PUTTING THE GR

RAAF to equip Growler for the future with AARGM & NGJ

RR IN GROWLER

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With the RAAF nearing an initial operational capability (IOC) for its Boeing EA-18G Growler, it is not resting on its laurels. Already, near and longer-term future capabilities for the Growler are being studied.

Determined to stay in "lockstep" with the US Navy as it continues to develop the Growler's electronic attack capabilities, the RAAF has already committed to two major capability enhancements for its EA-18G.

AARGM

Well before the Growler acquisition, the RAAF had long sought to equip its combat aircraft with an anti-radiation missile (ARM) capability to attack hostile radar systems.

In the 1960s, the RAAF looked at various ARMs to equip its new F-111 strike bombers, including the French Martel AS-37 and the US's AGM-45 Shrike and Standard ARM.

US forces fired a great number of Shrikes in the Vietnam War with marginal effect, highlighting the shortcomings in this first-generation capability.

The first Shrike was followed by a succession of variants designed to deal with obvious problems, including differing radar bands and the tactical reality that any radar operator spotting an incoming missile promptly switched off. But Shrike was considered too slow, and the warhead too small for assured destruction of the targeted radar system.

Israel found this out the hard way during the 1973 Yom Kippur War. Its Shrikes could target Russian SA-2 and SA-3 missile radars, but had difficulty with the more advanced SA-6.

Both Shrike and Standard ARM were superseded by the AGM-88 HARM (High Speed Anti-Radiation Missile) which was developed in the 1970s and adopted into US service in 1985. Again Australia was interested, and the RAAF Aircraft Research and Development Unit (ARDU) in conjunction with the US Navy China Lake missile test facility conducted carriage and release trials with the F-111 in 1987-88 at a cost of $1.6 million.

Four inert test missiles were launched from ARDU's instrumented F-111C (A8-132) into the Southern Ocean under various test conditions, proving it could be done. But at that time there were other priorities, the primary one being the modernisation of the F-111's obsolete analogue avionics through the Avionics Update Program (AUP) which ran to 1999.

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Instead, an ARM capability would have to wait for the F-111's replacement with the acquisition of 24 Boeing F/A-18F Super Hornets, delivered from 2009.

Growler is the electronic warfare variant of the Super Hornet, with systems designed to degrade, deceive and deny enemy use of the electro-magnetic spectrum, including their radars and communications.

So alluring was the potential of this capability that in May 2013 it was announced the RAAF would instead buy 12 new-build EA-18G Growlers off the Boeing production line (instead of an earlier plan to modify 12 F/A-18Fs to Growler configuration), giving the Air Force a total of 36 Super Hornet/Growler airframes.

The final Growler arrived in July 2017, and initial operating capability is expected to be declared shortly. They are operated by 6 Squadron based at RAAF Amberley, and the RAAF is currently the only Growler operator other than the US Navy.

But to kill rather than just disrupt enemy emitters, Growler needs an ARM. And well before the first Growler landed, the RAAF had been thinking about weapons, specifically an ARM capability. In 2012, the US Navy signed an agreement with Australia to provide a training capability for HARM and for its successor, the AGM-88E Advanced Anti-Radiation Guided Missile (AARGM).

Last year, the US Defense Security Cooperation Agency (DSCA) announced a proposed Foreign Military Sale (FMS) deal, comprising up to 70 HARMs, 40 AARGMs, 16 captive air training missiles (CATMs) plus assorted control and guidance sections, support equipment and technical assistance. Estimated cost was US$137.6m (A$183m).

Prime contractors for the missiles and associated systems are Orbital ATK and Raytheon Missile Systems.

"The proposed sale will improve Australia's capability in current and future coalition efforts. Australia will use this capability as a deterrent to regional threats and to strengthen its homeland defence," the DSCA release stated.

"Australia will have no difficultly absorbing these additional missiles into its armed forces. The proposed sale of this equipment and support does not alter the basic military balance in the region."

In most recent conflicts in which air power has played a significant role, ARMs have been the first to be employed. Despite being obsolete, in the 1982 Lebanon war, Israel used Shrike ARMs to devastating effect against fixed Syrian air defences in the Bekaa Valley.

In the 1990-91 Gulf War, the US and allies fired more than 2,000 HARM missiles against Iraqi air defences. HARM was also used in the Balkans War, though this conflict demonstrated the challenge in achieving complete suppression of enemy air defences.

One Serb SA-3 missile battery and radar survived the initial air attacks by remaining silent, then on March 27 1999 switched on for just 17 seconds and fired a salvo of missiles, one of which famously hit and shot down

Carriage and release trials of the HARM on a RAAF F-111 in the late 1980s. DEFENCE

Top – test firing an AGM-88E AARGM from a US Navy Hornet. Above – the AARGM-ER features a larger rocket motor and redesigned missile body.
ORBITAL ATK

a USAF F-117 Nighthawk stealth fighter.

The biggest innovation of HARM over Shrike was its intelligent radar processor seeker designed to recognise the characteristic pulse repetition frequencies of threat radars in a manner similar to a radar warning receiver (RWR). HARM is also faster (Mach 2 +) than a Shrike, with a longer operational range of 150km, close to four times that of Shrike.

AARGM is the next iteration of HARM, and was developed as a joint program of the US and Italy. Commencing in the 1990s, full rate production began in 2012. AARGM uses the same motor, airframe and wings as HARM, but incorporates a new guidance section and modified controls.

The missile is 4.17m long, has a diameter of 25cm, and a wingspan of 1.12m. It weighs 361kg.

The seeker is an advanced multi-sensor system featuring an active millimetre wave (MMW) terminal seeker, advanced anti-radiation homing receiver, global positioning systems (GPS) plus inertial navigation system (INS). The active seeker is intended to counter radar shutdown.

AARGM can engage traditional and advanced enemy air defences plus other emitting targets should the need arise. In 2015, the US Navy successfully hit a ship, demonstrating a capability to strike moving targets.

The missile receives target information through an embedded Integrated Broadcast System Receiver. It even transfers real-time impact assessment reports back to the pilot or EWO (the Growler's backseater electronic warfare officer).

Development is continuing, with Orbital ATK unveiling an extended range version in 2016. AARGM-ER features a larger rocket motor, body strakes/chines that provide extra lift, and redesigned tail fins and flight controls to effectively double the missile's range, and will also offer greater effectiveness against emerging and advanced threats.

The US Navy contracted the AARGM-ER's development in January 2018.

"AARGM-ER will incorporate hardware and software modifications to improve AGM-88E AARGM capabilities and meet the approved requirements," NAVAIR's AARGM program director Capt Al Mousseau told *Defence24* in an undated interview. "The development timeline supports an initial operational capability in FY2023."

The US is integrating AARGM onto its Super Hornets and Growlers, while Italy and Germany are integrating it onto their potent Tornado ECRs. It is also planned to integrate AARGM and AARGM-ER with the F-35.

Next Gen Jammer

To complement the hard-kill effects of the HARM and AARGM, Growler also requires a dedicated jamming pod for the non-kinetic part of its mission to

RAAF pilot FLTLT Todd "Woody" Woodford lanches an AGM-88 from a US Navy Growler while on exchange with VAQ-135 in 2016. DEFENCE

counter current and future threats on the electro-magnetic spectrum (EMS).

The Growler currently carries the ALQ-99 jammer pods which come in mid-band and low-band configurations.

Despite being continually upgraded, the ALQ-99 was developed in the late 1960s and was first deployed on US EA-6B Prowler aircraft at the tail end of the Vietnam War.

To have remained in service so long, ALQ-99 must do a lot right. But the ALQ-99's technology is analogue-based in a digital age, and reported problems include poor reliability, regular failure of the built-in test facility, high drag resulting in reduced aircraft performance, and interference with the Growler's APG-79 AESA radar.

In Australian and US service, the ALQ-249 Next Generation Jammer (NGJ) will replace the ALQ-99, a limited number of which the RAAF acquired through the Foreign Military Sales (FMS) deal in which Australia acquired its 12 Growlers.

The ALQ-99 is not a single unit which does everything. Depending on the mission, a Growler could carry up to five of the 450kg 4.5m pods on wing and centreline hardpoints, but a typical Growler loadout is two configured for the mid-band of the frequency spectrum, and one for the low-band.

The ALQ-99 stands out for its little nose propeller which is a ram air turbine to generate power, rather than drawing power from the aircraft itself. But it was also fitted in a centreline 'canoe' fairing to US Air Force EF-111 Raven jammers in the 1990s.

The baseline Growler came with the familiar ALQ-99 pods plus the onboard ALQ-218 electronic surveillance and electronic attack suite.

But what Growler brings to the fight over the Prowler it replaced in the US Navy inventory is a far superior offensive and defensive capability, a higher performance airframe, plus the benefits of improved maintainability from a newer and younger airframe which is common to the F/A-18F Super Hornet.

From the outset of the Growler acquisition, it was envisaged that Australia would acquire a better jammer as the US Navy replaced its ALQ-99 pods. As the only Growler operator outside the US and at this stage the only other customer for NGJ, it not only seemed fair to contribute to development costs, but also gave Australia input to ensure it is capable of dealing with the kind of threats likely to be encountered in this region.

'Development of the new jammer has proven to be challenging.'

But development of the new jammer to succeed the ALQ-99 has proven to be challenging, with the US not expecting to see IOC of the NGJ mid-band (NGJ-MB) capability until early next decade, and the follow-on low band (-LB) capability later still.

Australia is definitely interested and is willing to share in the development costs, which are substantial. For a fifth-generation air force, Growler is a very important capability with nothing remotely comparable in service anywhere in the region.

In November 2017, Chief of Air Force Air Marshal Leo Davies announced the signing of an MoU between Australia and the US for the development of the NGJ, specifically, Australia and the US Navy will jointly develop the ALQ-249(V)1 NGJ-MB capability.

"This is a very important milestone for both nations, one that took four years of communication and collaboration to successfully achieve," AIRMSHL Davies said.

The MoU provides a framework for communication, coordination and cooperation between the US Navy and the RAAF during the engineering and manufacturing development phase. This followed an earlier announcement by Defence Minister Marise Payne at the Avalon Airshow in February 2017 that the government would invest A$250 million in this development.

"As this is a rapidly evolving area, we will work in partnership with the US Navy to develop the next generation jamming capability, which will ensure that our aircraft remain at the technological forefront throughout their service life," she said.

NGJ is a key element of the ADF's AIR 5439 Phase 6 enhancing Growler Airborne Electronic Attack Capability (AEAC) project. The wide-ranging program has a nominal budget of $5-6 billion over a two-decade

timeframe (2016-2035), and will ensure upgrades to the Australian Growler fleet mirror those of the US Navy.

NGJ has been a long time coming and much of its intended capability remains closely held. In the basic jamming role, it can produce sufficient power in appropriate frequencies to swamp hostile radars.

But more than that, it has been reported that NGJ will also have a cyber-attack capability, using the Growler's and perhaps the F-35's AESA radar to insert data into remote systems. That could have the effect of spoofing a hostile air defence system to conceal inbound aircraft, or show them as friendly, or at a different location.

On F-35, while it's still early days, it has been envisaged that NGJ could integrate directly with that aircraft's onboard systems and not require a specialised aircraft configured for EW.

In 2009 the US Navy invited proposals for NGJ-MB from four companies – Raytheon, BAE Systems, Northrop Grumman and ITT Exelis (since acquired by Harris) – and in 2013 Raytheon was declared the winner.

BAE appealed the decision which prompted a reconsideration but this was dismissed, and Raytheon was reaffirmed as the winner in January 2014.

That contest was for the NGJ-MB solution, initially termed Increment 1. The mid-band is the region of the electro-magnetic spectrum where most current threats reside, and this capability is now designated ALQ-249(V)1.

In 2016, Raytheon was awarded a $1 billion contract to deliver 15 pods for engineering and manufacturing development, and 14 aeromechanical pods for airworthiness certification. In January 2017 Boeing was awarded a contract to integrate NGJ onto Growler, and the (V)1 version completed critical design review in April 2017. IOC is currently set for 2021.

The low-band capability of the older ALQ-99 was more recently upgraded, and this version is still considered to be tactically relevant. That said, in April this year Lockheed Martin and Cobham were awarded a contract to develop the Increment 2 NGJ low-band (NGJ-LB) system, with IOC scheduled for 2022.

Lockheed Martin said NGJ-LB would provide significantly greater electronic attack capabilities in the lower frequencies against modern threats. Those modern threats could include HF radar systems able to detect and track low observable aircraft such as the F-35 and the B-2. Increment 3 will be a high-band capability not currently provided by ALQ-99, but is yet to be funded.

Raytheon says NGJ provides significantly enhanced electronic attack capability to the warfighter. "In general, the threats – typically radars – are becoming more adaptable and agile; meaning, if you try and jam them one way, they can change their way of operation to avoid being jammed," a company statement reads.

"NGJ provides additional capability and flexibility through both hardware and software implementations that address these modern threats. NGJ is also expandable to handle threats as they evolve in the future. This flexibility and expandability does not exist in current systems."

Raytheon says its mid-band NGJ was built with a combination of high-powered, agile beam-jamming techniques and cutting-edge solid-state electronics.

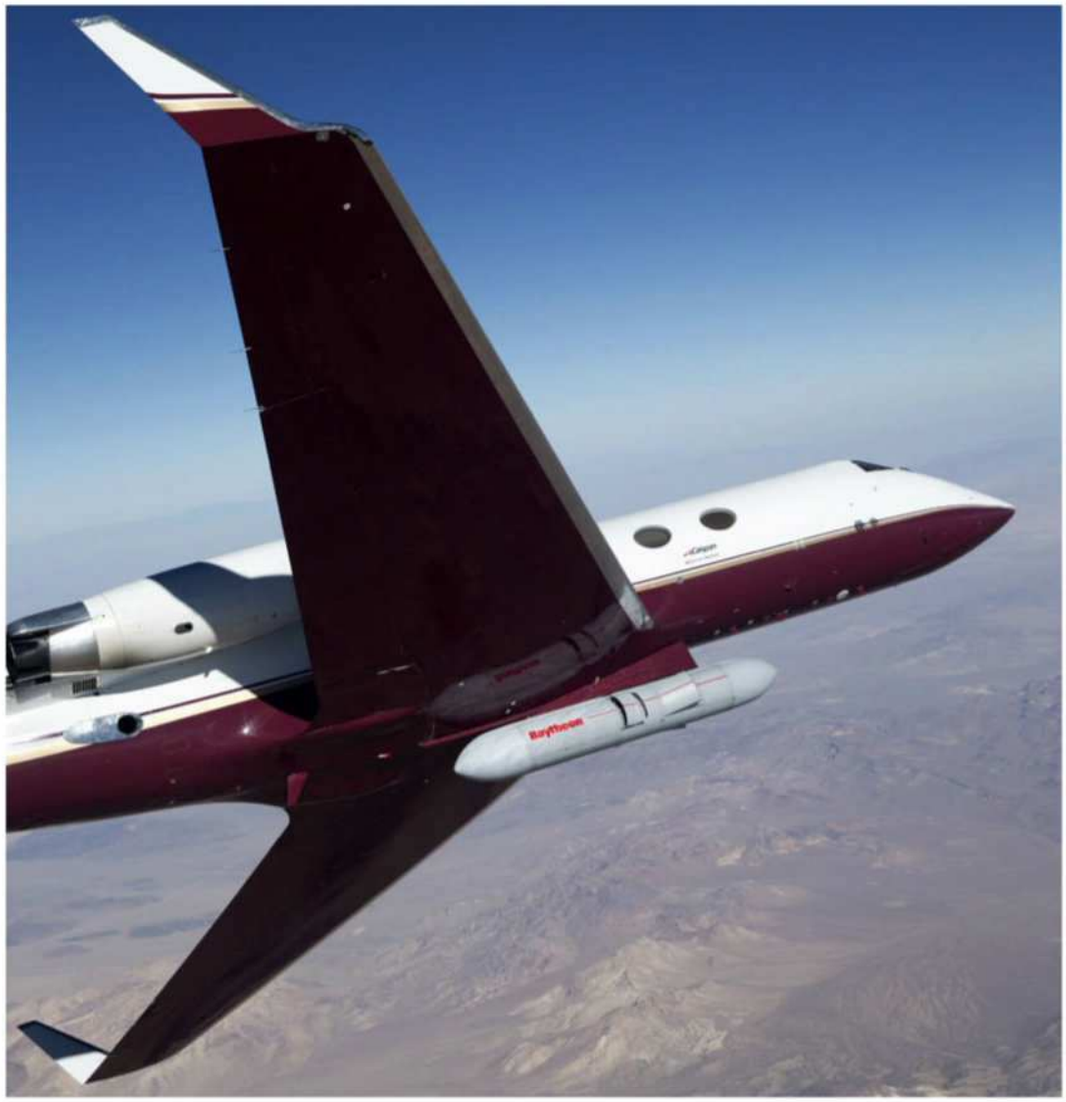
'It has been reported that NGJ will also have a cyber-attack capability.'

"Raytheon's NGJ-MB effort will provide the most reliable, dependable and affordable system to deny, degrade and disrupt threats while protecting US and coalition forces," the company promises.

"NGJ will enable aviators to complete their mission with greater effectiveness and enhanced personal safety."

The well-regarded website defenseindustrydaily.com said the broader aim of NGJ was to develop a more cost-effective airborne electronic attack system with better performance against advanced threats.

That will be achieved through expanded broadband capability for greater threat coverage against a wider variety of radio frequency emitters, faster collect-analyse-jam loops, more flexibility in terms of jamming profiles which could be changed in flight, better precision within jamming assignments, and more interoperability.



Flight testing a NGJ-MB under a Gulfstream testbed aircraft. RAYTEHON