snap". Air guns, another seismic survey device, produce a similar impulse using an explosive effect, rather than an implosive one. Both these devices are used routinely for seismic survey in the ongoing search for oil under the seabed.

The Joint Non-lethal Weapons Directorate supported the test and evaluation of these devices and other impulse generating devices as potential non-lethal diver interdiction tools. The R&D Center partnered with JNLWD and the Naval Submarine Medical Research Laboratory (NSMRL) at Subase Groton to leverage their expertise in the bio-effects of underwater sound. A small water gun and small air gun were used to evaluate the concept. A series of tests were conducted during the spring and summer of 2004 at the NUWC-NPT Acoustic Test Facility at Dodge Pond in Niantic, CT. to assess the acoustic characteristics and diver aversion to the acoustic impulse produced by these devices. The results are being analyzed.

Coordination

The process for developing new or enhanced tools for underwater port security has been a highly coordinated and cooperative one. This may provide a worthwhile example for the traditional waterways management community. The R&D Center is a critical member of the Underwater Port Security Working Group. As described earlier, this working group is comprised of Coast Guard Headquarters and field unit representatives, along with members from TSA and other agencies as appropriate. The purpose is to refine and formalize the mission requirements, and recommend a course of action that includes development of technology, doctrine, and policy, and provides input to training programs, concept of operations, and procurement strategies to enhance underwater port security. The working group ensures that requirements from all areas of the Coast Guard with an interest in Underwater Port Security are identified and included in the development plans.

The Coast Guard also participates in the Technical Support Working Group (TSWG). This is a national forum that identifies, prioritizes, and coordinates interagency and international research and development requirements for combating terrorism. Through the Department of Defense's Combating Terrorism Technology Support Program and funding provided by other agencies, the TSWG rapidly develops technologies and equipment to meet the high priority needs of the combating terrorism community, and addresses joint international operational requirements through cooperative R&D with major allies. The underwater loudhailer development described above was based on a TSWG effort. The Department of Homeland Security provided funding for this effort.

The Joint Non-Lethal Weapons Directorate (JNLWD) is another forum that the Coast Guard participates in. This organization addresses the needs of the DoD and the joint services (USN, USA, USCG, USMC, and SOCOM) and numerous law enforcement agencies. They are responsible for the centralized coordination and integration of non-lethal weapon technologies and systems that will support the Services and Combatant Commanders. Non-lethal weapons are defined as "weapons that are explicitly designed and primarily employed so as to incapacitate personnel..., while minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment". The acoustic impulse device assessment described above was a result of a JNLWD BAA solicitation for non-lethal technologies. JNLWD provided funding for this effort via NSWC-PC.

The Coast Guard has also partnered with several Navy labs and academic facilities to leverage their expertise and product development. Relations with the Naval Underwater Weapons Center (NUWC-NPT), SPAWAR System Center (SSC-SD), Naval Surface Weapons Center (NSWC-PC), and the Applied Research Lab at the University of Texas (ARL:UT) to name a few, have been particularly fruitful.

Conclusions

World events have mandated that the federal government enhance our nation's ability to provide homeland security. This is a broad undertaking with mission responsibilities residing within many agencies at the federal, state and local levels. As part of this undertaking, the Coast Guard has committed to improving our ability to provide underwater port security. In order to provide the most effective solutions in the shortest amount of time, coordination of these efforts, and leveraging of expertise, resources and results is critical. The Coast Guard, and the R&D Center serving as the Coast Guard's technical agent, has subscribed to this philosophy. The resulting partnerships and participation in various working groups and joint programs, have resulted in coordinated efforts that leverage expertise where it resides, funding that can be made available to a broader range of facilities, progress and results that can be shared with a larger group of agencies with common or related requirements, and minimum duplication. The rapid enhancement of the Coast Guard's underwater port security capabilities is an excellent example of how this process can produce cost effective capabilities in the field in a relatively short amount of time.