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AUSTRALIA'S FUTURE SEA MINE COUNTERMEASURES

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Sea mines are a very cost-effective weapon for asymmetric warfare in the maritime domain. This is because they engage an adversary with minimal risk and cost by using a covert weapon to maintain a continuous threat. That adversary may be forced to channel its naval and commercial shipping into narrow sea lines of communication that make them more vulnerable to other attack weapons launched from the sea, land or air.

The Australian Defence Force has to maintain and regularly update mine countermeasure capabilities that can cope with mines laid either around the Australian coastline or in overseas areas of operation. In recent years new developments in mine technology have made this a serious and pressing problem for RAN fleet operations.

When asked to provide an overview of the challenges facing alternative mine countermeasure techniques, Royal Navy veteran Neil Hodges, CEO of the Australian firm BlueZone Group, which specialises in robotics and mechatronics for use in coastal seas and deep ocean and 40% of whose work comes from defence projects, told APDR: "In mine warfare terms, speed is often the enemy of safe and efficient mine disposal."

Navy's mine countermeasures program is being developed in two separate projects. The existing minehunters are having their lives extended and capabilities increased, while a separate project is acquiring a deployable mine countermeasures capability.

Project SEA 1179 Phase 1 Minehunter Coastal Service Life Extension and Capability Program is addressing obsolescence issues in the current four operational Huon Class MHC vessels. This project is investigating options to upgrade four Huon class MHCs to extend their service life into the early 2030s ahead of the planned introduction of a new multi-role vessel capable of deploying autonomous and modular mine warfare systems in support of task group and amphibious operations. These upgrades will treat platform and system obsolescence and enhancing a number of the mine warfare sub-systems to keep abreast of the mine threat until the new capability is introduced.

Defence continues to work with Thales Australia during the initial risk-reduction phase to finalise the scope and engineering design to address the capability and technical needs established by Navy.

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The Royal Australian Navy operates the Double Eagle ROV, Seabotix ROV and Wave Glider ASVs. REMUS AUVs are owned by DST Group and often integrated into RAN exercises. Project SEA 1770 Phase 1 Rapid Environmental Assessment is scheduled to deliver two REMUS 100 AUVs to Navy during 2018.

The use of clearance divers - although these can threatened by fast tidal streams and sharks - and ROVs like the Saab Double Eagle are the only certain way of neutralising mines.

Project SEA 1778 Phase 1 Deployable Mine Countermeasures (MCM) is examining, after full testing of technology development, equipping different classes of naval vessels with USVs, AUVs and ROVs. These would comprise a modular mine countermeasures system that could be deployed. Navy has formed the specialist Minewarfare Team 16 to test and deliver this project's solutions.

The next major milestone for SEA 1778 Phase 1 is Initial Operating Capability (IOC) in the 2019–20 financial year. In the interim Thales Australia will progressively deliver the various sub-systems to Defence for acceptance and operation test and evaluation culminating in IOC. They have confirmed as suppliers:

• **Steber International,** who will supply five 38ft boats, three configured as Mine Countermeasures Support Boats and two configured as Unmanned Surface Vessels

• **General Dynamics Maritime Systems,** who will supply 4 small Bluefin 9 and 3 large Bluefin 12 AUVs

• **Sonartech Atlas,** who will supply the Seafox Expendable Mine Neutralisation System.

The suppliers of the Clandestine Swimmer Delivery System, and the communications systems for the unmanned surface vessel are yet to be confirmed.

It is normal practice to send out divers in small boats as long as a suitable support vessel is nearby deploying, controlling and reacting to information sent back from divers and ROVs. Some experts say unequivocally that the option of sending in small boats alone - instead of larger specialist support vessels - to neutralise mines using divers or ROVs, is folly and highly dangerous for those personnel being put in harm's way above and below the surface.

MINE CLEARANCE CHALLENGES

According to Navy "There are two main categories of sea mines, which can be further subdivided by their method of operation and actuation:

• **Moored Mines.** Laid in water depths of down to 300 metres, these are positively buoyant and attached to the seabed, floating at a pre-determined depth below the sea surface.

• **Ground Mines.** Laid in water depths of down to 200 metres against surface shipping or 300 metres against submarines, these are negatively buoyant, resting on the seabed.

"The diversity of sea mine types available to an adversary means that the planners of MCM operations must consider a number of different approaches."

USV and associated technologies have come a long way in recent years allowing some of the

functions traditionally done by manned vessels to be undertaken by unmanned systems. USVs equipped with towed sonar systems, can be used to search for and classify mine-like objects. These systems, along with computer-aided classification software, have the advantage of speed over more traditional methods of searching for mines using hull mounted or variable depth sonar fitted on a manned MCM vessel.

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USVs are also able to carry, deploy and recover ROVs/AUVs for search and classification tasks. ROVs can approach very near to the mine-like object and, by carrying advanced sensors, can positively identify mines.

For readers who want to know more about current underwater vehicles, APDR's May 2018 edition had a very informative article by Mike Yeo entitled "Underwater Unmanned Vehicles – the Quiet Revolution" on pages 22-26. venturaapdr.partica.online/apdr/apdr-may-2018/features/underwater-unmanned-vehicles-the-quiet-revolution (https://venturaapdr.partica.online/apdr/apdr-may-2018/features/underwater-unmanned-vehicles-the-quiet-revolution)

The clear advantage of unmanned systems is that the mother ship can safely stand off outside the minefield and deploy USVs and ROVs/UUVs into the minefield, thus providing increased safety for the ship and its crew. Of course, this assumes that the location of the minefield is actually known.

The challenge to keep the human out of the minefield while searching, classifying and in some cases identifying sea mines has largely been answered by the use of unmanned systems.

The acquisition of two Steber glass fibre USVs to be delivered in stages during 2018-19 will mean a major advance for finding and classifying mines but does not solve the clearance problem.

That question of what to do with sea mines that have to be removed or destroyed, is a whole lot harder to answer.

The concept that divers or ROVs can operate at safe distances from outside a minefield in small boats is inherently flawed. Small boats are notoriously unreliable, subject to weather limitations and have limited seakeeping capability. Momentary inattention to positioning, or GPS denial, risks the boat drifting into the minefield – placing the crew at high risk. Both divers and ROVs require a suitable support vessel that is able to operate safely from within a minefield.

Where ROV mine destruction is planned, real-time control and live sonar/CCTV, implemented using a tether from the mother ship or USV to the ROV, is required for accurate and precise positioning close to the mine to allow deployment of a munition to destroy the mine. Double Eagle is unique in that it is able to actually look at the mine with both a sonar and onboard camera. Once it has worked out that the mine-like object is actually a mine it can then place a charge to destroy/neutralise said mine. Presently the RAN uses the DAMDIC charge. Once the charge has been detonated the Double Eagle can go back and confirm the mine has been neutralised.

Currently, and maybe never, totally autonomous systems will not be able to conduct full mine clearance operations. The reason is that the autonomous system would need to be equipped with some type of munition for mine destruction, and so in itself it would represent a high risk if control were lost. An autonomous system, without man-in-the-loop control, must not happen in the foreseeable future.

SEA 1179 PHASE 1 MINEHUNTER COASTAL SERVICE LIFE EXTENSION AND CAPABILITY PROGRAM

In August 2017 the Commonwealth announced First Pass approval to extend the service life for Navy's Huon Class Minehunter Coastal vessels, with Thales Australia as prime contractor. Government is expected to consider Second Pass for the project in late 2019.

The Head of Navy Capability, Rear Admiral Jonathan Mead, said the project forecast in the Defence White Paper 2016 will ensure Defence is able to provide an effective maritime mine countermeasure capability out to the 2030s.

"Minehunters play a vital role in protecting Australia's ships, harbours and infrastructure from the threat of sea mines," RADM Mead said. "First Pass approval is a major milestone for this project that will see the life of the Minehunters extended to ensure there is no gap in mine warfare capability as we determine the replacement vessels." (APDR notes RADM Mead is referring to the vessels, systems and capabilities delivered by SEA 1778 Phase 1 and SEA 1180 Phase 1 OPVs, combined with technological advancements in autonomous and remote vehicles, which will serve to inform the requirements for the Project SEA 1180 Phase 2 Future Mine Countermeasures and Rapid Environmental Assessment vessel).

According to the RAN:

"Like her sister ships, lead ship Huon is made of fibre reinforced plastic and has a unique single skin solid hull that has no ribs or frames and provides high underwater shock resistance and very low magnetic and noise levels. This hull is designed to flex inwards if an undersea explosion occurs nearby. All machinery/ equipment is mounted on cradles or suspended from bulkheads to further enhance resistance to shock damage and protect ship systems."

For their mine countermeasure operations, the ships are fitted with a Thales Type 2093M variable depth sonar capable of detection ranges in excess of 1,000 metres ahead of the ship. When a mine is detected in a water column or on the seabed, the ship will 'hover' about 300 metres from the contact. Each Huon Class vessel carries two Saab Double Eagle mine disposal vehicles that will then be sent to investigate and neutralise the mine threat. In some situations, clearance divers will be sent.

The Huon Class MHC is built with consideration given to acoustic and magnetic signatures to reduce the likelihood of detonating the very mines it is trying to destroy. It provides maximum safety to the crew by being able to withstand a calculated level of underwater explosion. These requirements will always drive the cost up. However, safety of the crew should not be compromised by cost. In the bureaucracy of Defence, who will bear the responsibility for a decision to save money and expose crews to danger in an 11m fibreglass boat in a minefield?

INDUSTRY SUPPORT

Mike Yeo's APDR article referred to earlier gives details from several international companies on their unmanned surface and underwater vehicles. Support for these must be delivered locally to ensure vehicle capabilities are maintained and upgraded where appropriate.

Former RAN Mine Warfare Officer James Lawless of Saab Australia told APDR that:

"Saab is heavily engaged in supporting Thales as part of SEA1179. We are also assisting DSTG with detailed risk reduction activities for future mine warfare capabilities. Specifically, we have proposed

a complete and integrated Internal/External Communications suite built using our IP based tactical system and also some obsolescence management/enhancements to the Double Eagle. This includes exploring future evolutions of the system such as providing the ability to render safe multiple mines using one vehicle.

“Double Eagle is a one of kind system and is in operation with over nine declared Navies worldwide and will be supported to 2040 and beyond. Australia, in particular, has a very unique operating environment with currents up to 7 knots and a multitude of different coastlines and bottom types. Double Eagle is perfectly suited to operate in these conditions.”

Boeing’s Liquid Robotics Wave Glider AUV has been provided to the RAN for testing this long endurance sensor platform which can be operated at great distances.

APDR has studied the capabilities of the BlueZone Group that provides specialised support for ADF autonomous and remotely operated maritime vehicles including Saab Double Eagle ROV, Seabotix ROV, Hydroid REMUS AUV, Teledyne Oceanscience Z-Boat USV and Liquid Robotics Wave Glider AUV.

BlueZone offers a wide underwater technology product portfolio representing leading underwater equipment product manufacturers.

One of their executives told APDR: “We service what we sell and our workshops in Newcastle, Melbourne and Perth provide local service and support to the ADF for our full product range. Our application engineering team provides design, product development and integration of products for new and existing underwater and maritime systems.”

Steber is also a key partner with Ocius Technology in the innovative Bluebottle Program. The Bluebottle AUV runs on the surface fuelled by solar, wind and wave energy and can remain at sea for months at a time. One role could be to watch choke points and harbour entrances for signs of minelaying.

CONCLUSIONS

The Mine Hunter Coastal upgrade project and the deployable Mine Countermeasure Capability (SEA1778 Phase 1) are being managed under a broader mine warfare program, however the two projects each have a distinct scope and purpose. Defence continues to work with Defence Science and Technology Group, industry and international partners to design a balanced mine warfare capability in order to develop the necessary capability and technology initiatives required in the early 2030s. Both projects contribute to this goal.

With regard to deployable mine countermeasures, RADM Mead said the prevalence and increasing sophistication of sea mines means the RAN must continue to improve the way it finds and disposes of these mines. “New autonomous and remotecontrolled technologies deployed from within the maritime task force provides the opportunity to find and dispose of sea mines more safely and efficiently.”

One expert consulted by APDR cautioned, “1778 is proposing a solution where a boat will carry crew to launch a one-shot system – this is the point that must be challenged. Sending crew into a minefield in a small boat to launch an ROV like the Seafox one-shot mine disposal system to destroy mines is madness!”

Autonomous Warrior 2018, being held at Jervis Bay 5th to 23rd November, will see domestic and

international organisations testing minefield countermeasures using a variety of unmanned surface and underwater vehicles. APDR will be presenting a preview of this major exercise in a future edition.

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