# APDR

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# REPLACING THE **COLLINS CLASS**

**AUSTRALIAN**
SOVEREIGN GUIDED WEAPONS CAPABILITY

**ARAFURA CLASS**
OFFSHORE PATROL VESSELS PROGRESS REPORT

**SEA 5000**
AND AUSTRALIAN SPECIFIC CHANGES

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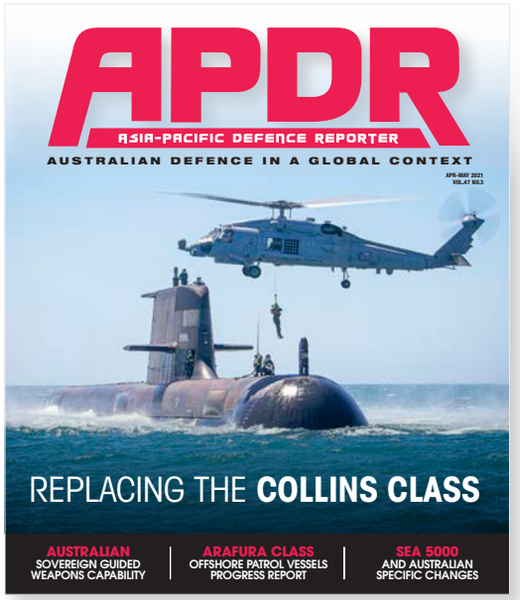


HMAS Rankin and her crew conducted workups and training assessments in the Western Australian Exercise Area to ensure the Collins Class Submarine is ready to safely deploy later in the year. Part of her assessment is helicopter transfers which ensures the crew are able to winch personnel on or off in the case of an emergency. Credit: CoA / Richard Cordell

## REGULARS



## NEWS



## FEATURES



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# CHALLENGES FACING NEW DEFENCE MINISTER PETER DUTTON

**KYM BERGMANN // CANBERRA**

One of the benefits of appointing Peter Dutton to the position – something that has been predicted for ages – is that he has been a member of the National Security Committee of Cabinet for the past six years. He therefore should be well aware of our deteriorating strategic circumstances, which have one major cause – the increasingly threatening conduct of China, coupled with Beijing's massive arms buildup during the past decade. At least the US can once again be considered a reliable ally with President Biden at the wheel – but if another Trump-like figure is elected in 2024 we risk being left on our own.

As Peter Jennings, the head of the Australian Strategic Policy Institute, has said the most obvious current flashpoint is Taiwan. Australia has no direct security connection with the island – but the US does and undoubtedly would expect Australian support in the event of armed conflict. While deploying ground forces to the area seems unlikely, in the event of a looming invasion both the RAAF and the RAN will need to be ready to deploy alongside US and possibly Japanese forces.

The message from Australia to China needs to be this: rather than continually threatening to invade Taiwan, why don't you concentrate on making your own country so attractive that neighbouring states will be clamouring to join it? The Chinese claim to the island is flimsy at best – and without recounting centuries of history, suffice to say that Beijing handed it over to Japan in 1895 at the end of the first Sino-Japanese War with the signing of the treaty of Shimonoseki. Since that time, it has never been part of China – though paradoxically as a consequence of the retreat of nationalist forces there at the end of the ghastly civil war in 1949, many Taiwanese politicians maintained for decades that they were the rightful rulers of the mainland.

Short of a declaration of Taiwanese independence – which most agree is a step too far – China should respect the status quo and accept the reality that the island has a complex history and separate identity. The very best thing that Beijing could do is encourage more cross-straits investment and tourism rather than invade Taiwanese airspace on a daily basis with nuclear capable bombers. As Prime Minister Scott Morrison has indicated in a number of speeches, without directly mentioning Taiwan, Australia has a moral duty to protect and defend fellow liberal democracies in the face of aggression from an amoral, heavily armed, bullying neighbour.

Minister Dutton finds Defence in good shape from a financial perspective with money available for new capabilities, but even that might not be sufficient given the rate of China's expansion. In the event that he will take his cues from APDR, we set out these urgent priorities:

First - implement a crash program to develop at least four New Generation Collins class submarines equipped with lithium ion batteries. By all means proceed with France's Naval Group for a longer-term option – though preferably with nuclear propulsion. Ignore the bleatings of the RAN that neither can be done. Speak officially with Saab-Kockums about continuing the work on a new submarine that was abruptly and outrageously stopped by Defence in 2014 for no good reason. Try and get these in the water before the end of the decade. Speak with the Netherlands navy about their submarine procurement plans. Bring forward the life of type extension of the Collins class from 2026 to next week.

Second – churn out more Arafura class OPVs and dramatically increase their armament. As good as the Hunter class will be, they are a decade away. Get more hulls in the water – fast. Discuss with Civmec if they can increase the rate of production in Western Australia; ask BAE Systems if they have the resources to resume a two yard build. Equip them with canisterised missiles for self defence and surface strike. Commit to at least 18 of them and lift RAN numbers from 15,000 personnel to 20,000.

Third - the RAAF is in good shape, though the time is now to commit to the extra three squadrons of F-35s that has been on the books for almost 20 years. Do not use them to replace Super Hornets and Growlers – use them to supplement those aircraft. The 'Loyal Wingman' autonomous combat aircraft project seems well funded but keep pushing that – along with sovereign guided weapons. Contract for at least another three Triton surveillance drones and increase the number of armed MQ-9Bs from 12 to at least 24.

Fourth - Army has pulled off one of the most extraordinary achievements in the history of Australian defence procurement by stealthily managing to scrap a perfectly good fleet of Tiger armed reconnaissance helicopters and buy AH-64E Apaches instead for an extra $4 billion. Review the decision – and at the very least keep the Tigers and add the Apache fleet to the existing force, generating a major increase in Army firepower. Look at buying more long-range rocket artillery systems than planned.

Fifth - Progress is being made in developing a sovereign satellite capability – but direct Defence in no uncertain terms that Australia needs to have its own communications and earth observation satellites in orbit within five years. All of the local experts say that it can be done – it just needs the political will to make it happen. Nations such as Israel and South Korea developed their satellite sector very rapidly for reasons of national security. Ask for their cooperation, if necessary.

Sixth - Put more effort into regional alliances – and make the signing of a detailed security pact with Indonesia a high priority. Set yourself the goal of having all of these things in train by the end of 2021. After that have a rest.

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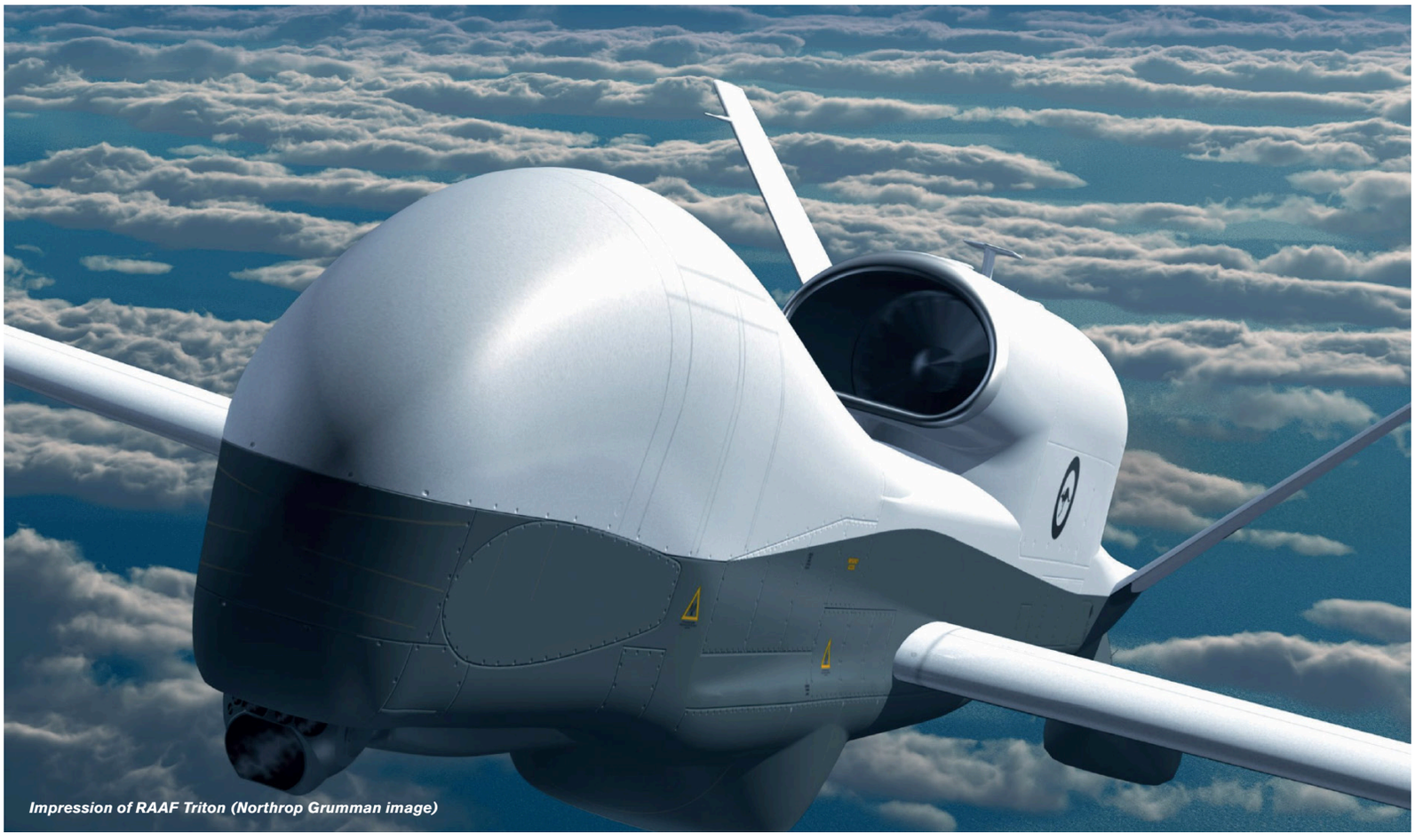

*Impression of RAAF Triton (Northrop Grumman image)*

## AME SYSTEMS ACHIEVES MQ-4C TRITON CERTIFICATION FROM NORTHROP GRUMMAN

**CANBERRA – 6 April 2021**

AME Systems, headquartered in Ararat, achieved the stringent certification to produce wire harnesses for the MQ-4C Triton system.

AME Systems (Vic) is now a key Northrop Grumman supplier of cabling and wiring harnesses associated with the MQ-4C Triton program for the Royal Australian Air Force.

"AME Systems is extremely proud to be partnering with Northrop Grumman," said AME Systems managing director, Mr. Nick Carthew.

With the U.S. Navy's planned program of record for 68 operational Tritons and the Royal Australian Air Force's planned acquisition of six to seven Tritons, the opportunities for AME Systems are significant.

AME Systems' enhancement of production capabilities has been further strengthened by being awarded Northrop Grumman's harness manufacturing certification. AME Systems is now one of only three companies globally certified to this level of manufacturing, positioning AME Systems to potentially supply a new level of technology to Northrop Grumman and the broader Australian defence industry.

"Growth of Australian industry content within our programs is one of Northrop Grumman's top priorities," said Chris Deeble, chief executive, Northrop Grumman Australia. "AME joins a growing number of Australian companies supplying components for the Triton system and we look forward to delivering the first Australian Triton, built with Australian-made components, in 2023."

AME Systems received certification to begin manufacturing wire harnesses for Tritons in January and delivered the first batch in February. The harnesses will be used in the production of both Royal Australian Air Force and U.S. Navy Tritons.

## SAFRAN AND THE UNIVERSITY OF ADELAIDE COLLABORATE TO ENHANCE SOVEREIGN MARITIME CAPABILITY

**26 March 2021**

Safran Electronics & Defense Australasia (SEDA) will make its largest investment in Australian research to date, after being awarded a grant in the latest round of the Australian Research Council's prestigious Linkage Program.

The $1.8M multi-year collaboration between SEDA and the University of Adelaide (UoA) is enabled by $643,565 in matched funding via the Linkage Program.

Entitled Collaborative Sensing and Learning for Maritime Situational Awareness, the project aims to demonstrate coordinated autonomous sensing of naval assets in dynamic maritime environments. Artificial Intelligence based technology will reduce the operational load required to deliver high quality maritime situational awareness to help underpin stability in our region.

With the goal of retaining its leadership position at the cutting-edge of maritime technology, Safran will take advantage of novel and emergent artificial intelligence technologies developed collaboratively with UoA.

"Safran considers collaboration in early stage research a key pillar of our business and it brings us a competitive advantage. Through this project, we will advance Australian sovereign capability by developing maritime intelligence gathering technology for the Royal Australian Navy. " said Alexis de Pelleport, Safran Pacific CEO.

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Image of RAN ship © Australian Department of Defence.

## AUSTRALIAN DEFENCE INDUSTRY GROWS WITH NEXT GEN COMBAT MANAGEMENT SYSTEM EXPANSION

**22 March 2021**

The expansion of Defence's 'next generation' combat management system has created more than 100 local jobs and is creating new opportunities for Australian businesses.

Minister for Defence Industry Melissa Price said the expanded combat management system will now include Maritime Mine Counter Measures and Military Survey Vessels.

Minister Price said it would drive the next phase of growth and investment by Saab Australia, the nation's sovereign Combat Management System provider.

"This project will create Australian jobs for engineers and project managers, developing further capability within the industrial supply chain and supporting a major, multi-million dollar expansion of Saab's South Australian and West Australian facilities," Minister Price said.

"Saab's investment and recruitment since signing their Enterprise Partnering Agreement with Defence in February 2020 is clear evidence that the Morrison Government's Naval Shipbuilding Plan is creating jobs and delivering sovereign capability.

"In the first 12 months of the EPA, Saab has been awarded almost $20 million and welcomed 108 new staff across Australia."

Saab Australia is a key partner in the delivery of Australia's sovereign shipbuilding capability, with almost 600 highly skilled engineers, project managers and specialists delivering defence and security solutions.

Today's announcement means Saab's CMS will be equipped on six of the RAN's classes of vessels: Anzac, Canberra, Supply, Arafura, Mine Countermeasures and Military Survey Vessels.

"This is another major milestone for the Morrison Government's investment in a National Naval Shipbuilding Enterprise, where $75 billion will be spent on maritime capabilities over the next decade," Minister Price said.

***HMAS Arunta fires an Evolved Sea Sparrow Missile off the coast of Western Australia to test its missile systems after undergoing the Anzac Midlife Capability Assurance Program upgrade. Credit: (CoA / Ronnie Baltoft)***

***ViDAR pod (Sentient Vision Systems photo)***

## SENTIENT VISION SYSTEMS – MEDIA RELEASE

**MELBOURNE - 30 March 2021**

Australian search and surveillance specialist Sentient Vision Systems has announced the first flight of its ViDAR pod system, the VMS-5 (ViDAR Maritime Surveillance) Day/Night Optical Radar pod. The VMS-5 Day/Night pod is the first of a range of ViDAR surveillance pods configured for different missions and aircraft types. VMS pods will be available for customer delivery during the first half of 2021.

ViDAR (which stands for Visual Detection and Ranging) is an Optical Radar that can autonomously detect small objects on the sea surface over very wide areas, by day and night, in conditions up to Sea State 6. ViDAR has proven its capability as both a Search and Rescue (SAR) and a maritime search and surveillance tool, with demand for support of a wide range of missions growing globally, including drug interdiction, anti-piracy and illegal fishing detection.

Since 2016, Sentient has supplied ViDAR as a software-based solution to operators who've integrated it successfully aboard many manned and unmanned, fixed-wing and rotary wing platforms. Responding to market and partner demand the company is now stepping up to also become an Original Equipment Manufacturer (OEM) offering ViDAR as a complete solution, including sensors and processors, for operators around the world.

"ViDAR offers customers much better wide-area situational awareness at a lower cost than anything else available," said Dr Paul Boxer, Sentient Managing Director. "This is especially the case in Search and Rescue (SAR) operations."

"By building our own integrated ViDAR pods we're able to offer customers an enhanced surveillance capability backed up by dedicated support. Importantly, we control the quality and reliability of the ViDAR installation to deliver a more consistent, well-engineered, end-to- end integration and training process."

"And in many cases these new ViDAR systems will be more cost effective than a bespoke ViDAR

installation or a one-off installation," Dr Boxer added.

The ViDAR VMS-5 pod is equipped with multiple fixed, high-resolution cameras with a combined Field of View (FoV) of 180 degrees. From an altitude of 1500ft at a speed of about 90kt, they scan a surface swath 3.2 nautical miles wide to find targets as small as a person in the water. If the mission objective is to find a suspicious boat with a low radar cross-section then the ViDAR swath can easily be increased to over 25nm from 5,000ft.

If the target is within its field of view, ViDAR will spot it, even in Sea State 6 – increasing probability of detection to over 96% on first pass. The ViDAR software provides a thumbnail to the operator's mission system showing the target and its location, enabling the operator to slew the platform's primary sensor onto it for further inspection. The pods will be offered initially with two sensor types: a 60 Megapixel Electro-Optic (E/O) installation and a HD Infrared (IR) sensor for night and bad weather operations. Depending on the application these can also be equipped with a camera turret.

"One size definitely does not fit all," said Dr Boxer. "Which is why we're developing a range of ViDAR pods and installations for different missions depending on the speed and altitude of the aircraft and whether operations call for day-only or day-night capability. We're also very aware of the budget pressure that COVID-19, for example, has put on many customers."

"A new generation of higher-definition sensors and enhanced processors becomes available roughly every 18 months, so the ViDAR pods are designed to accommodate new payloads with minimal re-design," he added.

The initial VMS-5 pod design is being flight tested and demonstrated on a Cessna 172, with pod designs being developed for larger, faster aircraft such as the Viking Twin Otter, King Air 300, Boeing 737 based maritime patrol aircraft, helicopters such as the AS365, AW139, AW189, AW101 and a range of medium-altitude long endurance (MALE) UAVs.

The company is developing both a Universal Mount for light aircraft applications and NATO-standard mountings compatible with the external stores pylons of military aircraft and large UAVs. The company already provides Mission Planning Tools as part of its ViDAR offering, and the pod can also be integrated with the aircraft's own mission management system.

**A new generation of higher-definition sensors and enhanced processors becomes available roughly every 18 months, so the ViDAR pods are designed to accommodate new payloads with minimal re-design.**

As part of its customer service commitment Sentient Vision Systems' Field Integration and Training team will continue to help customers with ViDAR pod integration and operator training.

The release of this first ViDAR pod follows some two years of self-funded R&D by Sentient Vision Systems. The company continues to work with a number of specialist pod manufacturers on a range of projects. "Different pod designs suit different missions and aircraft installations, so we're deliberately offering customer flexibility," said Dr Boxer.

## IMPROVING CAPABILITY AND COMPETITIVENESS IN DEFENCE INDUSTRY

**8 April 2021**

Ten local businesses have been selected to participate in Raytheon Australia's recently launched industry engagement program designed to help small businesses win defence work at home and abroad.

Minister for Defence Industry Melissa Price welcomed the Raytheon initiative, which offers the selected businesses an invaluable opportunity to partner with Raytheon Australia to grow their businesses and support delivery of capability for our Defence Force.

"Raytheon's Capability Plus program will support local businesses to improve their competitiveness to win defence work here and overseas," Minister Price said.

"It will support their long-term sustainability and our goal of building supply chain resilience and self-reliance.

"The Morrison Government remains committed to ensuring Australian industry benefits from its commitment to invest $270 billion in Defence capability over the next decade.

"Initiatives such as Raytheon's Capability Plus will help Australian industry realise these benefits."

Minister Price congratulated the Australian businesses selected for the inaugural Capability Plus program:

- AOS Group (Melbourne, Australia)
- archTIS (Canberra, Australia)
- Calytrix (Perth, Australia)
- Coherics (Adelaide, Australia)
- Daronmont (Adelaide, Australia)
- JEDS (Sydney, Australia)
- Plexsys (Williamtown, Australia)
- Redarc (Adelaide, Australia)
- Silentium (Adelaide, Australia)
- Willyama (Canberra, Australia)

Programs like Capability Plus are a great example of how large defence contractors can provide pathways for smaller Australian businesses to improve capability and competitiveness through opening opportunities, mentoring and training.

The tailored program will support the local enterprises in leadership, engineering, project management, cyber security and quality and ISO certification.

It will also create pathways for local businesses to access Raytheon Technologies' global supply chain.

## HUNTER CLASS FRIGATE BLAST TRIALS

**6 April 2021**

An Australian business that provided an autonomous robotic abrasive blast solution for the Sydney Harbour Bridge has been engaged by BAE Systems Maritime Australia to showcase its innovative technology for the Hunter Class Frigate Program.

Recent robotic blast trials at Sydney based Burwell Technologies' aim to understand, explore and evaluate the operation, capability, opportunities, and limitations of the equipment in a confined space shipbuilding environment, and will inform technology planning in the Hunter program's prototyping phase with the fundamental aim to improve efficiency and worker safety in the shipyard.

Blast trials took place in one of four large modules that BAE Systems Maritime Australia had constructed to support the Hunter program's prototyping phase. The six-metre modules resemble ship blocks, and have similar features including bulkhead doors, manholes, hatches, passageways and confined spaces.

The prototyping phase aims to establish and test the systems, processes, facilities and workforce competencies, providing a solid operational foundation before construction starts on the first frigate next year.

Burwell Technologies' collaboration with BAE Systems Maritime Australia is the first time the Sydney-based business has worked with an Australian defence company.

BAE Systems Maritime Australia Global Combat Ship Manufacturing Director, Alastair Bacon:

"We are delivering digital shipbuilding in a way that has never before been done in this country – in particular we are seeking to apply a number of technologies from adjacent sectors such as robotics and industry 4.0.

"We know that technology and manufacturing capability will evolve across the three batches of Hunter class frigates, and it's vital that we continue to look at new ways of working and advanced and innovative manufacturing methods, which will improve productivity, quality and safety outcomes at the state-of-the-art shipyard at Osborne."

Chief Operating Officer Burwell Technologies, and CEO Sabre Autonomous Solutions, Damian Williams:

"Through our investment in Sabre Autonomous Solutions and its robotic blast technology, we are striving to ensure that we remain on the forefront of industry technological advancements.

"This technology ensures, first and foremost, that humans no longer have to carry out blasting within confined spaces, such as those commonly found on ships.

"We are extremely excited at the prospect of working with BAE Systems Maritime Australia and utilising our technology on the Hunter Class Frigate Program, with our goal to deploy robotic blast technology into Australian Defence programs and beyond."

*BAE Systems blast trials (BAE Systems photo)*

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# RAYTHEON AUSTRALIA OPENS CENTRE FOR JOINT INTEGRATION TO BOOST MISSILE CAPABILITIES

Three things occurred on March 31 of significance for the development of Australia's sovereign missile manufacturing capability. The first was the opening of Raytheon's Joint Integration Centre at Mawson Lakes in Adelaide that will support the company's activities for LAND 19 Phase 7B in particular. The second was the signing of a support contract for that project between Defence and Raytheon worth $111 million. The third was the announcement by the Prime Minister of a $1 billion fund to accelerate the development of a sovereign guided weapons capability.

The Joint Integration Facility is a 6,500 square metre building that will encompass workspaces, laboratories and light manufacturing under one roof, initially to produce missile-equipped vehicles for Army's signature ground-based air defence program. Worth an estimated $1.5 billion, this will see vehicles such as the Thales Hawkei equipped with radars from CAE and missiles in the form of AIM-120 AMRAAMs. It is understood that Raytheon are investing around $50 million in developing one of the world's most advanced and largest such technology centres.

After a euphoric introduction from the Head of Public Affairs Gerry Wheeler, the Managing Director of Raytheon Australia, Michael Ward said:

"Raytheon Australia has heavily invested in this new precinct in response to the Australian Defence Force's increased focus on joint integrated capabilities. The facility has been designed to help defence meet its needs of today as well as its greater challenges of tomorrow.

"In this facility, we will work with defence and industry in sophisticated systems integration laboratories, as well as experimentation areas and training rooms. These spaces will ensure we can work with our

## BAE SYSTEMS AUSTRALIA INVESTS IN HYPERSONIC WEAPONS CAPABILITIES

**30 March 2021**

BAE Systems Australia announced today that it will increase its investment in Australia to support the rapid development of a sovereign high speed weapons capability.

The company will also draw on the wide-ranging capabilities and expertise across Australian industry and academia to build an Australian high speed weapons eco-system with the aim of demonstrating a sovereign capability over the next four years.

The company's "Project Javelin" builds on more than three decades of world leading research by BAE Systems in the design and development of Australian weapons, autonomous and hypersonic technologies including the Evolved Sea Sparrow Missile, Nulka and the Advanced Short Range Air to Air Missile (ASRAAM).

BAE Systems has invested more than $11 million in hypersonics and high speed weapon research in Australia in the past decade in collaborative programs with Defence, industry and academia.

Recognising the Australian Defence Force's requirement for this disruptive technology-based capability, the company will spend $5 million fast tracking technology development in 2021 with additional investments planned for the next four years.

"Project Javelin" complements the company's existing industrial capabilities in advanced manufacturing and prototyping, battlespace management systems and flight vehicle platform technologies.

The development of a sovereign high speed weapons capability will create new opportunities for Australian industry and academia, through the investment of new and complementary design, development and manufacturing capabilities and could lead to potential defence exports.

BAE Systems has been assembling weapons in Australia for the ADF and for export to the US and Canada for more than two decades.

As well as hypersonics weapons technologies and capabilities, BAE Systems is developing technologies to support the nation's defence against high speed weapons.

Today's announcement follows the Australian Government's commitment to the development of long-range strike capabilities at the end of last year. The 2020 Force Structure Plan includes an investment of around $30 billion for both high speed strike and defence capabilities, including hypersonics development, test and evaluation.

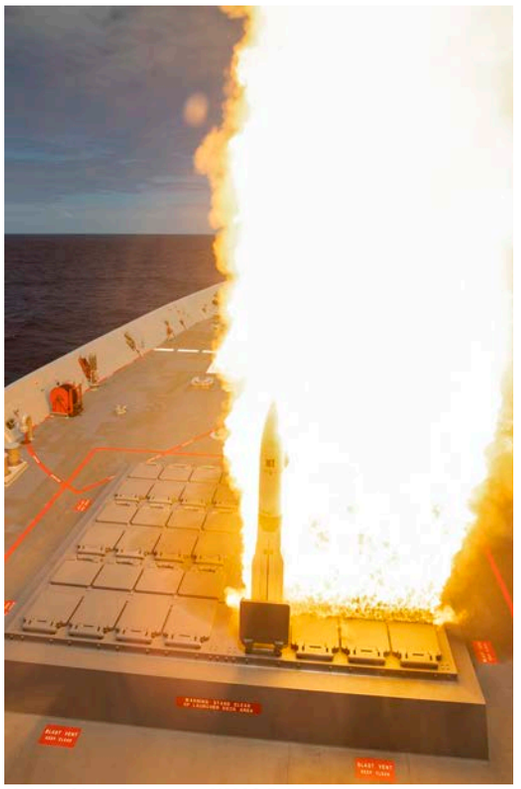
BAE Systems Australia Chief Technology Officer Brad Yelland said:

"That Australia has a solid foundation of research built over decades means that the rapid integration of newly developed weapons into the force structure is achievable.

"BAE Systems has a rich history of working closely with defence companies and defence customers around the world, particularly US Primes on weapons programs.

"Australia's future investment in high-speed weapons systems, including hypersonic long-range strike and hypersonic and ballistic missile defence, provides the opportunity for the nation to create an enduring sovereign capability and position the country as a major global contributor in this disruptive technology field.

"It's so important that the Intellectual Property of new weapons technologies resides with Australia so that as well as developing a sovereign capability, we can continue our work with Defence, academia and industry to evolve these technologies over time."



*Hobart Class Destroyer, HMAS Brisbane, conducts a Raytheon SM-2 standard missile live firing during Officer of the Watch manoeuvres off the coast of New South Wales. Credit: CoA / Thomas Sawtell*

customers and partners to deliver fully integrated sovereign capabilities and also train the workforce of the future."

"This precinct will be home to Australia's premier integrated air and missile defence capability."

The LAND 19 Phase 7B solution is based on the NASAMS concept (National / Norwegian Advanced Surface to Air Missile System) and it is the most prolific missile-based air defence system in the western world with users ranging from the US to Indonesia. The first version was fielded in Norway – hence the dual meaning of the N in the title – and was jointly developed by Raytheon and Kongsberg. Raytheon Australia, partnered with Kongsberg, was selected in April 2017 as the winner of the local competition.

The genesis of the system was a Norwegian requirement for an airfield defence capability – and analysis showed that rather than use a dedicated ground-to-air missile, a better option was to develop a land-based solution using an existing air-to-air weapon, with the AIM-120 the logical choice. The Advanced Medium-Range Air-to-Air Missile (AMRAAM) is a high performance beyond visual range weapon manufactured by Raytheon and regarded as the best in its class.

It is one of the most prolific and successful air-to-air missiles in the world with around 40 users – including the RAAF, so it is already in the Australian inventory. The ground-launched version obviously burns fuel to reach the speed and altitude of one carried on a combat aircraft – but nevertheless it develops enough kinetic energy to be able to engage hostile aerial targets in a large envelope. The AIM-120 is being continuously improved and an extended range version has been developed with NASAMS users in mind.

The system is sensor-agnostic and for Australia will use CAE phased array radars – the ground-based version of the highly successful naval product first employed on upgraded ANZAC frigates. They will supply detection, tracking and targeting information to the mobile missile batteries, which form a distributed and networked system. Once a missile is launched, its course can be corrected during flight and as it nears the target it switches on its own homing radar for the terminal part of the engagement.

During the keynote speech opening the facility, Prime Minister Scott Morrison painted a somewhat gloomy picture of Australia's strategic circumstances – without once needing to mention China. He spoke of shared values with other liberal democracies such as the US and the willingness of Australia to defend them – taking the lead if necessary. This was the background to announcing the acceleration of the development of a sovereign guided weapons capability. In the associated media release, he said:

"Creating our own sovereign capability on Australian soil is essential to keep Australians safe, while also providing thousands of local jobs in businesses right across the defence supply chain.

"As the COVID-19 pandemic has shown, having the ability for self-reliance, be it vaccine development or the defence of Australia, is vital to meeting our own requirements in a changing global environment.

"It's an imperative we now proceed with the creation of a sovereign guided weapons capability as a priority, accelerating this process following the idea first being explored in the Force Structure Plan."

The quick background is that Australia depends almost completely on overseas suppliers for guided weapons – be they air-to-air missiles, torpedoes or previous generation anti-tank weapons. While this might have been acceptable for limited conflicts, being so beholden to imported solutions is a major strategic vulnerability that the government is now keen to address. Put simply, in a major conflict under existing conditions once our relatively small stockpile of weapons is used, that's it. We won't be receiving any more from the US, at least not in the short term, which would focus on its own needs – or from Europe because it is too far away.

Raytheon Australia would like to become the preferred strategic partner in this endeavour – and as one of the world's largest producers of missiles clearly has a strong case, especially with the opening of the Adelaide centre. However, the Department of Defence is now conducting an evaluation of the field and other companies that have been mentioned as candidates include Lockheed Martin, BAE Systems and – somewhat surprisingly because of their small

## VRA WELCOMES SOVEREIGN GUIDED WEAPONS MANUFACTURING ANNOUNCEMENT

**8 April 2021**

Jacob Blitman, CEO of Varley Rafael Australia Pty Ltd (VRA) has welcomed the 31 MAR 21 Morrison Government's announcement to "accelerate the creation of a $1 billion Sovereign Guided Weapons Enterprise".

VRA, a joint venture between the 135 years old, wholly Australian owned Varley Group and RAFAEL Advanced Defense Systems Ltd will deliver the SPIKE Guided Weapon system selected by Army as its Long Range Direct Fire Support Weapon capability (LR2) and is included in both the LAND400 Phase 2 and Phase 3 programs.

The Spike LR2 is a 5th generation weapon system, already selected by some 6 nations, with an extensive Transfer of Technology (ToT) program enabling Australian industry to move into domestic guided missile production and comprehensive in service support.

VRA has been engaging with relevant Australian defence manufacturing companies, reviewing the existing in-country capabilities and progressing detailed path to deliver sovereign capabilities.

The ToT approach will utilise proven RAFAEL processes and extensive experience in establishing local production and support capabilities to deliver Sovereign Guided Weapons Manufacturing capability, high technology local content jobs and high end upskilling of Australian personnel.

VRA looks forward to continuing to work with the Commonwealth and Australian industry in moving forward with the SPIKE capability and delivering sovereign battlefield advantage to the ADF.

*HMAS Stuart conducts a live Harpoon Missile firing off the coast of Hawaii during Exercise Rim of the Pacific 2020. Credit: CoA / Christopher Szumlanski*

size – Kongsberg. The Department will use the Smart Buyer mechanism to make a quick selection of the preferred partner.

There is no technical reason why Australia cannot make guided weapons – this has not happened in the past because of a combination of lack of political will and bureaucratic timidity. Nations with much smaller economies than Australia have developed numerous highly capable weapons – including Israel, Taiwan, Norway and Sweden. South Korea – with a GDP identical to ours – is an emerging guided weapons powerhouse and is enthusiastically looking for opportunities to cooperate with Australia.

Several companies in Australia already have guided weapons expertise – though mainly at subsystem level. Thales makes rocket motors and warheads; BAE Systems produces the Nulka rocket powered naval active decoy system – and also the seeker for the Kongsberg Joint Strike Missile. For ground-based applications, Israel's Rafael has combined with Varley to manufacture anti-tank guided weapons and potentially other systems including anti-torpedo weapons. Nioa is another relative newcomer to the weapons and munitions sector that also has a number of relevant skills.

It would seem unrealistic for Australia to be able to do everything at once – even with $1 billion of available funding. However, it will be able to come up with a prioritised list and given our strategic circumstances a good place to start would be a long-range anti-ship missile able to be fired from aircraft, ships, submarines and from mobile surface launchers. Another area worth a look would be lightweight anti-submarine torpedoes building on the experience gained on the unfairly much maligned MU90 from Eurotorp.

A problem with US missiles is that the sector is heavily protected by both the Pentagon and the State Department with overseas production a virtual impossibility from a legal point of view. However, at the ceremony in Adelaide one of the speakers made an intriguing reference to the role of former Defence Minister Linda Reynolds and the discussions she had been conducting with Washington about an Australian sovereign guided weapons capability. If some sort of deal has already been struck about transfer of technology and intellectual property to enhance Australia's strategic self-reliance that could be good news for Raytheon because of its prominent position in the design and manufacture of air-to-air and naval air defence missiles in particular.

Not only would a local guided weapon producer contribute greatly to Australia's security, it would also be huge business. Sources vary in their estimates but the ADF will probably spend around $40 billion during the next 20 years on a variety of missiles, torpedoes and other high technology expendables that will be essential during any future conflict. As new Defence Minister Peter Dutton put it:

"The manufacturing and supply of weapons in Australia will not only benefit and enhance our ADF operational capacity but will ensure we have adequate supply of weapon stock holdings to sustain combat operations if global supply chains are disrupted."

Better late than never.

*(Disclaimer: Kym Bergmann travelled to Adelaide as a guest of Raytheon Australia and would like to thank both Gerry Wheeler and Ann-Maree Andritsakis for making the visit possible)*

## GUIDED WEAPONS MANUFACTURING TO BOOST JOBS AND AUSTRALIAN SUPPLIERS

**31 March 2021**

Thales Australia welcomes the announcement by the Prime Minister today of an acceleration in Australia's development of sovereign guided weapons manufacturing capability.

The Government's commitment to advanced guided weapons manufacture in Australia is strategically important and will also generate jobs, particularly in regional Australia.

Thales Australia CEO Chris Jenkins said the Australian manufacture of guided weapons was a key element of Australian self-reliance in long range strike and deterrent capability. It would also drive the development of local supply chains linking advanced manufacturing capabilities, research agencies and high tech SMEs.

"Thales Australia provides core industrial capabilities for guided weapons production including manufacture of high performance propellants and explosives for warheads, solid fuel rocket motor manufacturing and associated R & D and support services," Mr Jenkins said.

"These critical munitions manufacturing capabilities are delivered by Thales Australia and our suppliers through the Commonwealth owned facility at Mulwala. Scaling up production of military-grade rocket propellant, high explosives, solid fuel rocket motors and boosters from Mulwala will be essential to achieve the ADF's goal.

"The significant capital investment made by the Commonwealth in the Mulwala facility over the past decade, combined with Thales Australia's multi-million dollar investment in R&D on advanced propellants means the facility can respond quickly to the accelerated plan outlined by the Prime Minister today.

"An expansion of the production capabilities at Mulwala is already underway with the acquisition of new production technology.

"We have well established relationships with international partners and an extensive local supply chain of more than 1300 Australian companies that will enable the expansion of these key industrial capabilities with additional investment. It will generate jobs in regional NSW and Victoria in addition to the more than 600 employees of Thales Australia across the Mulwala and Benalla munitions manufacturing sites."

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KYM BERGMANN // CANBERRA

# AUSTRALIAN CONTENT FOR THE ATTACK CLASS TO REACH 60% - EVENTUALLY

The recent political turmoil affecting Defence – Minister Reynolds taking medical leave; then Marise Payne acting Defence Minister; and finally Peter Dutton taking over the role on March 30 – has made it difficult to receive answers to questions about the critically important future submarine program. Nevertheless, we can report some progress, particularly on the combat system part of the equation, as well as some more definition on Australian content.

Measuring developments on the platform has proven difficult, with prime contractor Naval Group responding to a request for information by a French style forwarding of a few media releases already in the public domain. Let the local peasant media eat cake! To date, Australia has spent about $2 billion on SEA 1000 with little to show for it in any tangible sense because in the early stages of a major project a lot of money goes into planning activities rather than the delivery of hardware.

Of that huge amount of money already spent, probably in excess of 70% has gone to Naval Group. How much they have kept for themselves is unknown, with some of it being passed on to various contractors and suppliers. Nevertheless, it has given the company enormous cash flow and a very healthy profit margin – and it would certainly be interesting to know in detail what they have been doing with all of those Australian dollars.

Alas, it is not to be – even though when companies are doing something worthwhile they are normally eager to communicate with the outside world in general and the media in particular. However, this does not seem to be the French way and particularly not from a company that is 62.5% owned by the French government. The supplied media releases were about: 1) Naval Group agreeing to a total of 60% AIC by value during the construction phase; 2) progress on the Adelaide land-based platform test site; 3) the launch of a jobs package with the intention of boosting Naval Group Australia numbers to 500 by the end of 2021; and 4) an announcement that more than 120 Australian companies had registered for a share of a $900 million industry fund to help them become part of the supply chain for the 50 year construction phase of the project. Yes, it does say that – which is about 20 years longer than even the Department of Defence believes it will take to build the submarines.

*Illustration of an Attack class submarine (Naval Group image)*

Regarding the AIC percentage, the problem is that the 60% total will be measured across all 12 submarines – so we won't really know if Naval Group have succeeded until 2050 – or beyond. Apparently the Department of Defence is aware of the issue and has included interim targets, but won't say what they are. This means, for example, that the first few submarines could have very low levels of Australian stuff and this could increase over time – but who is going to care about it in the 2040s and beyond?

Turning to the combat system, Defence provided a brief update saying:

"Decisions on the designers of major subsystems for the Future Submarine are made when needed to support the schedule for the design of the submarine. Lockheed Martin Australia selected Thales UK Ltd to design the Outboard Flank Array Sonar and announced by the Minister on 3 December 2020. Announcements about the suppliers to design remaining major sonar subsystems will be announced as needed. It will not be necessary to select a towed array for the Attack Class submarine for some years, which offers the opportunity for industry to mature new technologies that may offer performance improvements over existing arrays.

"Weapon launch systems in the Attack Class submarines are being developed cognisant of existing operational requirements, the type of weapons that may be employed over the life of the class, and other considerations including the size of the submarine, the balance of other capability to be incorporated into the submarine, and our understanding of the development of payloads (which extends to the development of uninhabited underwater vehicles)."

As well as Thales being selected for the flank array, we note that Atlas Elektronik via their Australian

subsidiary Sonartech Atlas was selected in February to develop the submarine's conformal bow array at company headquarters in Bremen, Germany.

Turning to the role of Lockheed Martin Australia, Chief Executive Joe North said:

"Lockheed Martin Australia is investing in Australia's sovereign defence capability through growing our workforce as well as investing in research and industry partnerships.

"Nowhere is this investment more prominent than in South Australia. The initial design of the Future Submarine combat system is centred at LMA's premises at Mawson Lakes in Adelaide, where the vast majority of our dedicated 230-strong team, comprising over 90% Australians, is based.

"An independent report by consultancy AlphaBeta recently confirmed Lockheed Martin Australia delivers over $100m of impact to the South Australian economy annually."

Early in 2020, the company established a functional baseline for the combat system, from which detailed design can take place. Other achievements for that year included:

- Advancing major combat system component and subsystem procurements;
- Progressing the overall combat system design, and the design of those combat system components LMA is developing in-house;
- Supporting the broader submarine design, and in particular the design efforts of LMA's tripartite partner, Naval Group.

The Mawson Lakes team started with three people in 2016, giving an indication of how rapid the growth has been. Most are engineers – and as well as experienced people the company is also recruiting graduates directly from universities.

Taking over from the well regarded Mike Oliver, the new Combat System Integrator head John Chandler said:

"With our tripartite partners, Naval Group and the Commonwealth of Australia, we have a once-in-a-generational opportunity to contribute to the delivery of a regionally superior submarine capability for decades to come.

"2020 was a year of substantial progress for Lockheed Martin Australia's Future Submarine Program combat system integration team and we remain on track with our key program delivery milestones. As we head towards the Preliminary Design Review for the Future Submarine combat system scheduled for later in 2021, we are focused on finalising our remaining major procurements, and continuing to progress the combat system design.

"Looking further ahead, we anticipate commencing work on the design of the combat system elements of the support system later this year and preparing for our next core work scope that we anticipate will focus on further combat system development, prototyping and verification.

"Our opportunity is to deliver not just a regionally superior submarine for Australia, but a regionally superior submarine capability. We are working towards establishing a highly capable and sustainable industrial base to support Australian sovereignty in relation to its Future Submarine capability."

**"With our tripartite partners, Naval Group and the Commonwealth of Australia, we have a once-in-a-generational opportunity to contribute to the delivery of a regionally superior submarine capability for decades to come."**

According to various sources, LMA is moving at a brisk clip and to date has awarded 53 separate contracts to Australian companies worth almost $77 million spread across all States. Seven of these have gone to tertiary institutions, including to the Universities of Adelaide, Melbourne, South Australia, Tasmania and Curtin University.

On Australian Industry Content, the combat system is treated separately from the platform. It is unclear whether the combat system, which includes all of the complex sensors such as sonar, periscope, radar, ESM and so on has a similar financial target – which would be difficult to meet because so many electronic components are mass produced overseas - but there are objectives in terms of sovereign capability.

What can be written is that LMA is committed to supporting the Future Submarine Program Strategic Objectives, including to maximise the involvement of Australian industry in all phases of the Future Submarine Program without unduly compromising capability cost, and schedule. To deliver a regionally superior submarine capability, LMA draws on combat system component and subsystem inputs from multiple countries – including most obviously back to the U.S. parent company and presumably via them to the USN.

This commitment to maximise the involvement of Australian industry in all phases of the Future Submarine Program includes:

- Centring Combat System Integration activities in Mawson Lakes.
- Supply chain involvement such as that of Acacia Systems and Thomas Global Systems as local subcontractors to Safran Electronics and Defence Australasia, themselves a local first tier supplier to LMA.
- The award of local Research and Development contracts. In November 2020 LMA announced the award of seven contracts to Australian industry and academic organisations for a combined value of $525,000 to author White Papers on the development of novel and emerging advanced technologies in support of Australia's Future Submarine combat system. That was the third cycle of research and development funded under the Future Submarine CSI program, bringing the total awarded to date to over A$2m across 19 unique Australian industry and research organisations. The Future Submarine CSI Program features an ongoing process to foster the development of Australian combat system technologies. The Program includes a defined approach for the transition of successful R&D outcomes into the evolving Attack Class combat system baseline configurations.

**One of the benefits of Peter Dutton taking over as Defence Minister is that he will be looking at the project with relatively fresh eyes.**

One of the benefits of Peter Dutton taking over as Defence Minister is that he will be looking at the project with relatively fresh eyes. Since he was not connected with the original decision to sole source this massive deal to the French he might be inclined to look at what else Australia can do to bolster national submarine capabilities in the medium term. Purely by coincidence, there are signs that finally people in the system are showing more of an interest in a New Generation Collins class – possibly as a gap filler – than at any time since Saab-Kockums were inexplicably dropped in 2014.

**GEOFF SLOCOMBE** // VICTORIA

# AUTONOMOUS UNDERWATER VEHICLES: ROLES IN FUTURE MARITIME WARFARE?

Since the author attended Autonomous Warfare 2018 at HMAS Cresswell, Jervis Bay, NSW in November 2018 there have been significant developments in the capabilities of unmanned air, land, surface water and sub-surface autonomous (intelligent and not requiring continuous control) vehicles.

APDR has been following these events, especially in the maritime domain, because of controversy over the current Australian plan to build 12 manned submarines, called the Attack Class. With the first one not becoming operational until the early 2030s and the Class likely to remain in service until the 2070s, how might autonomous technology develop to render these submarines too vulnerable to be deployed in maritime warfare?

Harking back to that same November, the 2018 Winter Olympics held in the mountainous region of PyeongChang, South Korea had an opening ceremony which featured over 1200 specially designed drones lighting up the night sky in a never-before-seen swarm that danced and maneuvered in readily recognisable formations.

The possibility, nay probability, that swarms of unmanned explosive vehicles will feature in attacks on naval and land targets, or need to be defended against, must be foremost in the minds of defence strategists and planners.

A large number of small unmanned aerial systems could be stored and transported underwater by extra-large autonomous underwater vehicles (XLUUVs), like Boeing's Orca, until they get within range of their warship targets. On instruction from their mission control submarine or distant small surface vessel these transporting vehicles would then surface and launch their weaponised swarm towards the target aircraft carrier, cruiser, destroyer, large support vessel or land target.

If each XLUUV carried 40 UAS, five vessels could launch an attack with 200 drones on their target and overwhelm the warship's defences. Not all drones would survive and they wouldn't sink the warship, but they can be used to saturate and deplete the ship's defences against incoming missiles to render that vessel vulnerable to follow-on attack from the air.

Drones can also use visual recognition to destroy aircraft on a flight deck, or perhaps fly inside a well or hangar deck and detonate.

XLUUVs capable of these types of missions could be acquired for around $US60 million each, so even a small country could afford to wage limited asymmetric warfare against the sophisticated warships of much larger nations like the United States or China.


***Members of the United States Explosives Ordnance Disposal Mobile Unit Five (EODMU) recover a Remote Environmental Monitoring Unit System (REMUS) Autonomous Undersea Vehicle (AUV) used in shallow water mine countermeasures (MCM) and hydrographic reconnaissance off a Royal Australian Navy (RAN) Steber during a joint USN/RAN exercise held in Cockburn Sound, Western Australia. Credit: CoA / Bradley Darvill***

## AUTONOMOUS UNDERWATER VEHICLES (AUV) POTENTIAL ROLES

Autonomous underwater vehicles can be used in a range of military applications including ISR, mine countermeasures, inspection and identification, oceanography and payload delivery. As already noted in an attack role autonomous XLUUVs like Boeing's Orca could initiate swarm strikes on warships.

Although Navy already operates Remotely Operated Vehicles (Double Eagles) in the Mine Warfare branch, the use of REMUS 100 AUVs is a new and exciting technology for the Hydrographic Branch, which allows the branch to avoid having to put sailors and officers in risky environments to achieve some tasks.

Specifically, when conducting rapid environmental assessments in an amphibious, unknown or tactical environment, there is an option to use an AUV rather than putting humans in harm's way.

These new systems will also be utilised when responding to a humanitarian or disaster relief situation, to enable the faster and more reliable collection and dissemination of data.

Andrew Hazell, General Manager, Defence at BlueZone Group (BZG) told APDR:

"BZG is HII's authorised Australian sales and support partner for REMUS AUVs. We are currently supporting the RAN's 2 REMUS 100 NGR vehicles as part of the SEA1770 program and will be providing Depot level maintenance services prior to September this year. BZG is providing Australian Defence with a sovereign Remote and Autonomous Systems support capability. Such a capability is critical to Australia's current and future un-crewed, remote and autonomous systems programs."

The RAN has at least eight Liquid Robotics Wave Gliders, supplied in 2013 and continuously supported since by BZG subsidiary UVS, which can provide intelligence, surveillance and reconnaissance (ISR) at great distances and an over extended period. Home grown Bluebottle, from Ocius Technology has similar capabilities.

Andrew Hazell advised us:

"BZG is Liquid Robotics' authorised Australian sales and support partner. We are able to supply extra units in addition to our ongoing service and support activities, and indeed have done so as part of our Offboard DCL (detection, classification and localisation) collaboration with Defence, Sonartech Atlas, and Acacia, through our recently awarded Defence Innovation contract."

This Defence Innovation Contract was announced in October 2020 to develop Anti-Submarine Warfare (ASW) capability using Australian-developed sonar and combat data processing systems installed in unmanned surface vehicles.

The project applies automation to a range of ASW operations including deployment of wide area surveillance systems, sonar processing and tactical track management and reporting procedures. The project will deliver automation and autonomy to ADF ASW to a level never before attempted anywhere in the world.

BZG has also provided Tasman DVL (Doppler Velocity Log) units both as a discrete piece of equipment and as part of the AUVs supplied to the SEA1770 program. A DVL is an acoustic sensor that estimates velocity relative to the sea bottom. It is a subsea navigation aid and not an object detection tool like the variations of sonars (multibeam, side scan, synthetic aperture etc).

Ocius Technology's Bluebottle 6.8 metre autonomous surface vessels (ASVs), which are a 100% Australian sovereign capability, offer serious advantages for maritime warfare. They are renewable energy powered vessels that use solar and/or wind and/or wave energy, so are persistent and can stay at sea indefinitely, only limited by biofouling.

These USVs can carry a 300kg modular payload and provide 50W average payload power. A keel winch can lower sensors to variable depths up to 200 metres.

They have silent operation, can have active and passive arrays, have sufficient 5 knot speed to resolve left to-right ambiguity of passive sonar systems. These ASVs are able to intelligently network and collaborate with other Bluebottles and other assets to deploy team behaviour.

For mine counter measures they can manage fleets of underwater assets, execute intelligent path planning and manoeuvring systems, all the while remaining safely in proximity while exchanging high-volume data.

When fitted with cameras, sonar arrays, Automatic Identification Systems (AIS) and Automatic Dependent Surveillance Broadcast (ADS-B) they can survey the environment for submarines, ships and aeroplanes.

In June 2020 Ocius Technology was awarded a $5.5 million contract by Minister for Defence Industry, the Hon Melissa Price MP. "This technology could provide the Royal Australian Navy with a unique capability to protect Australia's maritime borders," Minister Price said.

These USVs can monitor a large area of the ocean continuously at a disruptively low cost without having anybody in harm's way, said Robert Dane, Founder and CEO at Ocius Technology.

"Under this 2-year contract, we will deploy 5 intelligent networked Bluebottles to 3 different Areas of Operations doing 3 different types of jobs," said Mr Dane. "We look forward to working again with DIH, Navy and Thales Australia, as well as demonstrating Bluebottle's persistent maritime surveillance capability to other agencies and industry partners across Australia.

"Autonomous unmanned surface vessels that don't use any fuel, don't need a crew and are cheap to operate are perfect for these missions"

Ocius's Bluebottle can tow small sonar arrays. By employing artificial intelligence, swarms of Bluebottles can form sensor barriers that react to threats in the most efficient and effective way. While these small ASVs have limited power, they have virtually unlimited endurance.

Moreover, by aggregating their sensor data, they can cover a significantly greater area than a single traditional large surface combatant.

A single Arafura Class OPV can carry 12, since two Bluebottles fit in a standard 20-foot container, and this OPV can carry six such containers.

## PASSIVE GUIDED TORPEDOES AS AUTONOMOUS UNDERWATER VEHICLES (AUV)?

Small AUVs possess neither speed nor endurance to chase their warship targets which would immediately commence evasive action.

Could two or more guided torpedoes, using passive guidance to help avoid detection and autonomous control, operate as a small swarm? Passive guidance usually tracks the target by homing in on its noise emissions, although this can be defeated by acoustic decoys.

Pattern-following and wake homing passive guidance technology has also been developed. As standard acoustic lures can't distract a wake homing torpedo, on an experimental basis the U.S. Navy installed the Surface Ship Torpedo Defense (SSTD) on aircraft carriers that uses a Countermeasure Anti-Torpedo (CAT) to home in on and destroy the attacking torpedo.

APDR has read a declassified FY2018 research report by the U.S. Navy Director, Operational Test & Evaluation, who concluded that 'in September 2018, the Navy suspended its effort to develop the SSTD system. The Navy plans to restore all carriers to their normal configurations during maintenance availabilities between FY19 and FY23.'

The RAN's Collins Class submarines carry 22 torpedoes which can be fired from six 530 mm torpedo tubes. The future Attack Class submarines have eight torpedo tubes and are designed to carry 28 Mark 48 MOD 7 heavyweight torpedoes, Harpoon anti-ship missiles or Mk III Stonefish mines.

## ORCA XLUUV

There is no limit to the size and scope of XLUUVs. The largest autonomous underwater robot currently in development is the Cutthroat LSV-2, a 33m long AUV weighing in at around 185 tonnes. It is designed as a smaller, autonomous version of the US Navy's Virginia-class attack submarine. The Cutthroat is used by the US Naval Surface Warfare Center for hydro-acoustic research and vehicle research.

Boeing's Orca AUV, already mentioned, can eventually be upgraded to support mine countermeasures, anti-submarine warfare, anti-surface warfare, electronic warfare and strike missions. It can be at sea for months at a time.

To sum up, the saying "Predictions are difficult, especially about the future" is attributed to 1922 Novel Prize winner Danish physicist Niels Bohr, and latterly used frequently by comedians around the world.

The future patterns of maritime warfare are difficult to predict.

One thing is certain. Highly visible to surface, aerial and space surveillance systems, large and relatively slow warships will be increasingly vulnerable to attack from high-speed missiles or guided bombs and underwater munitions delivered by swarms of autonomously guided torpedoes.

ISR missions can be conducted successfully by small and inconspicuous AUVs like Liquid Robotics Wave Glider and Ocius Bluebottle. They are almost impossible to detect in the open sea, have long endurance which can be measured in months, possess many useful sensors and communications with them are relatively easy, although not completely secure.

Relatively large manned submarines will have to remain deeply submerged and silent if they are to survive missions. Their role will be much more about controlling large unmanned underwater vehicles like Boeing's Orca, which in turn will be able to release high-speed swarms of small explosive-laden AUVs towards their hapless target(s).

This prospect calls into serious question the necessity for an Attack Class fleet of 12 conventional submarines. Maybe 6, two certainly and possibly four of which, can be operationally deployed at any time, would be more than sufficient because AUVs could maintain the ISR role, reducing the need for this to require a manned submarine.

A challenge which cannot be ignored is that an adversary's AUVs could attack our conventional manned submarines. Will this threat be sufficiently great to make the fleet of manned Attack Class submarines obsolescent before they first enter the water operationally in the early 2030s?

*Illustration of Hunter class underway (BAE Systems image)*

**KYM BERGMANN** // CANBERRA

# FUTURE FRIGATE UPDATE – DESIGN CHANGES REMAIN WITHIN GUIDELINES

To date Defence has spent around $1.3 billion out of an allocated $6.234 billion for the first phase of SEA 5000. At this point much of the activity remains in the design and planning stage, which is typical of these massive shipbuilding projects. A forthcoming major milestone is the System Definition Review, which is scheduled to start in the next few weeks – and this is expected to continue until the end of the year.

Defence says that it remains committed to ensuring minimal change to the U.K. Type 26 Reference Ship Design with implementation of the Australian-specific changes, which, at a top level, include:

Aegis combat management system with the Saab Australia developed Australian Interface;

- Australian design and built CEAFAR2 phased array radar;
- Integration of the Seahawk Romeo Maritime Combat Helicopter;
- Australian communications systems; and
- Australian legislative requirements.

The Department says these requirements do introduce changes throughout the ship, not just to the superstructure, although the structure supporting the radar will be the most obvious external change. Defence says that it continues to work with Canberra's CEA Technologies on development of the Phased Array Radar and its inclusion in the Hunter Class design. Defence is in the process of delivering two Land Based Test Sites, which will be key to the development and integration of the Combat System for the Hunter Class.

The project has not been without critics, with rumours that the ship is growing enormously in size because of Australian-specific design changes and that levels of Australian Industry Content are disappointing. On the latter, Defence explains:

"Under the Hunter Class Head Contract, BAE Systems Maritime Australia have committed to achieve a minimum of 54% of their contract spend in Australia under the Design and Productionisation Phase an 58% over the life of the acquisition contract. BAE Systems Maritime Australia report progress against the planned expenditure at the Contract Status Reports."

Regarding the impact of design changes, to set the record straight APDR put a number of questions to Craig Lockhart, Managing Director of BAE Systems Maritime Australia. Asked to comment on reports that there has been alarming growth in the size of the Hunter class compared with the Royal Navy's Type 26 reference design, he explained:

"Design maturity for Hunter is progressing well.

"The first design milestone, the Systems Requirements Review, was passed in September 2019 on schedule and the next design milestone, the Systems Definition Review (SDR), commenced at the end of March 2021 and will continue throughout the year.

"The commencement of SDR was pushed back a few months to allow the work arising from the Government-mandated changes associated with the combat system, including the hosting of Aegis, the Australian interface and the Australian radar and their impact on the platform to continue in tandem; but this

movement has not impacted the overall schedule.

"The SDR will provide confidence that while incorporating the Australian elements of the frigate, and the reference ship design changes, we are still within the parameters of the ship's key performance characteristics, including speed, seakeeping, stability, range and through-life margins."

According to Mr Lockhart a second big milestone this year is design separation, on track to occur in late 2021. Design separation is the transfer of many of the control processes, tools and systems to Australia. Essentially a copy of the reference ship design will be taken zone by zone as the design matures - known as "refresh and merge" - and the CAD model and product data set will then be hosted in Australia. An important first step has already occurred with an initial snapshot of the Type 26 dataset taken to allow the test of the set up and configuration of the Hunter production IT environment to begin. He continued:

"Much has been written about the Hunter frigate weight, so it is important to put some facts out.

"The Type 26 reference ship design experienced some growth in weight during the design phase as the ship design and supplier data matured; this is not uncommon for first-of-class warships. As a result, the light ship weight for Type 26 has increased, which has increased the Hunter light ship weight.

"Further, Australian-mandated design changes are also contributing to an increase in weight due to the additional combat systems equipment, together with the cooling measures and other infrastructure required for the CEAFAR radar and combat systems.

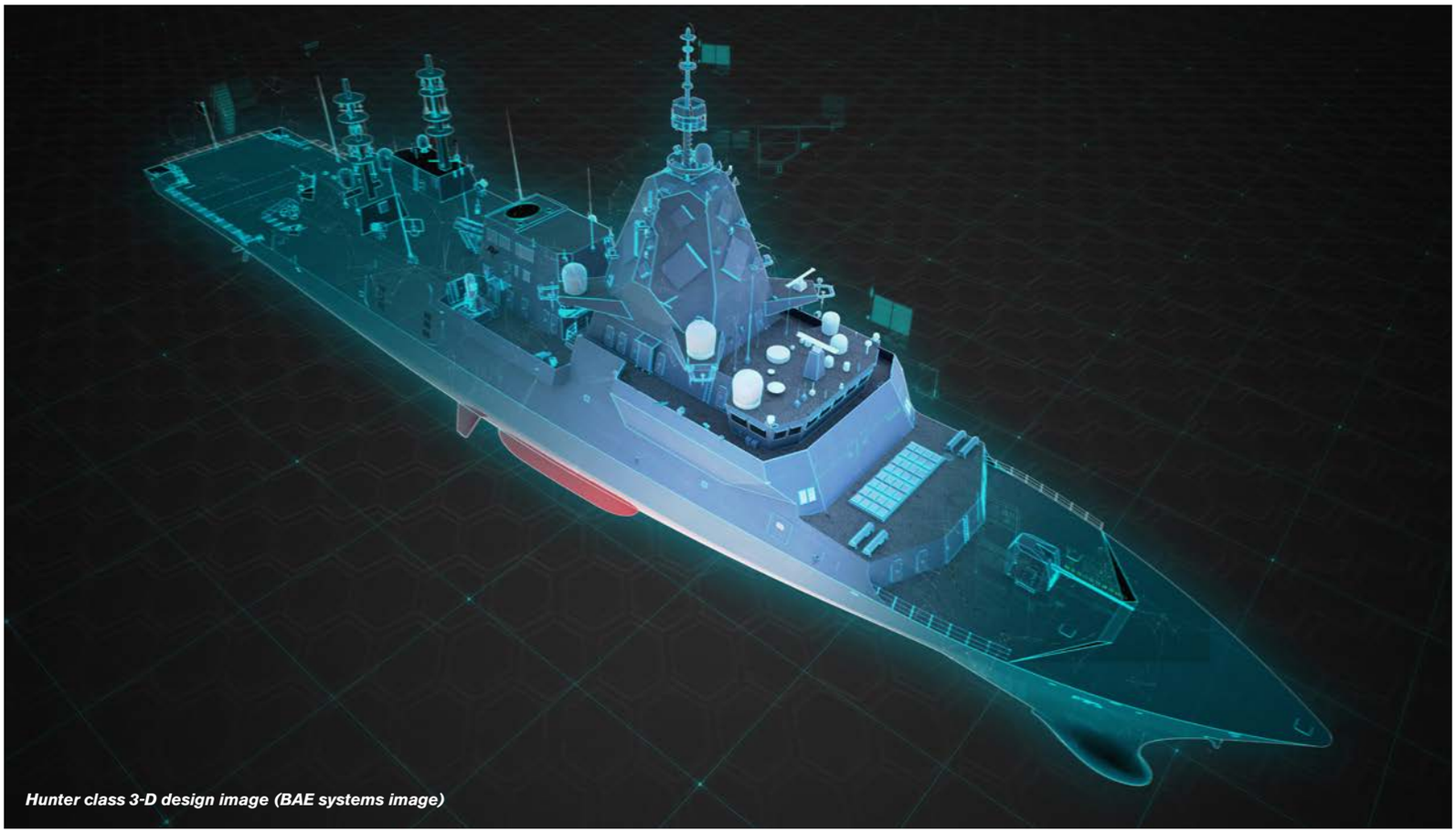
"However, the Hunter design remains within the agreed weight and space envelopes and is expected to meet the performance and capability needs of the Royal Australian Navy and deliver the required through life growth margin."

Mr Lockhart confirmed that The Hunter frigate will be the same overall length and beam as the Type 26 frigate, with the hull form modified slightly to accommodate the weight margins required. Full displacement weights across the classes of vessels will differ because of the different combat systems and payloads, capability insertions and operational requirements of their parent navies, but he says that's not unusual, or of concern.

He says that 2021 will be another busy year for Hunter as the company prepares for the start of construction. After cutting steel in December last year prototyping activities at the Osborne Naval Shipyard are well underway. During prototyping five ship blocks of increasing complexity will be built. But apparently prototyping is not just about building the blocks, it's about testing the entire shipbuilding enterprise – the processes, the systems, the tools, the facilities and the workforce.

The aim of prototyping is to stress-test everything to de-risk the full-scale build in later years. He says that if the company is not testing everything to breaking point, stopping, reviewing, learning, improving, then it

**The Department says these requirements do introduce changes throughout the ship, not just to the superstructure, although the structure supporting the radar will be the most obvious external change.**



*Hunter class 3-D design image (BAE systems image)*

is not truly prototyping. He continued:

"On workforce, our team continues to grow. We currently have more than 1,200 people on the program and more than 200 of those have joined us in the first few months of the year, including welcoming back 51 of our former AWD-workers who took part in Australia's first digital shipbuilding diploma, our second intake of apprentices (18) and more graduates (24).

"On supply chain we've already placed around 40 contracts with Australian businesses to support design and prototyping with more than 20 to come, for things like ship outfitting, gaskets, wholeship eyeplates, insulation and deck coverings, and now we're turning our attention to creating the opportunities for Australian businesses on the first batch of three frigates."

He gave some case studies to illustrate how the AIC plan is being implemented:

Example 1: We are actively pursuing Rolls-Royce and successful Australian company Marand to work together to produce gas turbine enclosures. But not only do we hope to maximise Australian industry capability through Marand on Hunter, we're exploring options for them to supply the enclosures on the Type 26 and CSC programs too.

Example 2: Valves are another great example of opportunities available for Australian businesses and is a case of where we've listened to Australian industry and worked with the Commonwealth and Score Marine Australia. As a result, additional work packages for Australian industry have been listed on the ICN and more will be listed in coming weeks and months.

Example 3: The A bracket on the ship is a third example. The A bracket is a 10-tonne piece of kit that supports the shaft external to the hull, in particular to stop flexing of the shaft caused by force exerted by the propeller. It is cast in a foundry, and our supply chain believes that's something that can be done here in Australia, rather than importing one from the UK, so we're actively pursuing options for that.

Asked about the timing of the Critical Design Review – which in essence will finalise the configuration of the ship – he said:

"With regards to the Critical Design Review (CDR), it's important to talk about the design work that occurs in lead up to that activity, rather than simply talking about when it will occur.

"As we discussed earlier, we are holding the Systems Definition Review this year. The critical path through a successful SDR is still related to combat system architecture and integration challenges which has a direct relationship to when CDR is set. Following that, we will be progressing the design of all the changes to the ship systems, integrating the Australian combat systems and working with our supply chain to develop their product designs.

"Following design separation later this year the detail spatial design process will commence across the 12 design zones of the Hunter frigate. This will occur in two stages. Initially the CAD spatial design model will be refreshed and merged through each design zone to incorporate all of the detailed design changes for the Hunter frigate, then once each design zone is complete the production outputs (drawings and digital data) are produced that will enable our operations team to construct the ships."

He explained that the first design zones to go through this process will be in the lower part of the hull, which generally have a smaller level of change to the Type 26 reference ship design. This will allow the construction of the frigates to commence in December 2022 as planned with a very high level of engineering maturity, while the zones that require updates to the design to include the Government-mandated combat system changes – including the distinctive superstructure - will continue to mature and go through the same process before they commence construction later in the build schedule.

The Hunter program expects to exit the final CDR in 2025 once the detail spatial modelling has been completed across all 12 design zones, so while it is after the "cut steel" date, this approach is common on major shipbuilding programs to balance the competing needs of cost, schedule and capability.

Next, we discussed the global nature of the

program, with the Type 26 selected by the U.K., Australia and Canada for a total of more than 30 hulls if each country maximises the number of ships they build. Asked if this tri-nation activity might see export opportunities for Australian suppliers, he explained:

"It's certainly not theoretical. There are already seven Australian businesses contributing to the Type 26 program and we're actively working on opportunities across the Global Combat Ship programs.

"I flagged earlier the gas turbine example – where we're looking at Geelong-based Marand to do the Hunter enclosures for Rolls Royce, and how we're also examining how that could be done across the Type 26 and Canadian programs also.

"Back to Hunter Batch 1, over the next two years there will be well over 100 work packages available for Australian businesses.

"The Commonwealth have identified areas they want us to focus on: valves, propeller and brake blades, davits, watertight and gas tight doors, hatches and scuttles, X/Y gantry crane, wholeship pumps, HVAC system, light fittings and shaftline system."

He said that to date dozens of Australian businesses have recently submitted Expressions of Interest for things like mission bay side doors, door hatches and scuttles for the mast and around the ship, catering and laundry equipment. The company has recently listed Milspec valves and valve component casting packages on the industry portal, with armour windows and X/Y crane to be advertised very soon.

Another point is that it's important for Australian industry to note that just because a supplier isn't engaged on Batch 1 does not mean they will miss out altogether. The Hunter frigates will be contracted in batches of three, and the supply chain will be as well.

There will no doubt be design and configuration changes between each batch, as manufacturing methods also become more advanced and new technologies emerge. Put another way, the ninth frigate to be launched in the mid 2030s will have the same hull form, but many of the systems and components will be newer versions of those found in the first of class.

Finally, we turned to the status of the reference program – the RN's Type 26. One of the strong features of the BAE Systems bid was that Australia would be following on from the UK activity and therefore would be able to incorporate lessons learned from the parent program since that is about four years ahead of SEA 5000. Craig Lockhart summarised:

"The Type 26 program's first of class HMS GLASGOW is expected to roll out of the Ship Block and Outfit Hall in Govan, Scotland, in Q2 2021 and to be structurally complete in the following months.

"The impact of COVID-19 in the UK has presented challenges for the Type 26 program, but BAE Systems has been working closely with the UK Customer, international customers including Australia, to agree priorities for the respective programs and put in place measures to minimise the impact. Sites have been reconfigured and new safe systems of work have been implemented to maintain operations while homeworking was rapidly enabled. As such, BAE Systems remains on track for the planned delivery of the first vessel in the mid-2020s.

"As for the impact of the UK COVID-19 situation on the Type 26 program and the flow on to the Hunter program; it is of course creating challenges. But they are challenges that are being managed through close collaboration between the two nations. As such, Hunter continues to be on track to meet its design milestones this year (more on that later) and the next cardinal milestone of cutting steel for first of class construction in December 2022.

"Of course, the full impact of the pandemic is not yet known and will continue to be monitored and measures put in place to mitigate risk where possible.

GEOFF SLOCOMBE // VICTORIA

# ARAFURA OPVS WILL BE WELCOME VESSELS FOR NAVY BUT COULD HAVE WIDER FUTURE ROLES

In Q2 2022 the Royal Australian Navy will take delivery of the OPV NUSHIP Arafura, the first of a planned fleet of 12 vessels. But already there is discussion about extra roles for these Arafura Class vessels. Specifically, there could be a small number of anti-ship missiles added to extend the roles of these OPVs at a relatively low cost, possibly 10% of the cost of fitting these missiles to larger warships.

Navy currently expects the primary roles for these OPVs will be maritime border patrol, maritime constabulary roles including interdiction, fisheries patrol plus humanitarian and disaster relief.

An area causing concern amongst commentators, including this author, is the inability of RAN's existing Taipan and Romeo helicopters to land on the OPV's flight deck. Defence's view is that this capability is replaced by operating lighter unmanned helicopters from the OPVs.

The SEA 1180 Phase 1 project is proceeding smoothly with the first of two OPVs nearing completion in the Osborne Dockyard, South Australia. OPVs 3 and 4 are under construction at Civmec's modern and very capable shipyard at Henderson, WA. The remaining eight OPVs will commence construction at Civmec in approximately 18-month intervals.

APDR asked CDRE John Stavridis – Director General Littoral how he felt the program was running. He responded "The Arafura class offshore patrol vessels will be an excellent addition to the Fleet. These ships will continue to build on the fantastic constabulary work being done by our current Fleet of Armidale and Cape class patrol boats, by patrolling our maritime approaches and exercising sovereignty in our maritime zones."

## WEAPONS AND SENSORS

The OPVs are being fitted with a 40 mm Oto Marlin gun which manufacturer Leonardo claims 'provides superior performance for challenging missions such as anti-missile defence, anti-aircraft warfare and ship-to-ship engagement.'

The gun features a dry weight of only 2,100 kg in its remotely controlled version, high manoeuvrability (the barrel can move at 120°/s thanks to powerful and accurate servo-systems), and the ability to fire multi-purpose programmable fused ammunition.

*Bow of the first OPV at ASC's Osborne yard (ASC photo)*

Leonardo state 'Marlin 40 is fully digital and can be configured as either fully slaved to a Combat Management System/Fire Control System (CMS/FCS) or with autonomous local control by means of an independent optical sight and ballistic computation. Installation and integration procedures are straightforward, the system is compact and no deck penetration is required.'

The OPV's Marlin 40 gun will be controlled by Saab's Situational Awareness System (SAS) as per a contract for the design and integration of the Arafura class SAS which was signed by Saab with Luerssen Australia in April 2018. The combination of Saab's EOS-500 director and the 40 mm gun under SAS fire control is likely to be the deadliest short-range defence system in Navy service.

The SAS is based on Saab's 9LV Combat Management System (CMS) technology and a new 9LV Next Gen combat console has been designed in Australia using a modular concept to simplify future upgrades.

The main publicly identified sensors on the OPVs appear to be Saab Situational Awareness System (SAS) with Saab EOS500 electro-optical fire control director, Terma SCANTER 6002 radar, Safran Vigy Engage electro-optical surveillance and fire control multisensor system.

Track information from the Terma Scanter is sent to the 9LV CMS along with both the air and surface radar video. The radar video can be displayed at any CMS console and the track data is fused by the CMS with other track data that is in the system to contribute to the tactical picture. 9LV includes sophisticated functions to ensure multiple track sources of the same target are correlated into a single track.

The inherent video tracker in the Saab EOS-500 provides automatic detection of up to four concurrent threats. Track information and TV/IR video from the EOS-500 is sent to the 9LV CMS and integrates with the tactical picture, which can then be selectively displayed on any CMS console.

Similarly, the Safran EOS track information is sent to the 9LV CMS and integrated with the tactical picture. The EOS video can also be selectively displayed at any console.

Daronmont's CommSECA RF Communications Surveillance and Direction-Finding system monitors the electro-magnetic spectrum for transmissions of interest. It is especially suitable for monitoring search-and-rescue, illegal fishing activity, smuggling and piracy and the security of Exclusive Economic Zones.

CommSECA can run a general or directed

search using a comprehensive and reliable passive component point-of-interface (POI) configuration for signal integration and transmission, when you know which frequencies and bearing sectors to survey.

Technically, POI uses multi-frequency low-loss combiner technology to carry out effective combination and division of uplink and downlink RF signals of operators, which can ensure that the system distortion-less combiner transmits uplink and downlink signals without interference among signals in each network, and different systems share an indoor distributed system.

There is configurable signal detection to support operations in blue water and littoral RF environments and for signal intercepts capabilities to recognise signals and demodulators for various transmission types.

Direction finding features an adaptable antenna interface with high accuracy setup and the possibility to allow simultaneous operations in both Search and DF modes

The OPV Communication and Navigation System (CNS) includes an integrated electronic navigation system, internal and external communications systems such as Satellite Communication (SATCOM), Maritime Tactical Wide Area Network (MTWAN) and High Data Rate Line of Sight (HDRLoS) capability.

## FUTURE OPV ROLES?

APDR asked Dr Marcus Hellyer, a widely respected Australian Strategic Policy Institute (ASPI) senior analyst who focuses on defence economics and military capability, for his views on how these OPVs' roles might be extended in the future.

He directed us to his ASPI Special Report published in June 2020 entitled 'From concentrated vulnerability to distributed lethality - or how to get more maritime bang for the buck with our offshore patrol vessels'.

With ASPI's permission we quote directly from this report.

'At the core of this proposal is the accelerated acquisition of more offshore patrol vessels (OPVs). The Department of Defence is acquiring 12 OPVs to perform constabulary and border-protection tasks.

'However, they have considerable inherent potential to contribute to war fighting across the spectrum of operations. Due to their flexible design and design margins, these vessels can be modified to deliver a range of variants optimised for a broad spectrum of war-fighting roles:

- anti-submarine warfare (ASW)
- anti-surface maritime strike
- support for autonomous and unmanned systems
- offensive and defensive mine warfare
- air warfare
- light amphibious and riverine operations and support to special forces.

'The key is to resist the temptation to turn each OPV into a multi-role vessel that attempts to do everything. That path will result only in exponentially spiralling cost, schedule and risk.

'Rather, this paper proposes an accelerated acquisition of a larger number of OPVs—indicatively, 18 rather than the current 12, not including any mine warfare vessels—that would be optimised for different roles.

'They would operate in artificial intelligence (AI)-enabled teams that would form and reform as needed to provide the commander with many options while confusing and disrupting the adversary.

'The teams would consist not only of the OPVs and their autonomous systems, but also Defence's traditional platforms such as frigates, destroyers and submarines; air combat and maritime patrol aircraft; and even land forces such as special forces and long-range fires.

'These adaptively reconfigured swarms would employ enabling technologies such as a common control system that would allow a human operator to command multiple autonomous systems of different kinds, as well as state-of-the-art AI-enabled spectrum management to ensure that increasing amounts of sensor data could be shared and command and control of both manned and unmanned platforms could be preserved.

'Due to their relative simplicity, additional OPVs could be built quickly at Civmec's state-of-the-art shipbuilding facility at Henderson in Western Australia.'

When APDR asked Dr Hellyer about the types of weapons that could be fitted to the Arafura Class OPVs he responded "Putting eight LRASM or NSM on an OPV already gives it more surface warfare capability than an air warfare destroyer at 1/10 the price."

APDR notes that Dr Hellyer's reference to the LRASM is to Lockheed Martin's AGM-158C LRASM (Long-Range Anti-Ship Missile) which is a stealthy cruise missile developed for the United States Air Force and United States Navy by DARPA and in service since 2018. It is a high-subsonic weapon with a 450 kg blast-fragmentation penetrator warhead.

The Naval Strike Missile (NSM) is a sea-skimming anti-ship and land-attack missile developed by the Norwegian company Kongsberg Defence & Aerospace. It fires at high subsonic speed a 125 kg high explosive blast fragmentation warhead. It is now in service with Norway, Poland, Malaysia, United States (US Navy littoral combat ships, and by their Marine Corps who will fire it from land against warships) and Germany.

## OPV SUPPORT AGREEMENT

On 7 March 2021 Australian Secretary of Defence Greg Moriarty, together with a large contingent of Defence senior leaders, launched the Arafura Class Offshore Patrol Vessel Enterprise and opened the OPV System Program Office at the Henderson maritime precinct.

"It is great to see the co-location of Commonwealth shipbuilding and sustainment personnel and Luerssen, CIVMEC and Raytheon industry partners delivering outcomes for our Navy," said Deputy Secretary National Naval Shipbuilding Tony Dalton.

Head Maritime Systems, Rear Admiral Wendy Malcolm said the establishment of the OPV Enterprise represented an important milestone under the Continuous Shipbuilding Plan. "The launch marks a critical step towards the implementation of Plan Galileo, an ambitious Future Maritime Sustainment Model which ensures our sustainment organisation engages with acquisition teams early in the build process."

## IN CONCLUSION

The OPV project has resourced extra shipbuilding capacity in Western Australia while maintaining the workforce employed at Osborne, South Australia, as that shipyard prepares to start construction of Navy's Future Frigates.

The OPV's design enables it to operate a wide range of unmanned vehicles in the maritime and air domains. Although there are some current types already in Navy service, the future will bring an even wider range of capabilities.

The future option remains to install harder-hitting weapons on these OPVs. Anti-ship missile launchers for up to 8 LRASM or NSM would provide serious hitting power without a significant increase in cost.

In January 2021 this information was promulgated by Defence. 'The Australian Government has announced that a down-select decision was made to explore a variant of the offshore patrol vessels for the new Mine Countermeasures and Survey Vessels under project SEA 1905 Phase 1 for the Royal Australian Navy.' This will mean the replacements for the current Huon Class will be brought forward from the 2030s to the mid-2020s.

In November 2020 the government announced that it is investing around $350 million for 6 new Cape Class Patrol Boats for the Navy to grow the patrol boat fleet to 16 vessels, while the new larger Arafura Class Offshore Patrol Vessels are introduced into service.

GEORGE GALDORISI // WASHINGTON

# AUSTRALIA'S OCEAN OBSERVATION CHALLENGE

**Europe is a landscape; the Indo-Pacific Region is a seascape.**
**The 21st Century represents a decided shift from Mackinder to Mahan.**
– Robert Kaplan, "Center Stage for the 21st Century", Foreign Affairs

*HMAS Hobart conducts a live fire exercise using the vertically launched RIM-66 Standard Missile 2 (SM2) as a test of capability before proceeding to their Unit Readiness Evaluation (URE).Credit: CoA / Cameron Martin*

## PERSPECTIVE

It is likely impossible to find a nation more focused on the ocean environment than Australia. Fronting three major oceans: the Indian, Southern, and Pacific, and with a turbulent sea frontier to the north, few nations are more impacted by the oceans.

The Indo-Pacific region includes the "long littoral" stretching from the Persian Gulf and the Red Sea to the South and East China seas. Australia has one of the largest areas of maritime jurisdiction in the world. This is vitally important to the nation's future prosperity and security, but managing this area is a major national challenge. Within this region, Australia has the largest area of maritime jurisdiction, with an Exclusive Economic Zone (EEZ) of 8.51 million square kilometres followed by Indonesia (6.16 mill.sq.km), India (2.30 mill.sq.km), the Philippines (1.89 mill.sq.km) and China (1.36 mill.sq.km).

Australia claims this large EEZ around the continental land mass and island territories. This EEZ increases to 10.19 mill.sq.km if the EEZ claimed around the Australian Antarctic Territory (AAT) is included (The legal continental shelf off the continent and territories has an area of 10.8 mill.sq.km (or 13.52 mill.sq.km if the one around the AAT is included).

The Commission on the Limits of the Continental Shelf adopted recommendations that confirmed the location of the outer limit of Australia's continental shelf in nine distinct marine regions. This decision gives Australia jurisdiction over an additional 2.65 million square kilometres of continental shelf that extends beyond 200 nautical miles from its territorial sea baseline. These figures mean that the maritime domain over which Australia has at least some jurisdiction is nearly twice the size of the continental land mass of Australia.

When Australia's claim to the AAT land mass is included, Australia becomes the country with the largest jurisdictional claim to an area of the earth's

surface – approximately 28.5 mill.sq.km, of which about half is over ocean or sea. The AAT is nearly one half of Australia's land territory but, even without this area, Australia would still rank second (after Russia) in terms of the area of the earth's surface under some form of national jurisdiction. This makes Australia an oceanic and environmental superpower with a clear responsibility to take a leadership role in managing regional oceans and seas.

## WHAT ALL THIS MEANS FOR AUSTRALIA

Far from just mundane statistics, what all this means for Australia is that this nation has stewardship for vast oceanic areas. Whether it is the ADF and RAN's use of oceans and seas for defensive purposes, the ongoing need to derive mineral and natural resources from the oceans, the need to patrol the near-seas to guard against the illegal import of persons or contraband, or simply the use of Australia's littoral waters for recreational purposes, having a thorough knowledge of the oceans and seas is imperative for Australia's security and prosperity.

For most nations, the task of ascertaining oceanic conditions falls to navies and coast guards. The ships of these entities have traditionally conducted ocean observation, with ships laboriously conducting sampling of the water column to determine criteria such as temperature, salinity, water currents and other important factors that help scientists determine how water conditions will impact naval operations, weather predictions, sea life health and the like.

However, for an Australian Navy with increasing regional and worldwide commitments, dedicating ships to conduct such oceanic sampling is becoming increasingly challenging. Indeed given the enormous costs of Canberra–class amphibious ships and Hobart-class Air Warfare Destroyers, using these expensive, multi-mission ships for tasks such as ocean sampling is not only counter-productive, it takes them away from their important naval missions.

With a coastline of over fifty-nine thousand kilometres, and the vast oceanic areas mentioned above – to say nothing of other maritime interests to support throughout the region – the ADF, RAN and Department of Home Affairs will have to find alternative ways to sample the ocean environment.

As Australia continues to lead the way with uninhabited vehicles, especially uninhabited surface vessels, it may be time to find a way to leverage these technologies to develop an affordable and sustainable way to sample the ocean environment. Here, recent developments by the U.S. Navy may offer a best-practices example worth examining.

***HMAS Canberra's embarked MRH-90 Maritime Support Helicopter conducts a vertical replenishment of stores with HMAS Stuart during the Regional Presence Deployment 2020. CoA / Christopher Szumlanski***

**When Australia's claim to the AAT land mass is included, Australia becomes the country with the largest jurisdictional claim to an area of the earth's surface – approximately 28.5 mill.sq.km, of which about half is over ocean or sea.**

## THE U.S. NAVY EXPERIENCE USING UNMANNED SURFACE VESSELS FOR OCEAN OBSERVATION

Recently, two major oceans stakeholders, the U.S. Navy and the National Oceanic and Atmospheric Administration (NOAA), signed an agreement to collaborate on ocean observation, data collection and analysis. This U.S. Navy-NOAA initiative includes the plan to jointly expand the development, acquisition, fielding and operation of unmanned maritime systems in the nation's coastal waters as well as in world's oceans waters. This opportunity has only become possible because of the rapid development of unmanned maritime systems that can be fitted with a package of sensors to accurately and comprehensively measure ocean phenomena and then communicate this information to land-based sites.

For the United States, this partnership presages a new era in ocean observation that will lead to comprehensive data collection to support naval operations across the globe. This effort will also enable a wide range of stakeholders to compile the data that is crucial to addressing the national security threat of climate change by enabling scientists to make data-driven decisions based on the health of the oceans and the atmosphere. But it is not just the United States that must make these decisions based on repeatable ocean observation. Increasingly, addressing climate change will become a team sport, and nations will be increasingly well-served to borrow each other's tactics, techniques and procedures.

## A NATIONAL SECURITY IMPERATIVE

Over the past several decades, volumes have been written about the negative impact of climate change and global warming, perhaps none as prominent as former vice-president Al Gore's 2007 book, An Inconvenient Truth: The Crisis of Global Warming. In 2021, this new shift in addressing climate change, not as an abstract issue but as a clear and present danger, was addressed by U.S. Defense Secretary Lloyd Austin: "The Department will immediately take appropriate policy actions to prioritize climate change considerations in our activities and risk assessments to mitigate this driver of insecurity." The Secretary of Defense went

*Hobart Class Destroyer HMAS Brisbane conducts Officer of the Watch manoeuvres in the Eastern Australian Exercise Area, off the south coast of New South Wales. Credit: CoA / Peter Beeh*

on to say:

As a leader in the interagency, the Department of Defense will also support incorporating climate risk analysis into modeling, simulation, wargaming, analysis, and the next National Defense Strategy. And by changing how we approach our own carbon footprint, the Department can also be a platform for positive change, spurring the development of climate-friendly technologies at scale.

From the U.S. perspective, in order to address climate change at the national level, a wide array of federal, state and local officials recognise that they must make decisions based on data, not conjecture. Making these data-driven decisions depends on collecting the right data, at the right place, at the right time. This is not a trivial undertaking, and in a budget-constrained environment, having various agencies collect – but fail to share – ocean data, is a recipe for failure.

Additionally, anecdotal evidence suggests that where those with stewardship for various aspects of ocean sustainment cannot find an affordable way to collect this data, it will simply not be obtained. These gaps lead to an incomplete picture of the ocean's health, and with it, suboptimal solutions to achieving long-term ocean sustainment, including dealing with climate change.

This U.S. Navy-NOAA partnership is a natural outgrowth of the fact that both organizations must collect and utilize much of the same oceanic data. Add to this the fact that the Navy and NOAA recognize the importance of unmanned maritime systems for a plethora of missions, ocean observation among them.

## A PARTNERSHIP TO COLLECT OCEANIC DATA BY LEVERAGING UNMANNED MARITIME VESSELS

One of the reasons for this new U.S. Navy-NOAA partnership is that by working together, NOAA will be able to leverage the Navy's expertise, infrastructure, best practices and training to accelerate its science, service and stewardship mission, especially its efforts to address climate change. The Navy's executive agent and key stakeholder in this effort is the Naval Meteorology and Oceanography Command.

The Naval Meteorology and Oceanography Command's mission is to define the physical environment from the bottom of the ocean to the stars to ensure the U.S. Navy has freedom of action to deter aggression, maintain freedom of the seas and win wars. Additionally, Naval Oceanography has been a global pioneer in the development and use of unmanned systems.

NOAA conducts research and gathers data about the global ocean and atmosphere to forecast weather, predict climate, protect the ocean and sustainably manage marine resources. These missions rely on a continuous process of testing and evaluation of new technologies such as unmanned systems to improve data gathering.

Importantly, much of this same data collected to support the operating forces is also vital to help assess the health and vitality of the world's oceans as well as the ability to make data-driven decisions to combat climate change. For both the Navy and NOAA, a major appeal of unmanned systems is to provide a persistent sensor picture for areas of interest.

One important factor that is driving this move to unmanned maritime systems is the high cost of using manned air or sea craft to conduct these observations. Add to this the dangers of using these vessels in bad weather, in turbulent waters, or at night. Given the totality of these factors, using affordable unmanned surface vehicles to conduct these observations has a strong appeal to a wide array of stakeholders.

The Navy and NOAA agreed to move rapidly in an effort to experiment with ways to enhance their ability to conduct comprehensive ocean observation. In order to organize an experiment in the near-term, a decision was made to use commercial-off-the-shelf (COTS) technology that was mature and which met the exercise objectives.

Based on these criteria, one U.S. corporation, Maritime Tactical Systems, Inc. (MARTAC), was invited to demonstrate the use of its unmanned surface vehicle to conduct a comprehensive environmental monitoring evaluation. This month-long endeavor was conducted under the auspices of the Naval Meteorology and Oceanography Command (CNMOC).

Under CNMOC's stewardship, an Advanced Naval Training Exercise (ANTX) was conducted in the Gulf of Mexico, south of Gulfport, Mississippi. Naval Meteorology and Oceanography Command scientists outfitted a COTS MANTAS unmanned

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*MANTAS stern view (MARTAC photo)*

surface vehicle with a CNMOC Environmental Monitoring System. These systems and sensors were designed to be carried by this USV to provide a one-vehicle solution to important environmental sensing that was, in the past, conducted by multiple platforms.

CNMOC equipped the MANTAS USV with seven state-of-the-art sensors. This sensor data was communicated in real-time to the CNMOC control station. A second unmanned surface vehicle (another MANTAS USV), this one equipped with a different suite of ocean monitoring systems and sensors, was employed to conduct a second round of testing.

As testing continued with both USVs, CNMOC scientists and engineers provided vital feedback and suggested several enhancements to these vessels. This iterative process between developers, operators and engineers was inspired, in part, by past Office on Naval Research work – in conjunction with the Navy laboratory community – in the area of user-centered design.

While the full details of the ocean observations collected are beyond the scope of this article, they included: wave height, wave frequency, current speed and direction, wind speed and direction, air temperature, barometric pressure, fresh and salt water concentration, density and bottom bathymetry/contour modeling. All of these measurements are essential components that feed environmental models vital to naval operations and also contribute to important data-driven decisions regarding climate change. Additionally, it was demonstrated that the MANTAS USV was also able to communicate with an unmanned underwater vehicle for further mapping of the seafloor.

The ability to conduct surveys in higher sea states had thwarted other unmanned surface vehicles in the past, but was one of the highlights of this month-long event. The catamaran-hulled MANTAS was able to operate in sea state five conditions. Additionally, the MANTAS USV is designed to use watertight enclosures and connectors for the protection of sensor components from any water intrusion into the hull that may occur in heavy weather.

## A NEW MODEL FOR PERSISTENT OCEAN OBSERVATION

Given the ongoing importance of collecting the right environmental information at the right time at the right place to support naval operations, as well as help make data-driven decisions to address the national security implications of climate change, finding a cost-effective means to collect this oceanic information autonomously while having humans on-the-loop (as opposed to in-the-loop) is critical.

The use of commercial-off-the-shelf unmanned surface vehicles successfully employed during this demonstration can be readily scaled-up in USV platform size thereby providing for increased operational endurance and the ability to carry and control added oceanographic sensors. This will allow for a further extension of capability within specific oceans, seas, bays, rivers and other waterways, and can also lead the way for enhanced data collection, transmission and evaluation of water conditions and the ocean environment.

U.S. Navy officials have encouraged MARTAC Inc. to scale-up the 12-foot MANTAS used for this CNMOC ANTX effort and produce larger vehicles in order to conduct more comprehensive ocean observation. To this end, in 2020, a larger 38-foot unmanned surface vehicle, now referred to as the DEVIL RAY T38 USV, was deployed during U.S. Navy exercise Trident Warrior. These new larger vessels (including 24-foot and 50-foot DEVIL RAY USVs on the drawing boards) could be ideal USVs to conduct extended and more detailed ocean observation with their added ability to carry considerably more sensors and remain at sea for longer periods.

As one example of what this increased size provides vis-à-vis ocean observation, a 24-foot, or 38-foot DEVIL RAY, using an ocean bottom surveying speed up to fifteen knots, can remain underway for up to seven days until it needs refueling, after which it can again resume its survey mission. Multiple USV craft can be used to perform independent scans within the same geographic area, thereby greatly increasing the amount of total area that can be surveyed. Leveraging these larger USVs to accomplish these priorities will go a long way toward making data-driven decisions to provide valuable environmental information to naval forces as well as help government agencies make better decisions to address climate change.

## THAT'S ALL GOOD, BUT IS IT RIGHT FOR AUSTRALIA?

In much the same way as the U.S. Navy, NOAA, and many other U.S. stakeholders, Australia's ADF, RAN and Department of Home Affairs recognise the critical need for understanding the ocean environment. The benefits of using commercial-off-the-shelf unmanned surface vessels to monitor Australia's vast oceanic areas may be the only affordable and sustainable way to conduct this important mission.

There will likely be an increased demand for unmanned systems prototyping and experimentation to support comprehensive ocean observation. The vast array of technologies emerging in today's unmanned maritime systems provides a tremendous opportunity to move forward with an effective and affordable ocean observation taxonomy. As a leader in uninhabited surface vessel technology, Australia is well-positioned to become a regional – and even global – leader in this vital mission.

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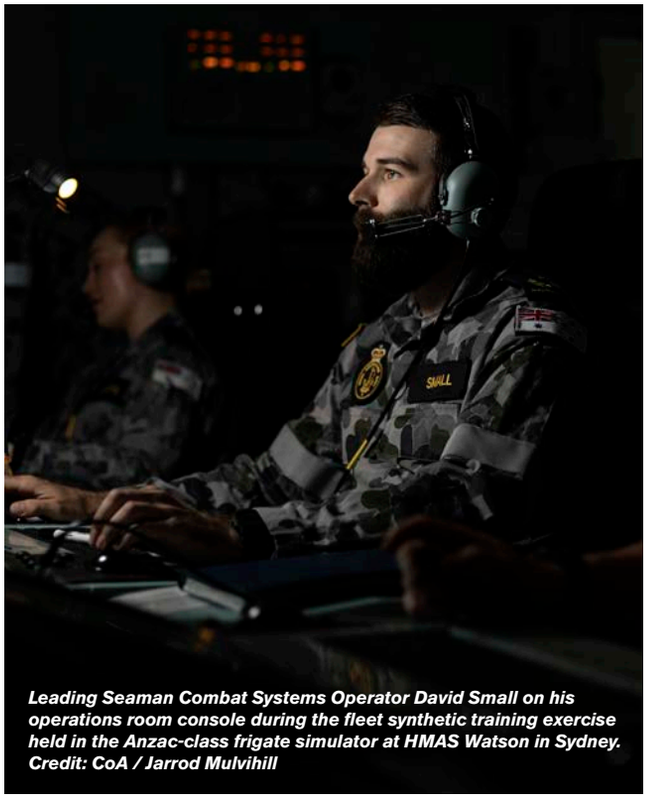
GEOFF SLOCOMBE // VICTORIA

# A HUGE LEAP IN NAVAL COMMUNICATIONS CAPABILITIES

Navies are large and complex organisations, needing lots of administration. The communications dangers associated with this are twofold as disorganised volume can drown the urgent and the important, and that the more signals are made, the more material is presented to enemy intelligence.



*Leading Seaman Combat Systems Operator David Small on his operations room console during the fleet synthetic training exercise held in the Anzac-class frigate simulator at HMAS Watson in Sydney. Credit: CoA / Jarrod Mulvihill*

Historically, hard experience has forced radio users to impose procedures to filter and classify signals, so that the routine does not drown out the important, and messages are routed to reach only those who needed to see them. Convenience and bandwidth are bought at the expense of security, often necessitating radio and radar silence in order not to betray the presence of warships or submarines.

A communications-dependent culture has had to learn to do without communicating for various lengths of time. A command system structured on the assumption that a central command could maintain contact with scattered ships at sea, has found it necessary to forgo contact for long periods.

Today, navies are once again luxuriating in a new communications technology, the internet transmitted over satellite links, which allows a huge increase in the volume of traffic. Once more, the attention of senior officers is distracted by a mass of administrative detail, while people of all ranks and positions can fail to see the messages which they need to see, when they need to see them.

The known insecurity of the internet leads to the over-use of security classifications, which simultaneously degrades security and overwhelms officers with trivia.

Moreover, the internet has a new weakness of its own, which radio possessed only to a limited extent. It is an open technology, accessible at many points to the outside world, and one in which many ordinary people are as expert as the military, if not more so. The more dependent navies become on the internet, the more vulnerable they make their expensive ships and advanced weapons to the skills of the teenage hacker. Here, it may be, is a fresh confirmation of the lessons of history.

Each generation of communications technology brings new possibilities of command and organisation, but these possibilities can only be realised by social systems that are organised and disciplined to exploit them, and they come at the price of new and initially unsuspected security dangers.

How does the Royal Australian Navy cope with these potential communications security issues?

Fortunately, their satellite communications are conducted with narrow band uplinks and downlinks, very hard to intercept. The terrestrial links within Australia between command office and satellite ground station are usually by means of optic fibre cable, again almost impossible to listen in to traffic.

For high frequency (HF), VHF, UHF and SHF radio communications across the Earth's surface new radios have very agile frequency hopping plus a range of waveforms, making interception extremely difficult.

Warship communications with submarines and vice versa are conducted at very low frequencies, and signalling to unmanned underwater vehicles reasonably close by can use acoustic transmission.

## MARITIME COMMUNICATIONS MODERNISATION

RAN warships are typically all equipped with a Communication and Navigation System which includes an integrated electronic navigation system, internal and external communications systems such as Satellite Communication, Maritime Tactical Wide Area Network (MTWAN) and High Data Rate Line of Sight (HDRLoS) capability.

New MASTIS (Maritime element of the Advanced SATCOM Terrestrial Infrastructure System) terminals are being installed on the Landing Helicopter Dock ships, the ANZAC fleet, the Guided Missile Destroyers and amphibious support ship HMAS Choules by contractor Leonardo MW Ltd.

Under the acquisition contract, Leonardo MW is designing, developing and installing the NewGen modernised communications system into Navy warships; designing, developing and installing the support systems (including a training system and an integration and test capability); plus developing and delivering integrated logistic support products. The support services contract became operative following acceptance of the first Anzac frigate and the associated support systems.

The project is also managing the acquisition of ARC-210 Gen 5 V/UHF multi-band multi-mode software defined radios through FMS with the US Government. The radios form part of the NewGen MCS.

This new system achieves delivery of vastly increased bandwidth which provides more efficient usage of defence satellite capacity and enhanced

network interoperability between ships, aircraft and land-based platforms.

The MASTIS terminals are equipped with two antennas which are capable of transmitting and receiving in X and Ka-bands simultaneously and they are able to connect to two different satellites at the same time. This dual-band, dual-antenna approach will provide the Navy with advanced SATCOM availability and a substantial increase in the ship's data capabilities, even under heavy interference conditions.

At the start of November 2020 HMAS Parramatta departed Garden Island, NSW, as the first of 14 RAN ships to have upgraded maritime satellite communications terminals installed.

HMAS Choules, the second ship to be upgraded, departed Garden Island shortly after Parramatta. HMAS Canberra has also now completed its upgrade in a program is progressing well with the Commonwealth expecting to achieve Interim Operating Capability milestone by October 2021.

The remaining 11 ships will be upgraded during their planned maintenance cycles over the next 12-18 months. As part of the program, the land based MASTIS training facility is being upgraded at North Ryde for RAN training.

Celebrating the completion of the first two RAN ship MASTIS upgrades, BAE Systems Australia Defence Delivery Director Andrew Gresham said, "the company is a world leader in the development and delivery of bespoke communications technologies including the long-standing support to the MASTIS terminals. The sailing of the first ships to receive their MASTIS upgrade is a really important milestone in this program and demonstrates our commitment to collaborating with the Commonwealth to bring timely capability to the end users."

## SEA 1442 PHASE 5 & JP 9103

Future SEA1442 Phase 5 will provide the RAN with a next-generation, integrated, maritime communications and information exchange capability designed to enhance interoperability and address communications system obsolescence.

Phase 5 scope includes acquiring the primary and alternate SATCOM terminals for RAN major fleet units for the eventual replacement of the currently-fitted primary SATCOM terminals, which are expected to reach end-of-life in the 2020's.

The project scope focuses on interoperability and system commonality by including a number of the complementary elements that make up modern maritime communications systems, including networks, aggregation and encryption equipment, bearers and antennas.

Facilities to support SEA 1442 Phase 6 renamed to JP 9103 in 2020 Protected Satellite Communications, moved forward in November 2020 when RJE Global has delivered the first of two Modular Data Centres (MDC) as part of the JP 9103 program, only three months after commencing construction.

The company was engaged by Thales Australia in December 2019 to complete the design, construction and installation of two state-of-the-art MDCs to support the RAN's Protected Satellite Communications capability.

The construction phase of the project has taken the team only three months to complete after receiving full client approval, with the first module and second module handed over before the end of 2020.

RJE Global Director Dean Cook said the MDCs are a pioneering concept, allowing them to be delivered to the Department of Defence as a plug-and-play facility with single modules.

"Each module exceeds 30 meters in length, 7 meters in width and 4.5 meters in height and are able to be placed side by side," Cook said. "The facilities can be designed to achieve security ratings stipulated in ASIO Tech Notes and the Defence Security Principals Framework, while achieving acoustic ratings of Dw50 radio frequency shielding, fire rating, ballasting rating, blast rating and suitable for cyclonic conditions."

## UNDERWATER COMMUNICATIONS

Communication between submarines and surface ships is technically challenging because normal radio wave signals are attenuated to a 10-metre distance when passing through salt water, because of its good conducting properties.

Although submarines normally severely limit their signals with the outside world, to protect their stealth, there are times when this in unavoidable.

There are two main choices. They can surface and raise an aerial, or remain below and float an aerial to the surface and begin transmitting through the air using normal radio frequencies. Or they can remain submerged and transmit at very low frequencies (3 – 30 KHz), although this still has a very limited range.

Either choice increases the risk of detection and consequent destruction.

Sound travels far in water, and underwater loudspeakers and hydrophones can cover quite a gap. For short-ranges underwater up to several kilometres, particularly between a submarine and unmanned underwater vehicles, acoustic signalling can be used since the low frequency sound waves are more secure, but suffer from the problem of emitting signals in a broad pattern. This is because of factors such as multi-path propagation, time variations of the channel, small available bandwidth and strong signal attenuation, especially over long ranges.

Several different modulation methods can be used with some better than others. Choices are normally made between frequency shift keying, pulse shift keying, frequency and pulse-position modulation.

Compared with terrestrial communication, underwater communication has low data rates because it uses acoustic waves instead of electromagnetic waves. They also risk being detected if they are near a pattern of hydrophones on the sea floor.

Countries like the United States, China and Russia can place sonic communication equipment in the seabed of areas frequently travelled by their submarines and connect it by underwater communications cables to their land stations. If a submarine hides near such a device, it can stay in contact with its headquarters, rather like an underwater telephone.

Blue-green lasers, whose wavelengths can penetrate seawater, are a potential high-speed secure underwater wireless communication method as long as there is a clear line of sight between transmitter and receiver. They offer a reasonably long-range high data rate in a small size unit with low power consumption. Distances available are typically limited to under 200 metres.

## IN CONCLUSION

A simulator at the Defence Force School of Signals Maritime Wing at HMAS Cerberus ensures Navy's newest Communications and Information Systems sailors join their first ships fully prepared for the rigors of operating at sea.

The simulator is based on a generic communication center in an enhanced frigate and is designed to mimic the operational environment at sea, using scenarios that may be encountered by communicators embarked in Major Fleet Units.

The current and future planned modernisation of Navy's communications systems, including satellite terminals, networks, aggregation and encryption equipment, radios, bearers and antennas will be completed in a few short years and be of lasting relevance until the end of the 2030s.

As each warships's communications equipment is upgraded, support services including integrated logistics, are vital to maintaining the installed capabilities. These will need to be deliverable at both domestic and overseas locations.

Navy is fortunate to be at the start of OPV, Future Frigate and later in the 2020s submarine construction programs so the systems being delivered to the existing fleet can be built in from scratch in the new vessels.

*Aircraft carrier HMS Queen Elizabeth with Type 45 destroyer in the background. (UK MoD / Crown copyright photo)*

**RICHARD GARDNER** // LONDON

# UK'S NEW ASIA PACIFIC DEFENCE FOCUS

On March 22, UK Defence Secretary, The Rt Hon Ben Wallace MP, presented to Parliament the long-awaited Defence Command Paper which is subtitled Defence in a Competitive Age. This document provides the most radical shift in UK defence strategy since the end of the Cold War and follows three decades of continuous overseas combat activity as well as facing up to an increasingly aggressive Russia and China.

It recognises that the world is facing a rapidly changing geopolitical backdrop and aims to adjust UK strategy in a new post- Brexit direction to a more relevant global response, adapting to new threats and new technologies. This is going to see a higher defence profile in the Asia Pacific region (referred to throughout the document as the Indo-Pacific), with more and closer cooperation with other military forces. To this will be added increased investment in base facilities in Africa, the Middle East, Indian Ocean and beyond, enhancing the defence relationship with long-established allies, particularly in India, Singapore, Australia, New Zealand, South Korea and Japan.

The report follows a few days after the publication of the government's Integrated Review, which provides a new assessment of the major trends that will shape the national security and international environment for the rest of this decade. It states that:

"The rising power of China is by far the most significant geopolitical factor in the world today. It poses a complex, systemic challenge…. we need to push back to protect our values and global interests, while maintaining our ability to cooperate in tackling global challenges such as climate change and the mutual benefits of our economic relationship.

"The significant impact of China's military modernisation (which is proceeding faster than any other nation) and growing international assertiveness within the Indo-Pacific region will pose an increasing challenge.

"China is developing a full spectrum of air capabilities including fourth and fifth generation fighters, ISTAR aircraft, heavy transport aircraft and armed, stealthy, Unmanned Air Vehicles alongside a fully integrated air defence system with the world's most modern surface-to-air missiles."

The report also points to their planned new fleet of up to five aircraft carriers and four helicopter carriers which will enable the projection of Chinese maritime power further afield and allow operations to be undertaken from increased range.

## KEY ASSET

A key Western asset, the Five Eyes partnership between Australia, New Zealand, Canada, the UK and USA is praised as:

"…fundamental to our approach. It is a group of like-minded allies with a shared view of the threats, the challenges and the opportunities. It is also the pre-eminent global intelligence sharing arrangement. But it is much more than that. It is the basis for collaboration on strategic analysis, capability development, interoperability, burden-sharing and operational co-ordination."

The document states:

"We will continue to engage as a Five Eyes community at all levels from Defence Ministers down to ensure we deliver on all that the group has to offer. Our partnerships with Canada, Australia and New Zealand will be at the heart of our tilt to the Indo-Pacific as we work to support them to tackle the security challenges in the region. The joint development with Australia and Canada of our anti-submarine warfare capability through the Type 26 and Hunter Class frigate programmes is just one of the benefits that deep collaboration can bring."

The report highlights that 1.7 million British citizens live in the Indo-Pacific region and trading relationships continue to grow and that the area is of growing importance to the UK's security and prosperity. It says:

"The region matters to the UK and is crucial to our economy, our security and our global ambition to support open societies." Increased engagement in defence extending across a wider coalition of partners is being actively encouraged to build resilience and capacity. "We will develop capability partnerships and support UK prosperity by strengthening defence exports and more specifically will:

- Increase capacity building and training across the region with more consistent military deployments and by better leveraging of our existing regional facilities.
- Maximise regional engagement as part of the Carrier Strike Group deployment in 2021.
- Increase our maritime presence in the region through the permanent deployment of Offshore Patrol Vessels from 2021, a Littoral Response Group from 2023 and later Type 31 frigates to uphold freedom of navigation.
- Pursue closer defence cooperation with the Association of Southeast Asian Nations (ASEAN).
- Guarantee regional access through existing UK bases including the British Indian Ocean Territory, access to allied facilities, and developed training facilities in Oman.

**The report also points to their planned new fleet of up to five aircraft carriers and four helicopter carriers which will enable the projection of Chinese maritime power further afield and allow operations to be undertaken from increased range.**

- Deepen and expand industrial relationships in the region including with Australia, Japan, Republic of Korea and India, underpinned by co-operation on science and technology. We will also enhance our programmes of exercises, exchanges and capability development with these key partners.
- Expand our Defence Attache and Advisor network and build a new British Defence Staff in Canberra to work alongside the existing Defence Staff in Singapore and coordinate defence activity across the region."

The document mentions that a defence relationship with Japan has deepened significantly in recent years with more training exercises and exchanges and capability development programs. Cooperation between UK forces and the Japanese Self Defence Forces will deepen, as it will by working closely in similar ways with the Republic of Korea. There are discussions in hand to develop closer industrial links with the ROK "particularly through their indigenous Light Aircraft Carrier programme."

It is understood that there are many design aspects of the UK's new aircraft carriers, such as the automated supplies delivery and weapon replenishment systems, and twin island deck layout that are of interest to the ROK, perhaps in a scaled-down iteration. There is growing regional interest in the STOVL F-35B combat aircraft which can operate from small carrier decks, and the Royal Navy and US Marines, following decades of Harrier operations, are pioneering new operational methods using their F-35Bs that maximise the efficiency of fast jet operations using short take-off and vertical or slow, rolling, landings.

These operational features will be displayed throughout the region when the UK's Carrier Strike Group makes its first deployment in a few months. Aircraft and crews from the US Marines will be integrated into the carrier air group alongside those of the RAF and Royal Navy.

## CYBER AND SPACE DOMAINS

According to the report the nuclear ambitions and activities of Iran and North Korea are threatening global stability as well as new missile programs in Russia and China. The biggest worries include the development of advanced long-range hypersonic missiles, some aimed at denying naval forces free access to open seas and the threat of disruption from the massive use of cyber interference impacting on every aspect of digital communications and core infrastructures civil and military.

This is one of the new priority areas for heavy UK investment in countering cyberspace attacks. With the UK defence budget expanding to £188 billion (AU $340 billion) over the next four years, an increase of 14%, over £6.6 billion will be allocated to research and development of advanced technologies within a new Defence and Security Industrial Strategy. This will see a new network of innovation hubs to help sustain strategic advantage through superior science and technology.

**The report highlights that 1.7 million British citizens live in the Indo-Pacific region and trading relationships continue to grow and that the area is of growing importance to the UK's security and prosperity.**

There is to be a new Defence Centre for Artificial Intelligence to be at the core of developments in AI-enabled autonomous capabilities. This is just part of a big effort to speed up what are described as "the benefits of these transformative

*NORTH SEA (Oct. 10, 2020) A Marine with Marine Fighter Attack Squadron (VMFA) 211 launches an F-35B Lightning II Joint Strike Fighter from the deck aboard the British Royal Navy aircraft carrier HMS Queen Elizabeth (R 08). (U.S. Marine Corps photo by 1st Lt. Zachary Bodner)*

technologies". It adds, "Future conflicts may be won or lost on the speed and efficacy of the AI solutions employed." More investment is also aimed at new Skynet 6 communications satellites and a UK-built Intelligence, Surveillance and Reconnaissance satellite constellation which will support a digital backbone in space. The Five Eyes nations are working closely with the US to develop suitable counters to new anti-satellite systems that are being tested by China and Russia.

## SHOPPING LIST GROWS

The shopping list of new "hard effects" UK defence programs is already very long, with priority being given to two classes of nuclear submarines, including a controversial 40% increase in new, more resilient, nuclear warheads to be carried by the next series of Trident missiles in the four new Dreadnought Class Ballistic Missile Submarines. The two latest frigate classes, the Type 26 and Type 31, will be joined by another class of frigate, the Type 32, few details of which have been released, but both the Type 31 and Type 32 are designed to be highly modular to be adaptable for varied uses.

The new Type 26 will be more fully fitted with advanced systems including an outstanding anti-submarine capability. A Royal Navy Littoral Response Group will be deployed to the Indo-Pacific region in 2023, and this will provide new and expanded opportunities for training with the Royal Marines. It will have some flat deck ships which may include the second QE Class carrier in an alternative role but will more likely include a modified Bay class ship "to deliver a more agile and lethal littoral strike capability." The Royal Navy is modernising its Type 45 destroyers with enhanced missiles and other systems and starting to design an all-new Type 83 for service in the late 2030s.

**The new Type 26 will be more fully fitted with advanced systems including an outstanding anti-submarine capability.**

The final number of F-35Bs being ordered by the UK is not yet finalised beyond the rather vague "more than just the first order for 48." The fast-emerging national Tempest program (also involving Italy and Sweden) for a Future Combat Air System is diverting funds away from the original F-35 commitment for 138 as the threats and technologies change. The report describes the Tempest as a key element in the future development of the RAF and, as with the US and Australian air forces, sees the development of "Loyal Wingman" capabilities with unmanned aircraft and future defensive/offensive ISR, EW and weapons on autonomous air vehicles.

To go with these new platforms and upgraded developments of existing combat aircraft, a new generation of high speed, long range attack and air-to-air missiles is being developed. Another measure is speeding up development of laser weapon systems which can provide a rapid-response defence against incoming anti-ship missiles as well as providing a possible airborne capability.

Together with new autonomous anti-mine and anti-submarine underwater systems and a desire to enhance measures and systems that can counter the underwater threat to sea-bed communication cables, this new defence report is seen as just an opening chapter in a very much re-focused UK defence stance. At long last, and politically freed from many of the restraints resulting from membership of the European Union, the UK's too-long neglected close defence relationship with allies in the Asia-Pacific region is destined to get the attention and upgrade that it deserves.

**GEOFF SLOCOMBE** // NEW ZEALAND

# NEWS FROM ACROSS THE TASMAN

## AUSTRALIAN MILITARY PATHFINDER SATELLITE LAUNCHED FROM NEW ZEALAND

On 23 March, at Rocket Lab's Launch Complex 1 on the Mahia Peninsula, New Zealand, the successful launch of 7 satellites included UNSW Canberra Space's M2 CubeSat satellite, which represented a significant step forward in Australia's sovereign space capabilities.

The M2 mission, a collaboration between UNSW Canberra Space and the RAAF, brings together emerging technologies that deliver advanced capabilities in Earth observation, maritime surveillance, and satellite communications.

UNSW Canberra Space Director Professor Russell Boyce said M2 will deliver world-leading CubeSat technologies including formation flying where the craft is able to split into two separate satellites (M2- A and M2-B) and fly in sequence enabling significant mission flexibility. Information collected is processed through advanced in-orbit artificial intelligence, on a platform reconfigurable throughout the mission.

"The M2 mission is one of the most complex CubeSat programs ever attempted. It will enable both UNSW Canberra Space and the RAAF to gain experience and capability in the development and operation of in-orbit space science and technology missions," Professor Boyce said.

Air Vice-Marshal Cath Roberts, Head of Air Force Capability said the M2 mission is incredibly exciting as it's the first time the RAAF has used formation flying in CubeSats.

"The two satellites will be able to communicate with each other as well as ground stations back here on Earth giving better quality data with greater detail and less lag time – all fundamentally important for Australia's defence. This innovative home-grown approach has been designed to meet Australia's unique requirements for sovereign space capability," Air Vice-Marshal Cath Roberts said.

APDR notes that Defence's Project JP 9102, costing around $A7 billion, is to increase the ADF's worldwide communications capacity through enhanced allied and commercial arrangements, as well as providing sovereign satellite capability through a constellation of owned satellites supported by ground stations.

UNSW Canberra Space's Spacecraft Project Lead Andrin Tomaschett said "M2 comprises two connected spacecraft that will separate on-orbit to engage in formation flying, followed by a multitude of radio frequency, imaging and laser experiments."

It follows in the footsteps of the M2 Pathfinder Mission, which was launched by Rocket Lab NZ in June 2020 and delivered various risk mitigation exercises for the team's technologies ahead of the launch of M2.

Seven satellites featured on the mission manifest, including a technology demonstrator for the U.S. Army's Space and Missile Defense Command, and Rocket Lab's in-house designed and built Photon Pathstone. This spacecraft will operate on orbit as a risk reduction demonstration to build spacecraft heritage ahead of Rocket Lab's mission to the Moon for NASA later this year, as well as Rocket Lab's private mission to Venus in 2023.

## NETWORK ENABLED ARMY PROJECT MAJOR MILESTONE

NZDF's Network Enabled Army (NEA) program's Tranche One is scheduled for initial operating release mid-2021. When this stage of the program is complete, the Army will have connectivity in the field across its ranks – from the soldier in a Light Infantry Company to command personnel at a Task Group Headquarters, and the superior headquarters.

The main components of this Tranche are the Command, Control, Communications and Computers (C4) project, which is comprised of command post environment (the physical command post and the IT systems for Command-and-Control (C2)), universal bearer network (common access nodes for communications) and mobile tactical radio system (network-capable combat radios, a battle management system and software).

Harris Defence Australia has supplied the mobile tactical command system, including network design and delivery, along with software, systems and connecting radio equipment.

The ability to transfer data across a deployed network enables commanders at all levels within the force to access the right information at the right time so they can make the best decision to ensure mission success. In essence, commanders now require situational understanding, not simply situational awareness.

The NEA program's C2 system supports the deployed tactical headquarters to manage and disseminate information to support the commander. This means a higher tactical commander's plan can be communicated to junior commanders and individual soldiers through a mobile tactical command system.

NEA's digital communications system hosts an enhanced Sitaware battlefield management system that enables junior commanders to see friendly forces as well as known enemy force dispositions. This includes non-combatants.

Multinational connectivity is essential to coalition joint operations in the contemporary operating environment. The ability to conduct effective combined operations, whilst reducing the operational risk to friendly forces is dependent on situational understanding, and battlespace de-confliction in what, in the future, will be an increasingly congested operating space.

(APDR is pleased to acknowledge receiving some information for this item from NZ Army News magazine February 2021)

## RNZN AS A ZERO-CARBON NAVY?

In November 2019, New Zealand's parliament passed the Climate Change Response (Zero Carbon) Amendment Act. Net emissions of all greenhouse gases, except methane, are to be reduced to zero by 2050. The act requires all parts of society to examine their emissions levels and reduce them wherever possible and practicable.

There aren't any net-zero-carbon navies. But the RNZN is the only navy paying into an emissions trading scheme. It pays New Zealand's treasury a capped price of NZ$25 per tonne of carbon dioxide equivalent and receives a substantial rebate for fuel assessed as burned overseas on task. That's because those emissions are deemed international and so fall outside the scope of the national scheme.

New Zealand's future Southern Ocean patrol vessel is expected to feature clean and efficient design practices and support climate change science in Antarctica. One suggestion is that the vessel aim for part usage of methanol as fuel, noting that any spill would be almost non-toxic. New Zealand has one of the largest methanol production plants in the world

The RNZN should declare its intent to work towards becoming the world's first zero-carbon navy and seek operational and technological efficiencies in its fleet.


# EVENTS

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## IMDEX Asia
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## Avalon Airshow
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