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ADF GUIDED WEAPONS & MUNITIONS

Acquisitions and Opportunities

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ADF GUIDED WEAPONS & MUNITIONS:

ACQUISITIONS and OPPORTUNITIES

CONTENTS

DEFENCE TECHNOLOGY REVIEW
IS PUBLISHED 11 TIMES A YEAR BY SABOT MEDIA PTY LTD

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Cover
A US Army HIMARS during Exercise Talisman Sabre 2023.
Image: ADF

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ADF GUIDED WEAPONS & MUNITIONS: ACQUISITIONS AND OPPORTUNITIES

A deep dive into the guided weapons, missiles and munitions technology and corresponding acquisition projects that will equip the ADF now and into the future. *Compiled by Robin Hughes.*

The Australian Defence Force (ADF) is in the process of augmenting its missile stocks with the acquisition, or planned acquisition, of a raft of missiles and munitions. These are of diverse capability and hosted by a multitude of platforms across all three armed services.

For the most part, these are the outcomes of programs and/or decisions associated with the ambitions of the *2020 Defence Strategic Update* or the earlier *2016 Defence White Paper.* Additional stimulus – in terms of advocating the acceleration and expansion of specific acquisition programs and identifying capability gaps and priorities – was delivered through this year's *Defence Strategic Review* (DSR).

While local industrial content and manufacture is starting to play a greater role, pending the establishment of a full sovereign Guided Weapon and Explosive Ordnance (GWEO) production capability, these weapon systems will be primarily, although not exclusively, derived from the US, Europe and other key allied nations. This chimes with the Defence mantra of commonality and interoperability with the US and other allies, and the initial focus of the Commonwealth's GWEO ambitions to increase stock and supply chain surety and delivering resilience.

Nonetheless, if anything has been made clear by the conflict in Ukraine it is that in whatever fight the ADF finds itself next, the assurance of munitions supply and access to its own deep magazines will be paramount. The ADF is nowhere near achieving these two outcomes at present time and consequently lacks the ability to stay in a high-end contest or war of attrition.

Against this background, a multi-track, multi-input GWEO supply chain that ensures reliability and redundancy in the supply of missile and munitions stocks from both the US as well as non-US supplier nations that include the UK, Israel, South Korea and others from Europe such as Norway's Kongsberg would combine with selected sovereign production of missiles and munitions in Australia. This sort of approach would provide the necessary resilience and magazine breadth and depth during times of conflict or global shortages such as that being experienced currently.

Critical to moving quickly on establishing a successful GWEO enterprise and sustainable eco-system will be leveraging Australia's existing strategic industrial capabilities at Mulwala in New South Wales and Benalla in Victoria.

The Mulwala facility is a strategic defence capability compromising two separate plants: one to manufacture propellants (gun powders) and the other to manufacture a diverse range of high explosives for the ADF and select export customers. Thales Australia incorporates these high explosives and propellants into ammunition, explosive ordnance and other munitions products at the Benalla plant. Mulwala also produces rocket motors.

Exploiting existing Australian industrial capacity and infrastructure will also be crucial in manufacturing 155mm artillery rounds and other ammunition used by the ADF and Australia's allies. Mulwala, Benalla and the new Rheinmetall NIOA Munitions Maryborough facility in Queensland set up to forge and finish 155mm artillery projectiles and metal parts for other munitions such as mortar bomb bodies and 127mm naval gun ammunition are central to this sovereign capability. The capacity to reliably manufacture large volumes of 155mm artillery ammunition strengthens the strategic supply security of this critical land operations munition.

Duplicating the capabilities, corporate expertise, know-how and management depth already resident at Mulwala and Benalla in standing up a GWEO enterprise makes little sense from cost, schedule and workforce perspectives. The two facilities, therefore, should form the core of Australia's expanded sovereign GWEO production capabilities.

The following is a summary of the relevant guided weapons and munitions that are known and thought likely to be procured by the ADF within a 5-year timeframe, as well as those that potentially may be acquired but are perhaps less obvious at this time.

Whilst the precise form the GWEO enterprise will take is not yet known and participating companies and stakeholders outside appointed strategic partners Raytheon Australia and Lockheed Martin Australia still unclear, it is these products which will be the subject of industrialisation and manufacture of guided weapons and munitions in Australia as part of building that sovereign GWEO capability.

Duplicating the capabilities, corporate expertise, know-how and management depth already resident at Mulwala and Benalla in standing up a GWEO enterprise makes little sense from cost, schedule and workforce perspectives.

AUSTRALIAN ARMY

The DSR has catapulted the Army into a new era of long-range strike, anti-access/area denial, air and missile defence and littoral manoeuvre. This comes alongside the realisation that current missile and munitions stocks are inadequate for sustained ground combat operations.

HIMARS

Under Land 8113 Long-Range Fires, Army is set acquire an initial batch of Lockheed Martin **M142 High Mobility Artillery Rocket System** (HIMARS) launchers, the 300km range MGM-140 Army Tactical Missile System (ATACMS) and associated Guided Multiple Launch Rocket Systems (GMLRS) variant rockets under the provisions of a US Government Foreign Military Sales (FMS) agreement approved in May last year. According to Defence, the HIMARS system will be in use with the Army by 2026/2027, although initial deliveries are expected in 2024. A second buy of HIMARS is anticipated, pushed along by the DSR recommendation that Land 8113 Phases 2-4 be accelerated and expanded.

The HIMARS system is mounted on a modified Family of Medium Tactical Vehicles 6x6 truck cab-chassis and furnished with a loader launch module that can accommodate a pod of either six guided GMLRS variant rockets in separate tubes, one ATACMS pod with one missile, or prospectively for Australia, two **Precision Strike Missile** (PrSM) land surface-to-surface effectors.

In April, the Albanese Government announced a commitment of AUD$1.4 billion to acquire more long-range strike systems and manufacture longer-range munitions in Australia. As part of a pivot to long-range deterrence, as advocated by the DSR, Australia will accelerate delivery of additional HIMARS and the associated acquisition of PrSM Increment 1, while in parallel creating a local production capability for long-range missiles. Intended to eventually replace the legacy non-insensitive munition-compliant ATACMS currently in the US Army inventory, PrSM is being evolved via an incremental capability development program. While the US Army has yet to disclose what the PrSM's baseline range will be when the PrSM Increment 1 system is fielded, it is expected to be beyond the original baseline objective range requirement of 499km. The US Army is designing a multi-mode seeker for integration into the future PrSM Increment 2 (which will be known as the Land-Based Anti-Ship Missile); PrSM Increment 3 then seeks to add enhanced lethality payloads. Lockheed Martin and a Raytheon Technologies-Northrop Grumman team have received Army contracts to develop a new missile form factor and propulsion system for the PrSM Increment 4. Intended to strike targets at ranges in excess of 1,000km, in US Army service this weapon will be designated as the Long-Range Maneuverable Fires missile.

LEFT: A US Army HIMARS being prepared at the firing point for the live-fire execution of the bilateral US-Australian Exercise Highball 2023. The launch, conducted in late July at the Lancelin Defence Training Area in Western Australia, resulted in the successful prosecution of a maritime target using advanced integrated targeting technology. *Image: ADF*

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CHUNMOO

Following Army's selection of the AS9 Huntsman 155mm self-propelled howitzer and AS10 armoured ammunition resupply vehicles as the preferred solution for Land 8116 Phase 1, and confirmation last month that the Redback infantry fighting vehicle (IFV) will enter service starting in 2027 under Land 400 Phase 3, Hanwha Defense Australia (HDA) is now positioning the **K239 Chunmoo** multiple launch rocket system (MLRS) as a complement to the incoming HIMARS capability.

Given the current pressures on the HIMARS production line for US and overseas customers – plus the fact that HDA could readily manufacture Chunmoo MLRS in Australia, facilitate rapid introduction into service and that it is a comparatively less expensive system than HIMARS – the move has potential merit in terms of both sovereign industrial capability and the Army's operational imperative.

Based on an 8×8 cross-country truck chassis with an armoured cab and in service with the Republic of Korea Army since 2015, the K239 Chunmoo is a self-propelled multi-calibre MLRS featuring two launch pods, each of which can accommodate: 20 K33 131mm unguided rockets (range 36km), or six KM26A2 230mm unguided dual-purpose improved conventional munition rockets (range 45km), or six 239mm guided rockets equipped with either high explosive penetration or cluster munition (300 bomblets) warheads (range 80km). Hanwha also offers a 400mm (two in each pod) missile with a 200km range and the 600mm (one in each pod) Korean Tactical Surface-to-Surface Missile (KTSSM) that can engage targets out to 290km.

In its standard configuration of two 6-round 230/239mm rocket pods, Chunmoo has double the firepower of HIMARS per launcher vehicle.

As part of an October 2022 order, Poland is scheduled to receive the first 18 of 288 Chunmoo MLRS by the end of 2023.

The move has potential merit in terms of both sovereign industrial capability and the Army's operational imperative.

BELOW: The K239 Chunmoo has been in service with the Republic of Korea Army since 2015. Inset Right: The KTSSM can be seen in the centre, with the 239mm guided rocket at right. The missile shown at left is the Korean Ballistic Aerial Target System. *Images: ROK Army, Hanwha*

SPIKE LR2, FGM-148F JAVELIN, CARL GUSTAF M4

The Army is set to significantly enhance its land combat capabilities through the acquisition of new vehicle-mounted and man-portable guided and direct-fire weapon systems.

The service has selected the Rafael Advanced Defense Systems **Spike LR2** electro-optical multi-purpose wire-guided missile system as the preferred anti-tank guided missile (ATGM) solution for the Boxer combat reconnaissance vehicle and Redback IFV and for dismounted use. *DTR* understands that confirmation by Defence of a contract for the Spike LR2 acquisition is imminent, with the initial quantity of missiles to be produced in Israel.

Spike LR2 is a fifth-generation evolution of the legacy Spike LR guided multi-purpose missile (now designated Spike LR1). Furnished with an extended fibre-optic data communications link for improved engagement ranges out to 5,500m, Spike LR2 features reduced weight (13kg), enhanced lethality, advanced target recognition and tracking and a new third-party target allocation (network-enabled) enhancement with an embedded inertial measurement unit assembly. Rafael has developed two warhead configurations for the Spike LR2: a tandem high-explosive anti-tank (HEAT) warhead designed to engage main battle tanks or heavy armour; and a 'smart' multi-purpose blast warhead, with selectable fuse options, designed to engage structures, soft-skinned vehicles and personnel in open terrain.

Army will also augment its Lockheed Martin/Raytheon **Javelin** fire-and-forget medium-range ATGM inventory with the acquisition of up to 250 missiles in the latest FGM-148F configuration (Spiral 2) under the provisions of an FMS deal approved in March this year. The order does not include the new lightweight Command Launch Unit, which would enable the standard 2,500m-range system to conduct engagements of more than 4,000m. However, the F-model introduces a significant lethality improvement through the integration of a new multi-purpose warhead (MPWH). The MPWH retains the compact tandem shaped charge warhead (precursor warhead and primary warhead) to preserve Javelin's lethality against current and future armour – including explosive reactive armour – and adds a naturally fragmenting steel warhead case for enhanced lethality against soft targets and lightly armoured vehicles. The March announcement builds on an earlier Javelin FMS procurement, approved in October 2020, which provides for the acquisition of 200 FGM-148E Javelin missiles.

First entering service with Special Operations Command around 2015, Australia will acquire an additional quantity of 84mm **Carl Gustaf M4** reloadable recoilless rifles under a AUD$56 million contract placed with Saab in July this year. Saab received an initial formal order for Carl Gustaf from Defence in August 2018, worth AUD$10.6 million, to supply 217 M4 model weapons. In April 2019, Defence placed a AUD$26.3 million with Saab order to supply an undisclosed quantity of 84mm programmable munitions for the new M4. Deliveries of the latest order, which will include a quantity of Saab's improved FCD 558 electro-mechanical fire-control systems, are scheduled for 2024-2025.

An undisclosed quantity of M4s were delivered to Army in January 2021 to commence technical certification, with the remaining units intended 'for delivery over the next 5 years', according to Saab. Army commenced operational test and evaluation of the M4 in May 2021 and introduction into service in mid-2021.

ABOVE: FGM-148 F-model Javelin missiles. More than 20 years after its first Javelin order, the latest order from Australia came in March 2023 for 250 F-model Javelins. *Image: Lockheed Martin*

BELOW: Despite having been used by special operations units for several years, the wider Army formally introduced the Carl Gustaf M4 into service in mid-2021. *Image: ADF*

SHORT-RANGE DIRECT FIRE SUPPORT WEAPON

European missile house MBDA Systems confirmed to *DTR* that it will compete its 89mm **Enforcer** shoulder-launched land combat guided missile system as a candidate solution for the Army's short-range direct fire support weapon requirement under Land 159 Tranche 2. Selected by the German Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support in December 2019 under a competitive acquisition process for its 'Leichtes Wirkmittel 1800+' project, Enforcer will enter service with the German Armed Forces – its inaugural user – in 2024 where it will initially equip special operations units.

DTR understands that Varley Rafael Australia will also put forward the **Spike SR** missile for the Tranche 2 requirement. The Spike SR round incorporates a Rafael-designed strap-down dual uncooled infra-red, high-resolution charge coupled device seeker, an advanced tracker able to acquire and track fast-moving targets at short range and a 'unified' motor (i.e the missile does not have a separate booster to expel it from the launch tube). The original stated maximum effective range for Spike SR was 1,000m (with a minimum engagement range of 50m), but Rafael is now declaring an effective range of 2,000m.

The original stated maximum effective range for Spike SR was 1,000m, but Rafael is now declaring an effective range of 2,000m.

BELOW: The Enforcer from MBDA is likely to be a candidate to fulfill the short-range direct fire support weapon requirement under Land 159 Tranche 2. *Images: MBDA*

HDA is here to stay

Hanwha Defense Australia

Hanwha Defense Australia (HDA) is committed to its Australian presence. We are ahead of schedule in the construction of the Hanwha Armoured Vehicle Centre of Excellence (H-ACE) next to Avalon Airport due for handover completion and the start of operations in Q3 2024.

This facility is supported by the Victorian Government and is the foundation of our Australian defence programs both current and future. The Huntsman family of vehicles will be manufactured here, bringing back high technology vehicle manufacturing to the Geelong region for Australian and international customers into the future.

Hanwha Defense Australia

READY. RELIABLE. RESPONSIVE.

NASAMS

Army will operate the Kongsberg National Advanced Surface-to-Air Missile System (NASAMS) capability as the lower-tier component of the burgeoning Air Force-led Integrated Air and Missile Defence (IAMD) architecture.

Approved in March 2017 as the preferred solution for Land 19 Phase 7B, **NASAMS** introduces a new distributed and networked tactical mobile short-range ground-based air defence (SRGBAD) capability that replaces the Army's legacy RBS-70 man-portable very short-range air defence system. The Army will acquire at least 20 NASAMS fire units. Land 19 Phase 7B is expected to declare initial operating capability this year, and final operational capability in 2026.

Currently the most advanced NASAMS configuration, the Australian solution introduces a new customised Fire Distribution Centre (FDC) manufactured and integrated in-country by Kongsberg Defence Australia (KDAu), the latest Kongsberg Mk 2 canister launcher and Raytheon-designed High-Mobility Launcher (HML), government-furnished **AIM-120 AMRAAM** and **AIM-9X** Block 2 surface-to-air missiles, a Raytheon AN/AAS-52 Multi-spectral Targeting System (an electro-optical/infra-red guidance system with a high resolution day/night imaging sensor, and integrated laser rangefinder) and mobility support delivered by the in-service Thales Australia Hawkei 4x4 Protected Mobility Vehicle – Light (PMV-L) and Rheinmetall 40M 4x4 and HX77 8x8 tactical trucks. The entire radar sensing component is built in Australia by CEA Technologies. Two configurations are being integrated: the HX77-mounted CEAOPS long-range surveillance and cueing radar (an evolution of the company's active phased-array S-band ground-based multi-mission radar) and the Hawkei-mounted CEATAC tactical radar.

BELOW: Images showing the NASAMS Mk 2 canister launcher firing an AIM-9X missile (left) and HMMWV-mounted HML firing an AMRAAM. *Images: Kongsberg, Norwegian MoD*

Outside of Australia, NASAMS is widely considered a medium-range air defence system.

NASAMS CONT.

However, even though Defence designates Land 19 Phase 7B as a SRGBAD, outside of Australia, NASAMS is widely considered a medium-range system. In theory, with the integration of longer-range effectors, notably the new **AMRAAM-ER**, this could potentially offer the ADF an accelerated, de-risked sovereign solution to the Air 6502 Medium-Range GBAD (MRGBAD) requirement as per the DSR directive for 'accelerated capability' and 'the exploration of in-service off-the-shelf solutions. A request for proposals for Air 6502 was released to industry in September 2021. A Defence spokesperson told *DTR* that "Air 6502 intends to present capability options for consideration to Government in 2025".

"NASAMS is in the early part of the medium-range spectrum, but it's still a medium-range capability," KDAu general manager, John Fry, told *DTR*. "The big change that is happening right now is the integration of the AMRAAM-ER missile. That essentially provides a third effector into the NASAMS capability. And AMRAAM-ER gives you a significant increase in range, altitude and speed. So, the range of NASAMS is significantly extended as a result of including AMRAAM-ER."

As an example, the Netherlands Ministry of Defence in June announced that it would merge its short-and medium-range air defence requirements into a single solution delivered by NASAMS, without mentioning AMRAAM-ER, but noting that its SRGBAD and MRGBAD system engagement ranges would be up to 15km and 50km respectively.

"Our configuration of NASAMS being delivered in Australia will already have the CEAFAR long-range radar, so we are suggesting that Defence acquire a longer-range effector. The system is hardware prepared – it just requires a minor software change and it's ready to go," said Mr Fry. "What we are proposing to Air Force for Air 6502 is the Mk 2 canister launcher with the HX77, CEAOPS radar, FDCs – all the hardware and elements that Army is already acquiring but with the addition of AMRAAM-ER – and they have a ready MRGBAD system. They can also leverage the lessons learned from Army – all the integration work that has been done for Land 19 Phase 7B, all the qualification etc. They'll have an architecture that carries short and medium range, and there are opportunities to even provide longer-range effectors into NASAMS, and shorter ranger systems."

An upper tier effects solution, delivered through the follow-on Air 6503 Advanced High Speed Missile Defence program, aims to develop a long-range air and missile defence capability against ballistic and manoeuvring hypersonic missiles which will also be integrated into the soon to be announced Air 6500 Joint Air Battle Management System as a supporting layer of the IAMD architecture. "Air 6503 intends to present capability options to Government beyond 2025. Government submissions will provide implementation options and timelines," a Defence spokesperson added.

BELOW: AMRAAM-ER undertaking its first NASAMS firing in May 2021. *Image: Raytheon*

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This means we are equipped and ready to deliver the next generation of guided weapons in support of the Commonwealth's aspirations to establish a national GWEO Enterprise.

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Expanding our Australian GWEO capability and capacity

As the nation's leading weapons system developer, BAE Systems Australia is expanding its advanced manufacturing capacity to support the establishment of a sovereign GWEO Enterprise.

BAE Systems Australia will design, develop, test and deliver a new generation of GWEO products that will increase and sustain sovereign industry capability for the Commonwealth and our global customers.

Nulka active missile decoy IN SERVICE LEARN MORE

BAE Systems Australia manufactures Nulka, a rocket-propelled, active missile decoy system designed to 'seduce' modern anti-ship missiles away from their targets, protect them and their crews.

Evolved SeaSparrow Missile IN SERVICE LEARN MORE

BAE Systems Australia manufactures sub systems for the Evolved SeaSparrow Missile (ESSM), a medium-range, surface-to-air missile developed to protect warships from advanced anti-ship cruise missiles.

Joint Strike Missile IN PRODUCTION LEARN MORE

BAE Systems Australia supplies Passive RF Sensors for the Kongsberg Joint Strike Missile (JSM), a long-range precision-guided missile primarily designed for integration with fixed-wing aircraft to engage land and naval targets.

Razer™ IN DEVELOPMENT LEARN MORE

BAE Systems Australia has created the Razer low-cost precision guided munition (LCPGM) as a sovereign glide munition able to be deployed from a range of airborne platforms to engage targets with great accuracy.

MBDA Partnership IN DEVELOPMENT LEARN MORE

BAE Systems Australia and European missile group MBDA have announced a collaboration agreement that will support Australia as it develops its sovereign Guided Weapon and Explosive Ordnance (GWEO) Enterprise.

Hypersonic Weapons IN DEVELOPMENT LEARN MORE

BAE Systems Australia is investing in high speed weapons systems, including hypersonic long-range strike and hypersonic and ballistic missile defence, providing the opportunity for an enduring sovereign capability and to position the nation as a major global contributor in this disruptive and important technology field.

BAE SYSTEMS

HELLFIRE, JAGM, SPIKE NLOS

The Army will acquire 29 Boeing AH-64E Apache Guardian attack helicopters from 2025 to replace the existing fleet of 22 Tiger armed reconnaissance helicopters via Land 4503. Equipped with integrated Link 16 networking and manned-unmanned teaming, the new AH-64Es will initially be furnished with the Lockheed Martin **AGM-114R2 Hellfire II** (Hellfire Romeo) semi-active laser homing air-to-surface missiles (current range 8-11km) and the BAE Systems **Advanced Precision Kill Weapon System II** (APKWS II) laser-guided 70mm rockets (range approximately 6km with the APKWS Block Upgrade).

However, the US Army and US Marine Corps are preparing to transition from Hellfire to the new semi-active laser/millimetre wave (MMW) radar-guided **AGM-179A Joint Air-to-Ground Missile** (JAGM) for their rotary-wing platforms. With the same range as Hellfire, JAGM has also been selected by the British Army to equip its AH-64Es. With its Apache 'interoperability' mantra firmly entrenched, Australia is likely to follow suit in the future once its Hellfire stocks are depleted or at end-of-life. "We want to stay aligned with what the US, and the UK, are doing on Apache," an Australian Army Aviation Command spokesperson told *DTR*.

Lockheed Martin is already investing in future JAGM product improvements including increasing range out to 16km in the JAGM Medium Range variant, without impacting the missile's length or diameter. JAGM-MR could potentially offer a longer-range air-to-surface solution for the Australia's Apache fleet.

BELOW: The Spike NLOS is likely to be proposed for the Australian Army's new AH-64E Apache as a longer-range complement to Hellfire and JAGM. *Image: Rafael*

The JAGM could also be a future option for the Royal Australian Navy's (RAN) Sikorsky MH-60R Seahawk naval combat helicopter fleet, which is currently furnished with the metal augmented charge-equipped AGM-114N Hellfire – a variant optimised for use in the anti-surface warfare role. The RAN's Fleet Air Arm will field three MH-60R squadrons (36 platforms) by 2025/2026, and the platform will be cleared for JAGM/JAGM-MR carriage following anticipated US Navy (USN) acceptance.

Rafael is positioning a sixth-generation evolution of its **Spike NLOS** (non-line-of-sight) dual-mode uncooled electro-optical/imaging infra-red (IIR) precision-guided missile – **Spike NLOS Mk 6** – as a complementary, longer-range effector to the AGM-114R2/JAGM for the Australian Army's Apache fleet. The US Army has adopted Spike NLOS as an interim, and potentially permanent, solution to the Long Range Precision Munition requirement for its AH-64E Apache fleet that allows engagement of threats from safe stand-off ranges.

The new Spike NLOS Mk 6 development retains the inherent functionalities of the Mk 5 but introduces new software-enhanced capabilities including 'salvo launch and control', allowing a single operator to launch and control salvos of up to four Spike NLOS Mk 6 missiles simultaneously from a single launcher, to engage four different targets, or deliver synchronised enhanced effects on a single target. The company has also integrated its new Target Image Acquisition (or scene-matching) technology with the Mk 6 to enable swift image transfer to the airborne missile system.

Rafael has also extended the range of the Spike NLOS Mk 6 to up to 32km from ground/surface launch and up to 50km for helicopter-launched applications. This has been achieved through a combination of hardware modifications to the deployed mid-body wing assembly and trajectory shaping through new software insertions.

The Spike NLOS Mk 6 integrated onto a two-door Hawkei PMV-L is being touted as a prospective land-based direct fires solution in an armed reconnaissance/anti-armour role for the Australian Army. A Rafael spokesperson told *DTR* that Spike NLOS Mk 6 is currently in "the final stages of development".


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The Enforcer light shoulder-launched guided weapon system can be used to engage a broad variety of targets at ranges beyond the capability of currently available infantry weapons, including fast moving vehicles and targets behind cover. Enforcer is under contract and ready when it counts.

155MM AMMUNITION

Whilst guided weapons and advanced munitions are fundamental to GWEO, so too is the domestic large-scale manufacture of 155mm artillery ammunition.

Under a US Army Co-operative Research and Development Agreement, Thales Australia has achieved certification from the US Government to manufacture TNT high-explosive (HE) content for 155mm **M795** artillery projectiles, with that same Australian-made TNT now being certified for export for use by the US military. Thales subsequently commenced production of M795 projectiles at the Benalla facility in 2022.

Through NIOA, the Army is using Rheinmetall's **Assegai** family of 155mm ammunition, with the Queensland firm formally extending its deal with Defence to 'future proof' supply surety of this ammunition under the Land 17-1C.2 Future Artillery Ammunition program.

The modular Assegai 155mm ammunition system of projectiles, propelling charges, fuses and primers can be configured in multiple ways to increase lethality and range for training and operations. Natures include conventional HE, insensitive munition HE (IHE), IHE pre-fragmented, screening smoke, illumination (infra-red and visual), base-bleed and the Extended Range Velocity Enhanced projectile.

BELOW: Local production of 155mm artillery ammunition will ensure adequate supply for use by systems such as the in-service M777A2 lightweight howitzer and AS9 Huntsman self-propelled howitzer. *Image: ADF*

ROYAL AUSTRALIAN NAVY

The RAN must contend with increasingly lethal operating environments and an expanded multi-tier fleet, whilst at the same time enhance its air defence and long-range strike capabilities in maritime and land domains.

ESSM BLOCK 2

Defence has already publicly acknowledged initial deliveries of the Raytheon **RIM-162 Evolved SeaSparrow Missile** (ESSM) **Block 2** advanced surface-to-air missile (SAM) capability for the RAN's surface combatants. Acquired through NATO's SeaSparrow Consortium under an initial tranche of Sea 1300 in February 2021, ESSM Block 2 will replenish and upgrade the RAN's existing ESSM inventory. The project also encompasses upgrades to the existing Australian missile maintenance infrastructure and to the ANZAC-class frigates so these ships are capable of using the full range of features on the new missile. ESSM Block 2 is initially being integrated with the eight ANZAC-class frigates and will later equip the Hobart-class air warfare destroyers, and in the longer term, the new Hunter-class frigates.

Building on the pedigree of the earlier Block 1 missile, ESSM Block 2 features new dual-mode X-band seeker, introducing an active radar channel alongside semi-active radar homing (the active seeker supports terminal engagement without requiring target illumination by the launch ship).

ABOVE: ESSM firing from the Mk 41 VLS on the destroyer HMAS Sydney. *Image: ADF*

SM-6/SM-2 IIIC

As part of Sea 1300 maritime guided weapons funding announced in February 2021, Defence also signalled an investment in Raytheon **Standard Missile 6 Block I** (SM-6) and **Standard Missile 2 Block IIIC** (SM-2 IIIC) air and missile defence interceptors to meet the RAN's advanced SAM requirements.

The RAN will field both variants on the Hunter-class frigates through a AUD$483.5 million FMS acquisition approved in August 2021. A modification to existing SM-2 Block III and IIIA missiles, the SM-2 IIIC is a medium-range SAM with an active radio frequency seeker derived from the SM-6. The SM-6 Block I is a longer-range air defence weapon that can also be used as an anti-ship missile. It could also provide a ballistic missile defence capability, which would require the Baseline 9 configuration for the Aegis combat system onboard the Hunter-class.

> ***The RAN will field both variants of SM-6 and SM-2 on the Hunter-class frigates through a AUD$483.5 million FMS acquisition approved in August 2021.***

RGM-109 TOMAHAWK

The Navy will also field a new ship-borne cruise missile capability to equip the Hobart-class destroyers under the provisions of a AUD$1.34 billion **Tomahawk** land attack missile (TLAM) FMS package approved in March this year. The package provides for up to 200 RGM-109E Block V (TLAM-E Block V) and up to 20 RGM-109E Block IV (T-LAM-E Block IV) Tomahawk missiles, along with the Tactical Tomahawk Weapon Control System and the Theater Mission Planning Center.

Introduced in 2006, the Block IV Tomahawk variant features a strike controller which can change the missile in flight to one of 15 pre-programmed alternate targets or redirect it to a new target. This targeting flexibility includes the capability to loiter over the battlefield awaiting a more critical target. The missile can also transmit battle damage assessment imagery and missile health and status messages via the two-way satellite data link. Firing platforms now have the capability to plan and execute GPS-only missions. Block IV also has an improved anti-jam GPS receiver for enhanced mission performance.

The latest Block V variant, introduced in 2021, embodies a navigation/communications package for enhanced navigation performance and more robust and reliable communications. It also provides the entry point for two additional sub-variants: the Block Va variant, which adds a seeker kit to enable the prosecution of moving maritime targets; and the Block Vb variant, which introduces a new multi-effects warhead in place of the existing unitary warhead.

ABOVE: A Tomahawk land attack missile is launched from an Arleigh Burke-class guided-missile destroyer during a 2019 live-fire demonstration exercise. *Image: US Navy*

The latest Block V variant, introduced in 2021, embodies a navigation/communications package for enhanced navigation performance and more robust and reliable communications.

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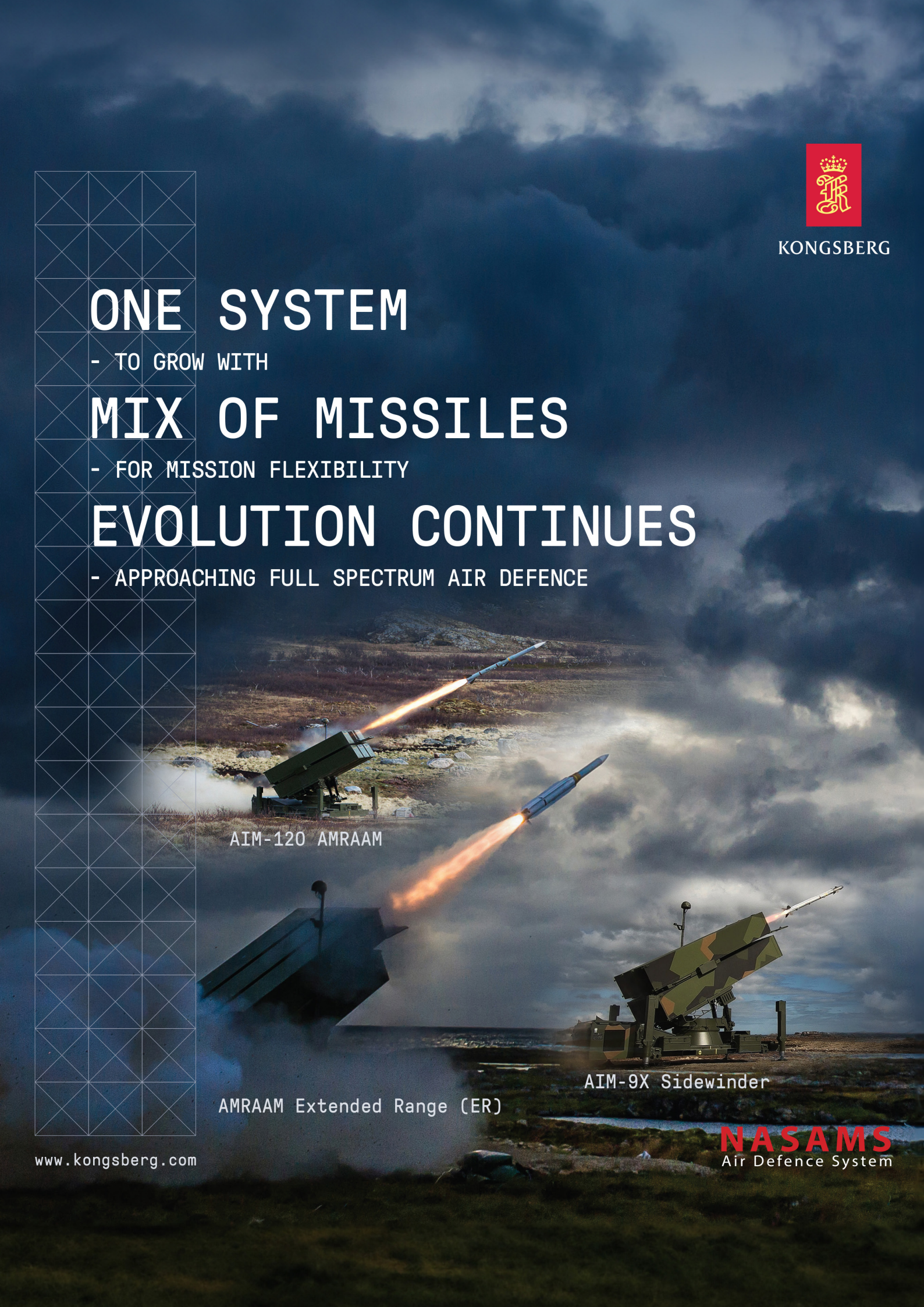

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NAVAL STRIKE MISSILE

The RAN is acquiring an undisclosed quantity of the Kongsberg **Naval Strike Missile** (NSM) Block 1A anti-ship missile (ASM) to replace the ageing RGM-84 Harpoon Block II ASM on the ANZAC-class frigates and Hobart-class destroyers, as part of a broader AUD$3.5 billion package announced in April 2022. The number of missiles, potential value contract, and delivery schedules have not been formally disclosed, although the accelerated timeframe provides for an installed capability on the surface fleet inside approximately 20 months, about 5 years sooner than planned for a new maritime strike capability.

Detail of the precise nature of the modifications and improvements embodied in the Block 1A missile have not been made public. However, Kongsberg now references a longer unclassified range of greater than 275km for the Block 1A. Key operational gains over the Harpoon include the Block 1A's high discrimination, low-observable, sea-skimming attack profile use of infra-red homing instead of detectable radar, and extreme endgame manoeuvres.

The NSM configuration on the ANZAC and Hobart classes has not been confirmed, although it should be a like-for-like replacement, with the two four-canister Harpoon launchers replaced with a pair of standard four-pack NSM Launch Missile Modules (LMM). NSM Block 1A will enter RAN service from 2024.

DTR understands that NSM will also equip the new Hunter-class frigates and may also be installed on the troubled Arafura-class offshore patrol vessels should the Commonwealth determine these platforms are to be up-armed.

ABOVE: NSM will replace the Harpoon ASM across all three of the RAN's surface combatant classes. *Image: Kongsberg*

In the land domain, NSM also has strong potential to meet the Australian Army's requirement for a vehicle-mounted land-based ASM capability via Land 4100 Phase 2. Here, NSM would be installed on the Bushmaster flat-bed utility, a coupling known as StrikeMaster. A joint development between KDAu and Thales Australia, the StrikeMaster integrates a twin NSM LMM configuration onto the vehicle.

C-DOME

Depending on the Commonwealth's appetite for improving the platform's offensive and defensive capabilities, a stand-alone weapon system option for the Arafura-class offshore patrol vessels might be Rafael's containerised **C-Dome** naval area air defence missile system.

A maritime version of the operationally-proven Iron Dome air defence/counter-rocket, artillery and mortar system, C-Dome in the containerised configuration consists of a container-mounted combat management system and radar paired with modular 5-round vertical launch packs of Tamir interceptors. Effective range of the Tamir interceptor is understood to be up to 70km.

Effective range of the Tamir interceptor is understood to be up to 70km.

ROYAL AUSTRALIAN AIR FORCE

Already well catered for in its inventory of precision-guided missiles and munitions, the RAAF will continue to acquire leading-edge air-to-air and air-to-surface weapons in support of air, maritime, littoral and land operations.

AIM-9X/AIM-120

The primary air-to-air missiles (AAM) for Royal Australian Air Force (RAAF) fixed-wing platforms (F-35A, F/A-18F, E/A-18G) are the RTX (previously Raytheon Technologies) active radar homing **AIM-120 Advanced Medium Range Air-to-Air Missile** (AMRAAM), and the **AIM-9X Sidewinder** IIR-guided within visual range AAM. Variants of both (namely the AIM-120C-7 and AIM-9X Block II) will also be used with the Army's Enhanced NASAMS SRGBAD system being introduced via Land 19 Phase 7B.

In 2019, the RAAF bolstered its air-launched AIM-9X inventory with the more advanced AIM-9X Block II+ variant. Block II/II+ adds a redesigned fuse and a lock-on-after-launch capability using a new weapon datalink to support limited beyond visual range engagements.

While the RAAF currently operates the AIM-120C-5, AIM-120C-7 and AIM-120D variants of AMRAAM in the air-launched beyond visual range role, the service has expressed an interest in the new, upgraded **AIM-120D-3 AMRAAM** variant, sources close to the program disclosed to *DTR*.

AIM-120D-3 is the new missile designation for the Form, Fit, Function Refresh (F3R) program for the active radar-homing AIM-120D. Launched in December 2021, F3R is a comprehensive AMRAAM Diminishing Manufacturing Sources and Material Shortages program designed to mitigate obsolescence issues – including a redesign of 50% of the critical circuit card assemblies – in the AMRAAM guidance section, and enable missile production beyond Production Lot 32, which was awarded in March 2018. In addition to the F3R hardware upgrade, the AIM-120D3 also benefits from enhancements introduced through the AIM-120 AMRAAM System Improvement Program (SIP) – a weapon software tape upgrade series enabled by the F3R's significantly augmented processing power and structured to deliver increased performance enhancements, including radar performance, to counter emerging threats employing advanced electronic attack. The latest SIP Tape 3F software, a re-host of SIP 3 capabilities specifically designed for the AIM-120D-3 (F3R) missile variant, will be incorporated in the AIM-120D-3 missile as part of Lot 33 AMRAAM production beginning this year. The combination of the new FR3 guidance section and software from SIP 3F will deliver 'significantly' greater range and performance to AMRAAM – where improved processing capabilities extend the missile's time of flight by more efficient navigation rather than by increasing the amount of propellant or changing the motor – although the specific engagement range of the AIM-120D-3 remains classified. The same upgrade will be tested on the exportable AIM-120C-8 variant AMRAAM.

ABOVE: In June this year RTX was awarded a AUD$1 billion-plus contract for AIM-120 D-3 AMRAAM. *Image: Raytheon*

The US Air Force (USAF) and Raytheon, an RTX business, this year successfully completed all developmental and operational testing of the AIM-120D-3, which concluded with an F-16 live-fire of the missile with production hardware and software. The new missile is on contract with Raytheon for production starting with Lot 33. Australia is on contract for new AMRAAM Production Lot 36 missiles, implicit to which is the AIM-120D-3.

However, as the air threat evolves, Australia will eventually require a longer-range air-to-air capability. This could, prospectively, be delivered through a new and currently classified beyond visual range AAM being developed by Lockheed Martin designated the **AIM-260 Joint Advanced Tactical Missile**. The AIM-260 will have similar dimensions to the AIM-120D to mitigate disruption of launch platform integration technologies. AIM-260 production is expected to overtake AIM-120 production by 2026.

JASSM-ER

The RAAF will also bolster is stand-off anti-surface warfare capability with the acquisition of 80 Lockheed Martin **AGM-158B Joint Air-to-Surface Standoff Missile-Extended Range** (JASSM-ER) weapons – prospectively including the latest AGM-185B-2 JASSM 'extreme-range' variant – following US State Department July 2022 approval of a possible FMS to Australia.

Furnished with a 2,000lb (907kg) penetrator/blast fragmentation warhead, the 370km-range baseline JASSM combines a low-observable airframe with a precision navigation and guidance package (combining inertial guidance with an anti-jam GPS capability) and an IIR terminal seeker. The AGM-158B JASSM-ER variant extends range out to more than 900km with the integration of the more efficient Williams International F107-WR-105 turbofan engine and a larger fuel volume that does not impact the missile's payload or electronics capability.

LEFT: RAAF leadership has said that acquisition of the JASSM-ER is planned for 2024. *Image: Lockheed Martin*

The latest AGM-158B-2 development effectively enhances the AGM-158B JASSM-ER with a new wing assembly to deliver a stand-off range in excess of 1,000km. Lockheed Martin characterises the wing development as a 'novel design' that leverages laminar flow technologies to deliver a "significant standoff range increase" for the JASSM-ER. The AGM-158B-2 development also includes integration of a Military-code (M-code) receiver – a new military signal used in the L1 (1575.42 MHz) and L2 (1227.60 MHz) GPS bands designed to improve security and anti-jamming properties of military navigation using GPS.

On 6 April 2021, RAAF Air Vice-Marshal Robert Denney, then Head of Air Force Capability, disclosed that JASSM-ER would be acquired in the 2024 timeframe, with an initial capability fielded on the F/A-18F Super Hornets around 2027. A US Defence Security Co-operation Agency notification disclosed that the proposed JASSM-ER sale will improve Australia's capability to "meet current and future threats by providing advanced, long-range delivery and offensive anti-surface warfare capabilities for RAAF air platforms, including, but not limited to, the F/A-18F Super Hornet and F-35A Lightning II".

LRASM

The RAAF will also acquire an advanced maritime strike capability for its F/A-18F Super Hornets with the Lockheed Martin **AGM-158C Long Range Anti-Ship Missile** (LRASM) under Air 3023 Phase 1. Derived from the AGM-158B JASSM-ER, the AGM-158C retains the AGM-158B 1,000lb (453kg) penetrator/blast fragmentation warhead and enhanced digital anti-jam GPS/navigation-grade inertial measurement unit and introduces a new multi-mode sensor/seeker package that combines a passive radio frequency long-range sensor (developed by BAE Systems) for wide area target acquisition, with an IIR seeker for terminal targeting. An advanced weapon datalink L-Band Unit enables in-flight target updates to 'collapse' the search area. LRASM's unclassified range is stated as 'greater than 200nm' (370km).

In February 2020, the US State Department approved a potential US$900 million (AUD$1.37 billion) FMS sale to Australia of up to 200 AGM-158C LRASMs. The type is still being negotiated as part of the roadmap for the F-35A Joint Strike Fighter (JSF); however, the missile is not compatible with the type's internal weapons bay and external carriage, although possible, would compromise the stealth signature of the platform. The DSR noted that the "F-35A Joint Strike Fighter and F/A-18F Super Hornet aircraft must be able to operate the Long-Range Anti-Ship Missile".

The USN is also pursuing a modification to LRASM 1.1, initially referred to as the LRASM C-2 (and expected to be designated the AGM-158C2) which is intended to remove certain components to reduce unit cost and provide both an Offensive Anti-Surface Warfare and land strike capability. The USN plans to conduct an integrated test shot for LRASM C-2 in 2024 and reach early operational capability later that year. The LRASM C-2 development is a logical progression for

LRASM CONT.

AGM-158 development, migrating the land attack capabilities in the AGM-158A JASSM and AGM 158B JASSM-ER, and the maritime strike capabilities in AGM-158C LRASM in a new effector. The RAAF's current maritime strike program is based around the LRASM 1.1 and it remains to be seen if the service will pursue a future LRASM C-2 capability.

RIGHT: An LRASM skims across the ocean during a test flight. *Image: US Navy*

LRASM SURFACE LAUNCHED

Lockheed Martin Australia (LMA) is now seeking to exploit the advanced maritime strike capability of the air-launched AGM-158C Block 1.1 LRASM variant in a surface-launched configuration for the RAN's Sea 1300 Future Maritime Strike project.

The baseline AGM-158C LRASM is 4.27m in length, has a wingspan of 2.4m and weighs approximately 907kg. LRASM-SL with the Mk-114 booster is almost 6.1m long, weighs 1,475kg and currently has a stated range decrement of approximately 5% compared to the air-launched LRASM 1.1 variant (putting range at approximately 350km).

DTR understands that in September 2022 the company submitted a study, funded by Defence, to evaluate the feasibility of integrating **LRASM-SL** on ANZAC, Hobart and Hunter-class platforms in both vertical launch and deck launch configurations, with initial focus on getting LRASM-SL on the Hobart-class by 2026. The study looked at not just the feasibility of LRASM 1.1 integration, but how to deliver a whole capability, including – in collaboration with Thales Australia – how to manage the boosters. The evaluation is expected to continue through 2023.

Designed to be compatible – and already qualified – with the Mk 41 Vertical Launch System, the LRASM-SL concept provides for a baseline LRASM furnished with a jettisonable booster. Initial LRASM-SL naval-launch testing has been conducted from the longer Mk 41 Strike Length Module using a modified Mk-114 booster and booster adapter derived from the Lockheed Martin RUM-139 Vertical Launch Anti-Submarine Rocket.

However, the Mk 114 booster is effectively a workhorse booster for the concept, and is overmatched for LRASM-SL. Accordingly, under the provisions of a wider April 2021 teaming agreement between LMA and Thales Australia in support of a sovereign national guided weapons enterprise, both partners are pursing the development objective of fielding an Australian-designed smaller form factor booster, along with associated rocket motor technologies, capable of launching an LRASM-SL. Testing of the new booster has already commenced.

Whilst the LRASM-SL is currently not a program of record in the US, LMA is also positioning LRASM-SL for the Army's emerging Land 4100 Phase 2 Land-Based Anti-Ship Missile requirement, specifically for launch from a modified HIMARS launch vehicle.

BELOW: A scale model of a standard HIMARS sits behind a canister launcher for the LRASM-SL shown in the foreground. It is believed the LRASM-SL would be integrated into the HIMARS platform, albeit with significant modifications to the launcher and vehicle. *Image: DTR*

STORMBREAKER

In late 2017, the US State Department approved a potential AUD$1.25 billion FMS sale to Australia of up to 3,900 Raytheon **GBU-53/B StormBreaker** (Small Diameter Bomb Increment II) air-to-surface weapons. StormBreaker will equip the RAAF's F-35A JSF fleet as part of the wider Air 6000 Phase 3 weapons and countermeasures initiative.

Weighing 94kg, the GBU-53/B StormBreaker is an unpowered glide bomb furnished with a unique tri-mode seeker that combines MMW radar, IIR and semi-active laser sensors with a GPS/inertial navigation system (INS) autopilot for high accuracy in adverse weather conditions. Equipped with a deployable wing assembly to achieve stand-off engagement ranges in excess of 100km against static targets or 70km against moving targets, StormBreaker incorporates a multi-function 48kg AFX-757-equipped warhead (blast, fragmentation, and shaped charge jet) designed to defeat armoured and non-armoured targets; a redesign of the warhead was performed during the development cycle to provide the capability to disable/defeat main battle tanks. The warhead fuse can be set to initiate on impact, at a pre-set height above the intended target or in delayed mode.

The munition operates in three principal attack modes: normal attack (NA), laser-illuminated attack (LIA), and co-ordinate attack (CA). It can be used against moving or stationary targets using its NA (MMW/IIR) sensors or LIA modes, and against fixed targets with its CA mode.

ABOVE: The GBU-53/B StormBreaker was most recently ordered by Norway. *Image: Raytheon*

The StormBreaker will soon achieve initial operational capability on the US Navy's F/A-18F Super Hornet.

RAZER

ABOVE: The Razer glide bomb depicted being carried by a Strix UAV. *Image: BAE Systems*

In line with the Commonwealth's GWEO drive, BAE Systems Australia is currently developing **Razer**, a sovereign air-launched weapon that effectively transforms a standard off-the-shelf warhead into a 40-50kg low-cost, precision-guided glide bomb.

Razer is intended as a payload for platforms such as the company's new Strix unmanned aerial vehicle (UAV) and rotary-wing aircraft that may include Australian Army AH-64E Apache attack helicopters and RAN MH-60R naval combat helicopters. Razer comprises a wing/body kit and tail unit equipped with a powered GPS/INS guidance control and navigation system.

Currently in the development stage with first flight trials scheduled by the end of 2023, the Razer project scope encompasses development, acquisition and testing of software, hardware, mechanical sub-systems and other system elements aspects of this system over the next few months to enable effective operation in air and maritime environments.

Razer is aimed at a gap in the market for sovereign guided weapons and would be manufactured in Australia.

BRIMSTONE, SPEAR 3 AND SEA VENOM

The AUKUS tri-lateral security agreement between Australia, the UK and the US lays the groundwork for alternative missile acquisition, integration and possible local manufacture opportunities, including those with MBDA Systems in the UK.

Weapon examples may include MBDA's 50kg-class **Brimstone 3**, an enhanced dual-mode guidance precision strike missile that could be optimised for Army air-to-surface strike applications with UAVs or surface-launched from a number of in-service vehicles such as the Bushmaster (flat-bed), 40M 4x4 and HX7 8x8 trucks. Brimstone could act as a 'smart' MLRS alternative, offering high-load out, salvo fire, fire-and-forget capability for both line-of-sight and non-line-of-sight engagements.

Similarly, MBDA's **Sea Venom** air-launched lightweight (120kg) anti-ship missile (range >20km) and/or the Select Precision Effects At Range **(SPEAR)** 3 network-enabled 140km range air-launched cruise missile could be integrated with platforms such as the Strix UAV for the Army (a SPEAR 3-Strix combination would have greater engagement range than PrSM at a lower cost) or operated from the RAN's Canberra-class landing helicopter dock amphibious assault ships to provide the ADF with an innovative asymmetric strike capability in support of littoral manoeuvre operations.

ABOVE: SPEAR 3 has been designed for launch by the F-35 JSF. *Image: MBDA*

GROUND-LAUNCHED SMALL DIAMETER BOMB

The Saab-Boeing **Ground-Launched Small Diameter Bomb** (GLSDB) could potentially fulfil a long-range precision strike capability for the ADF. It has the advantage of low cost compared to many other guided weapons and is built around proven sub-systems.

Under development for around 9 years, the GLSDB is designed as an affordable precision guided munition utilising common primary components. To this end, it mates the GBU-39 Small Diameter Bomb with the M26 rocket motor, both existing and proven products. Unit cost of the GLSDB is not disclosed, although the SDB costs around AUD$90,000 in 2022 dollars.

By use of a semi-active laser seeker and GPS-guided INS, the GLSDB is able to track and engage targets out to 150km. It is also able to attack targets at any angle, including behind the launcher and targets seeking cover in defilade or on reverse slopes.

Earlier this year it was announced that GLSDB will be supplied to Ukraine to provide a precision strike capability for Ukrainian ground forces. Deployment by Ukraine forces will mark the operational debut of the GLSDB, which is not yet in either Swedish or US service.

ABOVE: The Ground-Launched Small Diameter Bomb is to be supplied to Ukraine. *Image: Saab*

The GLSDB is able to track and engage targets out to 150km.

AARGM E2

Australia's EA-18G Growler electronic attack aircraft will field an enhanced capability to suppress and destroy land or sea-based radar emitters associated with enemy air defence systems at range using the Northrop Grumman **AGM-88E2 Advanced Anti-Radiation Guided Missile** (AARGM E2). Australia will acquire up to 15 AARGM E2s under the provisions of an FMS contract announced in June 2022.

The RAAF already uses the earlier AGM-88B High-speed Anti-Radiation Missile and AGM-88E AARGM with Growler. Northrop Grumman has not disclosed specific enhancements associated with the E2 variant, other than noting to *DTR* that the E2 expands "operational capabilities with both hardware and software upgrades to the advanced multi-sensor system including the MMW terminal seeker and the advanced anti-radiation homing sensor of the AGM-88E". *DTR* understands that, along with integration of the new M-Code GPS receiver, that E2 development may also include a propulsion enhancement, and possibly integration of Northrop's Lethality Enhanced Ordnance warhead technology.

More importantly, the AGM-88E2 development potentially paves the way for Australian acquisition of the in-development **AGM-88G AARGM – Extended Range** (AARGM-ER) variant.

Led by the USN, the AARGM-ER program is a range evolution of the earlier Mach 2+ capable AGM-88E Block 1 AARGM. The AGM-88G leverages existing AGM-88E baseline sub-systems and components, including the sensors and electronics, but introduces an increased diameter airframe, a new rocket motor, a new control actuation system and a new warhead design. A new solid propellant rocket motor, designed and integrated by Northrop Grumman, delivers a range increase conservatively stated as 'more than double' the existing 111km range of the AGM-88E AARGM. AARGM-ER will be integrated on USN F/A-18F, EA-18G and all variants of the F-35 JSF, accordingly making it compatible with current RAAF combat aircraft fleets.

ABOVE: It is not yet known whether Australia will acquire the new AGM-88G AARGM-ER anti-radiation guided missile. *Image: Northrop Grumman*

JOINT STRIKE MISSILE

While a contract has yet to be signed, it appears likely that the RAAF will also acquire the Kongsberg **Joint Strike Missile** (JSM).

Designed specifically for use with the F-35A JSF in an anti-ship or land attack role, the JSM is an air-launched evolution of Kongsberg's NSM and weighs 416kg, is 4m long, 48cm wide (stowed) and 52cm tall. Equipped with a programmable fuse, the missile features a 226kg combined blast (primary effect) and fragmentation warhead (secondary effect) high-explosive charge warhead encased in titanium alloy, with a gross weight of 120kg and a net explosive quantity of 100kg (TNT equivalent). A Link 16-compatible two-way datalink provides for target updates, re-targeting, mission abort and Bomb Hit Indication communication. Currently, guidance is delivered by an INS, aided by GPS and terrain contour matching systems. The missile features a terminal target acquisition capability with autonomous target recognition enabled by an IIR seeker. Terminal accuracy is given as less than 0.6m (distance between the aim point and actual hit point). The specific range of the missile has not been disclosed.

Integrating the JSM onto the F-35A is arguably key to the air capability program given that it is the only long-range strike missile that will fit inside the F-35A's internal weapons bay. The DSR recommends that "the Joint Strike Missile (JSM) should also be integrated onto the F-35A. To enable the F-35A fleet to operate the JSM, the aircraft will need to be upgraded to Block 4 configuration," to which the Albanese Government has agreed 'in principle'.

ABOVE: As one of few missiles designed from the outset for internal carriage by the F-35A JSF, the JSM is a high probability of being procured by the RAAF. *Image: DTR*

ADVANCED HIGH-SPEED WEAPONS

Current Australian initiatives in advanced high-speed weapons (AHSW) development draw on decades of indigenous pioneering research in hypersonic propulsion and other related technologies, and the incremental build-up of technology capability and management process conducted by Defence, in collaboration with academia, industry and international agencies.

An initial AHSW strike capability is expected to result from the Australian-US Southern Cross Integrated Flight Research Experiment (SCIFiRE) project – a collaborative research and technology agreement established between Defence and the US Department of Defense in November 2020 under the auspices of the Allied Prototyping Initiative. The program builds on legacy US/Australian hypersonics research collaboration established in 2007 under the Hypersonic International Flight Research Experimentation (HIFiRE) program.

Touted as a bilateral effort, which 'leverages' US and Australian collaborative hypersonic activities under the HIFiRE program, SCIFiRE is envisaged in Washington as a bridge between two US scramjet-powered hypersonic weapons efforts: the joint Defence Advanced Research Projects Agency (DARPA)-US Air Force (USAF) Hypersonic Air-breathing Weapon Concept (HAWC) and DARPA More Opportunities for HAWC (MOHAWC) programs and the USAF's Hypersonic Attack Cruise Missile (HACM) project.

"SCIFiRE is a part of the AUD$9.3 billion earmarked in the *2020 Force Structure Plan* for high-speed, long-range strike and missile defence, including hypersonic development, test and evaluation," a Defence spokesperson told *DTR*. "In addition to the financial commitment, Defence is providing in kind contributions inclusive of workforce, facilities and testing ranges, and science and technology resources. SCIFiRE is an example of our ability to work with our partners in the US on leading edge hypersonic capabilities," the spokesperson added.

According to the RAAF, the first iteration of an AHSW derived from SCIFiRE will be a Mach 5-class precision strike missile that is propulsion-launched and powered by an air-breathing scramjet engine. It will be capable of being carried by tactical fighter aircraft such as the F/A-18F Super Hornet, EA-18G Growler and F-35A JSF, as well as the P-8A Poseidon maritime patrol aircraft. However, SCiFIRE and other operational high-speed weapon activities in Australia remain largely classified.

In January this year, the Australia's Defence Science and Technology Group (DSTG) officially unveiled its new AUD$14 million purpose-built Hypersonic Research Precinct at Eagle Farm, in Brisbane. Research and development efforts at the facility – which supports collaboration between Defence, industry, academia and international partners to advance the development of hypersonic technology – will focus on high-speed and hypersonic flight research and technologies, with the goal of improving technical understanding and application through flight test vehicles.

According to Professor Tanya Monro, Australia's Chief Defence Scientist and head of DSTG, the precinct is a response to Australia's changed strategic circumstances and represents the organisation's confidence to develop capabilities that can deter adversaries or deliver response if required. "The Precinct allows us to quickly prototype hypersonic test vehicles and technologies that can then be flown at [the] Woomera [test range in South Australia]," Ms Monro said. This was the first time DSTG had publicly outed itself in terms of its sponsorship of Eagle Farm, and the fact that its Disruptive Hypersonic Technologies arm is working on a range of hypersonic activities there. DTR


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