

The role of micro ROVs in maritime safety and security

A The maritime security threat remains high worldwide. Experts have identified a nexus between maritime crime and maritime terrorist activity and there is international agreement that terrorist rhetoric and actions present a clear and present danger to the maritime industry. The areas which are most troublesome are the increased sales of underwater propulsion vehicles, the terrorist literature which has surfaced since 911 describing the use of explosives on ship hulls, and the terrorist training of SCUBA and mixed gas divers.

Micro-ROVs are an enabling technology particularly well suited for use by federal, state, local and private organizations that have inherited new requirements designed to improve the safety and security of ships, ports, harbors and other High Value Assets. (HVA)

The International Ship and Port Facility Code defines a hierarchy of Maritime Security (MARSEC) levels. The required actions of ships, port facilities and companies are defined in the Ship and Port Facility Security Plans based on ISPS Guidance. If closely examined, the MARSEC levels and their required protective security measures show a close resemblance to Military Threat Conditions (THREATCON) and the associated defense measures. Micro-ROVs are used by both civilian and military communities for similar purposes. These activities include the use of Micro-ROVs to search ships' running gear, ships' hulls, locate contraband, assist divers, penetrate small spaces, investigate pier pilings, bulkheads, and investigate mine-like objects.

Homeland Security grants have provided relatively new user groups the ability to purchase Micro-ROVs for maritime security applications. This has opened up a new marketing avenue and appreciation for the utility of Micro-ROV technology. It has also spurred evolutionary improvements in the capabilities of Micro-ROVs based on user needs. The applications of Micro-ROVs in maritime safety and security center around law enforcement, ship and port security, protecting high value assets, object recovery, and protection of civil infrastructure.

The capabilities of Micro-ROVs have developed over the years based largely on the user population's needs. A list of selected Micro-ROV user needs include: range capability, station keeping, topside visibility,

In this extract from the white paper 'The Role of Micro ROVs in Maritime Safety and Security', author **Marianne Molchan** of **Molchan Marine Sciences** considers the benefit of using micro ROVs for security operations.



daytime/nighttime underwater visibility, left/right/up/down field of view, strength of pull, portability. Equally important to the user community is ease of deployment and recovery, reliability, maintainability, performance vs. weight and cost.

There are constraints that limit Micro-ROVs and contribute to the fact that they are less capable in some areas to their larger counterparts. The limitations are related to thrust, the inability to retrieve heavy objects, positioning system costs, lateral mobility, limited payload capability.

If you think size matters, you are right. Micro-ROV's operational success has, in part, been due to its smaller size, portability and its ability to maneuver through tight spaces. If you think price matters you might be wrong. An objective set of field tests conducted by NAVSEA, testing specific capabilities of ROVs entitled, "Remotely Operated Vehicle Market Survey and Field Testing Results for Shipyard Drydock Caisson Inspection Applications", revealed that for the three most heavily

weighted tests: current capability, station keeping and bollard pull, the largest and most expensive ROV did not out-perform its smaller counterparts. For many applications, a more economical Micro-ROV may, in fact be more capable over their larger ROV cousins.

The maritime safety and security requirements have only been in existence for a few years. Most of the Micro-ROV maritime security customers are new to marine technology. New users like low-cost, low-weight technology that is simple to operate and maintain. The value of Micro-ROVs will evolve and grow as the user gains a better understanding of his own requirements. In fact, the vast majority of Micro-ROV users identify many more uses for the technology than they originally anticipated. Port facility owner/operators and port security enforcement personnel not only appreciate the ability to conduct rapid underwater surveys of their piers and bulkheads for maritime security purposes but they also recognize the value of knowing the condition of their underwater

infrastructure. Micro-ROVs are coming of age and evolving with the new opportunities and requirements in maritime safety and security. The possibilities for their use are limited only by our imagination. In the same way that technology has provided for greater capabilities with smaller platforms in space, so have we seen a similar shift in the size and capability with ROVs. Micro-ROVs are a promising technology that can be utilized by a broad spectrum of operators and is particularly well suited for maritime security applications.

The events of 911, the train bombings in Madrid, the explosions on the USS COLE and MV LIMBURG and the 2004 attack on the offshore oil rig in Iraq have changed the way in which the international military and civilian maritime communities view maritime security. Each of these events shed light on the tactics of this global, multi-modal terrorist threat.

Terrorists have used maritime attacks over the past several decades to further political and economic goals. Proving the vulnerability of the high value assets on land or at sea is a primary goal of terrorists. Al Qaida operatives call maritime defense and commercial assets as the “belly of the beast,” referring to the ease with which they are able to disrupt operations. The high risk targets include: warships, U.S. Government/MSC/Charter vessels, cruise liners, tankers, roll-on/roll-off, passenger ferries, special cargoes, terminals, nuclear power plants, port facilities and oil platforms.

Al Qaida spokesmen have made public threats against nuclear power plants and marine transportation infrastructure, causing the U.S. Department of Homeland Security (DHS) to publicly state that nuclear facilities and ferry operators should take extra precautions against the threat of terrorism from the air, land, or sea.

Information bulletins from DHS have provided updates on training, tactics, and strategies of terrorists. Since the beginning of 2003, DHS has asked submersible, and SCUBA diving equipment dealers to report “volume purchasing inquiries” related to Swimmer Delivery Vehicles (SDV) and Diver Propulsion Vehicles (DPV). They have also issued advisories on chemical weapons, stating that terrorist interest in toxic chemical materials and delivery methods has been growing and probably will increase further in the near term. A “181-page Al Qaida training manual obtained by Joseph Farah’s G2 Bulletin shows Osama bin Laden’s terrorist network has been focused on seaports as top-level targets since 2001.... G2B sources say there are reports that Al Qaida and other terrorist organizations have been practicing high-seas terror attacks by hijacking ships, kidnapping crews and studying diving as much as the Sept. 11 skyjackers learned to fly airliners.” Terrorists have been practicing small boat swarm attack tactics

on the high seas, and piracy is on the rise worldwide. Today there appears to be less of a distinction between “traditional” maritime piracy and crime and terrorist activities.

Suspicious events related to underwater port security have contributed to a growing concern and the need to develop Underwater Port Security CONOPS for ports within and outside the continental United States. As a result, Department of Defense has enhanced Anti-Terrorism/Force Protection measures for all of its vessels and has restructured its maritime defense forces. The Department of Homeland Security has enhanced Research and Development and operational Underwater Port Security programs within the USCG and Immigration and Customs Enforcement (ICE). State and Local Law Enforcement officials have been sharing threat information and applying for (and receiving) homeland security grants to purchase high tech equipment related to ship and port security. This equipment includes Micro-ROVs and sonars.

Despite national, state and local efforts to maintain a defensive posture in maritime security, the international terrorist network continues to presents a clear and present danger to ship and port security. Two of the most dangerous al-Qaida-linked groups in Southeast Asia are working together to train militants in SCUBA diving and seaborne terror attacks, according to the interrogation of a guerilla captured in spring of 2005 in the Philippines .

There is evidence that a middle eastern dive school owner / operator trained several suspected Islamic extremists in SCUBA at his school in the Netherlands. Dutch authorities suspected foul play; they checked the class lists and found one of his diving students was convicted in Morocco for plotting maritime attacks on U.S. ships in the Strait of Gibraltar.

The following February in 2004 there were a series of 4 unexplainable suspicious SCUBA diving incidents that occurred around the United States. In two separate incidents within a week period, SCUBA divers were seen at night on the surface of the water near USCG cutters and were chased off by ships personnel. A dead SCUBA diver was found floating in ice filled Hudson River near a power plant. He was not a U.S. citizen and was never reported as missing. In Hollywood Florida there was also a diver found dead, under suspicious circumstances near a park. It is not known if these incidents are related to each other or to terrorism but it does indicate there is a heightened sense of underwater port security awareness within the media.

On March 26, 2004 three diving terrorists came ashore in port of Tel Katifa, Israel. They came out of the water carrying weapons, walked up on shore, opened fire on a motorist and were subsequently were killed by security personnel. While they were unsuccessful in

launching a full fledged attack from the sea, they were successful in initially penetrating a coastal area by sea. Dive equipment and additional arms of the attackers were found subsequent to the firefight. This attack confirms the suspected practice or tactic of attacking a port with the use of divers.

The most critical underwater infrastructure to protect is that of high value assets. What is the appropriate role of Micro-ROVs in the protection of those High Value Assets?

WHAT ROLE DO MICRO-ROVS PLAY IN A LAYERED DEFENSE CONCEPT OF OPERATIONS?

The ISPS Code, Marine Transportation Safety Act, and Department of Defense Anti-Terrorism Force Protection requirements have defined a layered defense CONOPS for maritime security. This layered defense CONOPS calls for providing waterside security of critical infrastructures. (see Section 3.3 High Value Assets). There are a number of tools that are currently being used for underwater port security. These tools may include sonars and other acoustic devices, water quality sensors, underwater cameras, lights, divers, dolphins and Micro-ROVs. There is no one single tool that can do all that is necessary to protect a harbor. As a result, in order to provide the layered defense, there may be layers of capabilities that are used for specific conditions. Micro-ROVs are being used to inspect/search pier piling, bulkhead, running gear, harbor bottom and hull searches in the United States and internationally. They are also being used in conjunction with SCUBA and surface supply diving operations to assist the diver in locating objects. When the underwater environment poses too great a health risk for divers or if a special sensor is needed, Micro ROVs play a particularly critical role. Micro-ROVs can maneuver in locations where divers cannot and are able to provide an eyeball or sonar image on critical infrastructure that may not be accessible any other way. Micro-ROVs can assist in object recovery, and, with the right sensors, can assist in creating a detailed map of a harbor, pier, ship’s hull or bulkhead as a baseline from which to base future change detection information.

PRIMARY FACTORS IN THE USE OF MICRO-ROVS IN MARITIME SAFETY AND SECURITY

Most of the Micro-ROV customers are new to marine technology. They are, by and large resource and personnel constrained as well. They are interested in technology that is low cost, low weight, small size, and will require a minimum number of people to train an operate. Micro-ROVs are affordable to federal, state and local maritime law enforcement entities and, in some cases, have been purchased through the homeland security

grant process. Their portability, reliability, supportability, and maneuverability make them attractive tools in the maritime security arsenal. Initial hands-on training for Micro-ROVs can be as short as several hours. They do not have any special transport requirements for commercial aircraft. In fact, some Micro-ROV suitcases are small enough to travel with the operator as checked airport luggage. Typically Micro-ROVs can be operated by one or two persons and they require minimal set-up. Unlike their larger ROV counterparts, launch and recovery support of Micro-ROVs is minimal. They can be deployed from a small boat or over the side of a pier. Often an initial capability (such as ROVs) will evolve and grow as users gain better understanding of their own requirements and where Micro-ROVs are most effective is in their operations.

MICRO-ROVS AND DIVING OPERATIONS

Micro-ROV operations and diving operations should be considered complementary in nature. Diving communities that are unfamiliar with the benefits and limitations of Micro-ROVs may see the industry as a threat to the diving community but many companies with experience in combined operations can attest to the benefits. In fact, Micro-ROVs can make a diver's job more efficient and safe. Micro-ROVs can provide the first look at the diving environment and can warn divers in advance of adverse conditions such as contamination, excessive current, hazards to navigation, explosives, poisonous sea life, poor visibility etc. In most cases, the set-up of a Micro-ROV dive site can be accomplished in a shorter time-frame than a SCUBA dive site, making the Micro-ROV a rapid response asset. ROV tethers can lead divers directly to a target and provide the diver a clear path back to the surface. The ability of the divers to follow a tether directly to the dive-site saves time and adds an extra margin of safety particularly in deep dives and dives under the ice. One of the distinct advantages to ROVs over divers is that they can perform for extended lengths of time and beyond the depth range of divers. Likewise,

divers can lead an ROV to a hole in a wreck that might be too small for the diver to penetrate.

Each SCUBA or Surface Supply dive on a ship is preceded by a "tag out" procedure that should be conducted on the ship. This safety procedure must be accomplished by the Chief Engineer on watch to assure that the ships gear that could harm divers is turned off. (i.e. fathometers, sonars, intakes, suction etc.) Depending on the size of the ship and the availability of the engineer on watch, this could take several hours. In addition, divers should visit each of the ships in the adjacent piers to assure the divers are aware of the any ships movements and out of harms way. Both of these practices take more time than the dive itself. Tag-out procedures are not required prior to placing a Micro-ROV in the water for a hull inspection. The Micro-ROV operators should maintain a level of awareness of the ship activity in the pier area but they would not be required to visit each of the adjacent ships.

Many of the major ports and harbors have water quality issues that could adversely effect SCUBA divers or prevent diving activity altogether. Not only can the Micro-ROV be used as a substitute for some diving functions but with water quality sensor modules on the Micro-ROV they can perform as a sensor, revealing the real-time water quality conditions at the dive site. As a result, diving supervisors can maintain a level of awareness of contamination hazards. They can determine what type of protective equipment their divers need to wear or when it is too dangerous to send divers in the water. Likewise, sending a Micro-ROVs' into a nuclear, biological, and radiological environments is much less risky to human health than sending a diver. This brings to light that the ROV tender/operator health and protection is as important as the protection of a diver. The risks associated with divers and ROVs from exposure to nuclear, biological or chemical contaminants are not comparable.

Unlike their larger cousins, some Micro-ROVs are limited to inspection camera operations only. Other Micro-ROVs with open architecture advertise extreme flexibility, modularity and

interoperability employing mission modules such as sonars, water quality sensors, pinchers, probes, radiation detectors, metal thickness gauges, cameras, and lenses. Depending on the composition of the Micro-ROV, it can have a relatively low magnetic or acoustic signature making it attractive in Homeland Defense and military missions.

Marianne Molchan, President of Molchan Marine Sciences, is a maritime security expert with both military and civilian operational experience in port and harbor safety and security. She is certified NOAA divemaster, hydrographer and oceanographer, as well as U.S. Navy surface supply and EOD diver. She has participated in multiple harbor surveys and harbor defense exercises. Over the years, she has seen Remotely Operated Vehicle (ROV) technology develop and adapt for multiple user needs.

Marianne continues to be heavily involved in the implementation of the International Ship and Port Facility (ISPS) Code by training Ship, Company and Port Facility Security Officer courses, worldwide. She has conducted ship and port facility security assessments and has written ship and port facility security plans for commercial entities. This work has highlighted the need for relevant and available maritime security capabilities for ship and port owner/operators.

She served as an Anti-terrorism-Force Protection Officer for Military Sealift Command Europe's Crisis Action Team during Operation Iraqi Freedom in Naples, Italy and Rotterdam. This experience gave her first hand understanding of the port security measures taken by coalition partners in European ports. She is actively involved in the application of new navigational technologies with Naval Special Clearance Team 1.

Her interest in Micro-ROVs and their role in maritime safety and security increased while working with VideoRay and the USCG Marine Safety and Security Teams in an effort to tailor the Micro-ROV training materials to include aspects of the Port Security mission.

To access a complete version of this paper, either contact the author directly at molchanm@comcast.net. or visit the Molchan Marine Sciences Website at www.molchanmarine.com.