Defence in the North
NT welcomes US Marines
Navy in the Top End

SUSTAINMENT
A tale of two helicopters
Collins sustainment on the mend
The history of ASMD
ASMD – an outstanding success

Before construction of the RAN's Anzac class of eight FFH frigates was completed their need for better weapons and self defence capabilities had long been evident, especially in respect to anti-ship missile defence (ASMD).

NOW, some 15 years or so later, the whole fleet is being equipped with an outstanding, Australian developed anti-ship missile defence (ASMD) system, proven in successful missile engagements against multiple sea-skimming targets including, for the first time in the RAN, successful engagements by ESSM against two of the world's most advanced supersonic targets, the GQM-163 Coyote.

This rocket-boosted, ramjet-powered target was developed to simulate supersonic cruise missiles like the Brahmos, which are proliferating throughout the world. Their speed and evasive manoeuvres compress the amount of time a defence system has to deal with them to less than a minute. A training target that can simulate their performance is critical to effective ASMD preparedness and performance.

Timeline

Early deliberations on upgrading the war-fighting capabilities of the Anzac fleet had a broad focus, directed towards both the best anti-missile and air defence upgrades for the class. In August 1999 Defence sought costed proposals from three contenders for two ASMD and Air Warfare upgrade solutions, based on their choice of different primary radar solutions such as the BaeSEMA Sampson, CEA Technologies' CEAFAR, Lockheed Martin's SPY-1F and Thomson Signaal's APAR. Northrop Grumman's MESA airborne radar was also proposed.

The purpose of this competition was to enable Defence to determine the best equipment solution for the upgrade. This meant that there was a strong possibility that the preferred contractor could end up undertaking an initial definition study of primary radar and weapons control systems which he had not submitted in his response. But by October that year, shortly after responses were due, the WIP program was cancelled due to its cost and complexity, with the decision to not go ahead with the Air Warfare upgrade component of the WIP program, restricting the Anzac upgrade to ASMD only. And thereby hangs a tale!

Project Sea 4000 (Air Warfare Destroyer) was raised as a direct result of the decision not to go ahead with the Air Warfare (AW) capability upgrade since the RAN regarded AW as a critical capability, at the time provided by the three DDG destroyers, then being progressively retired, and in the knowledge that the upgrade of the FFG-7 frigates would not provide such a capability.

Consistent with the RAN's view of the critical importance of an AW capability,
it is interesting to note that only recently consideration is being given to replace the Anzac fleet with air warfare capable ships, possibly based on the AWD design.

**ASMD upgrade proposals**

Investigations by a combined Defence/Industry study team, the latter comprising Tenix, BAE Systems and SAAB Systems (an embryo Anzac Alliance), focussing on defence against missile attack—the major capability shortcoming—had recommended a series of essential capabilities as part of the class upgrade. These enhancements and additional important capabilities were subsequently assessed by DSTO in more stressing environments using its modelling and simulation techniques.

The Anzac Alliance was then tasked with determining whether the modelled capability could be procured, integrated and introduced into service and supported within the program budget. Subject to approval the Alliance would then be responsible for implementation of the ASMD upgrade.

In the event, the Alliance went to work and within a few short months produced a carefully costed system configuration for the baseline $500 million ASMD upgrade. Endorsed towards the end of 2002 it had the following components:

- An infra-red search & track system (IRST)
- A second 9LV fire control director
- Upgrade of the Mk 9LV combat management system to a COTS-based system (Mk 3E)
- A very short range air defence missile system (VSRAD)
- Upgrade of the SPS-49 radar to 49A

Another essential capability, Link 16, received priority approval for installation under a separate project.

But having worked so hard on assessing and selecting capabilities to meet the upgrade requirements, within a very tight budget and a looming in-service deadline, one can only imagine the dismay and irritation that was felt within Alliance ranks when the dead hand of the Defence Capability Review fell upon the program and its revised $520 million budget went unapproved.

And so the situation remained from the end of 2002 until a year later when Defence Minister Hill finally announced limited funding approval for the upgrade and the Alliance was awarded a $260 million contract to implement what were then seen as the high priority aspects of the upgrade.

These were for the IRST for improved detection of low level aircraft and...
incoming missiles, and an upgrade to the ship’s combat management system to match the functionality of the new equipment and increase its data processing capability. These were effected through procurement contracts signed with both Sagem (Vam- 
pir NG IRST) and Saab for the upgraded 9LV Mk 3E CMS which integrates all on-
board weapons and sensors, which can be controlled by any operator at any console. The system’s architecture also made it well suited to future upgrades and extensions with additional sensors and weapons.

**Anzac Alliance**

One of the advantages in forming the Anzac Alliance was that it would take over the implementation and management of every aspect of the Anzac ships’ evolution, from the basic frigate with little in the way of firepower or self-protection, to a much more capable surface combatant capable of holding its own against growing regional threats. This all-embracing management of the ship included the planning and coordination of every enhancement to the ship’s capability ensuring that there were no conflicts in the allocation of weight and space, power demand, access to cooling, RF interference and so on.

But ASMD wasn’t the only task on hand and previously approved upgrades, including satellite communications, replacing Sea Sparrow with ESSM, and therefore replacing the Raytheon MK 73 TCS with CEA Technologies’ Solid State Continuous Wave Illuminator (SSCWI) were progressing.

CEA’s CWI system offered significant reliability advantages when compared to earlier CWI transmitters and was installed specifically for operation with ESSM. At the time its successor, the CEAMOUNT was in development.

Other ongoing upgrades included the capacity to launch eight Boeing Harpoon anti-ship missiles as well as provision for the new Eurotorp lightweight torpedo. The class was also being equipped with the locally developed Thales Petrel obstacle avoidance sonar, together with torpedo detection and other ASUW improvements.

Thus there was a variety of work at various stages that lay between planning and completion as retrofits on ships now in service, according to their availability. But, in the absence of a confirmed ASMD configuration, such piecemeal additions can wreak havoc on space, weight and ship stability unless their inclusion is properly planned and coordinated.

Original ASMD component proposals were also being reviewed against advances in technology. A case in point was the choice of IRST, a system which was considered problematic since Naval applications for IRSTs present the most difficult environment due to variable climatic conditions, humidity and so on.

Image processing was not without difficulty, and interestingly BAE Systems were encouraged to produce a low cost dual band version based on their in-service LRTS thermal camera mounted on a Radar Director (also in RAN service). Because it rotated at a much lower speed than that for an IRST (60 rpm) this system would require far less complex video processing thus avoiding image smearing, a problem due to high rotational speed of the IRST.

Nevertheless any reservations the RAN may have had about IRST appears to have been quashed with the decision to acquire Sagem’s Vamir NG IRST for the Anzac fleet, the LHDs and the AWDS.

It is noteworthy that CEAFAR did not receive any detection or targeting data from the Vamir NG IRST for the HMAS Perth frigates. CEAFAR detects and tracks independently even in the most difficult environmental conditions (when generally IR performance degrades). It would seem that IRST is of greatest use when CEAFAR is silent for emission control purposes – it may also add some identification functions.

---

**“Another vital part of the ASMD upgrade had been to enhance the fully integrated combat management system performed by Saab’s 9LV 453 Mk 3E.”**

**Land and sea trials**

When Defence Minister Smith announced approval for the ASMD upgrade he also said Defence was assessing the potential of new radar technologies that could be employed in the Anzac ships. He was referring to CEAFAR Technologies’ CEAFAR active phased array surveillance and targeting radar, which he acknowledged could offer significant benefits over conventional radars in the detection of supersonic missiles. He said the outcome of current land and sea trials would determine whether phased array radar would be included in the ASMD package.

In December 2005 CEAFAR Technologies was contracted to supply one shipset and one land-based test set for the trials. The land portion of the CEAFAR trials took place at the Beecroft Range with the equipment, comprising four panels, arranged to ensure that target discrimination involved a realistic clutter background. Helicopters, Learjets and F/A-18s were used to represent missile and aircraft threats. It seems that the trial results exceeded Navy’s expectations and sea trials were soon underway on HMAS Arunta to test a similar panel arrangement under maritime conditions.

The CEAFAR radar design is based upon a modular tile and panel active array concept. The active array comprises a number of static faces usually six, to provide
360-degree surveillance. Each array face is made up of a number of panels and by increasing their number the performance of the radar is increased.

For the maritime trial four faces were fitted, two on each side forward of the mast. Normally six faces are preferred but the four used are more than sufficient for the trial. The number of signal processors used with CEAFAR can be configured from one shared by all faces to one for each face. This allows the scan time to be significantly improved by the parallel operation of the faces for most modes.

The most significant advantage of the six faces is the low degradation of the beam pattern and gain as the beam scan angle approaches the edge of the face coverage. For an ESSM-equipped Anzac frigate expected to operate in a complex air threat environment, a CEAFAR radar would consist of six faces of eight panels and multiple signal processors. Technical features of

was being progressed and work was well underway on the design and development of the system architecture and the completion of design and test documentation. In January 2006 a $12 million contract was awarded to CEA by the DMO for further design and risk reduction work.

As a risk mitigator to protect the phased array production schedule, an order was placed in 2006 for some long-lead items for the first two CEAFAR and CEAMOUNT shipsets, together with printed circuit boards and power-supply units. Defence reasoned that should schedule delays from signature of the production contract emerge, the test regime could proceed using the first two shipsets of equipment. This suggests useful prescience on Defence’s part because, despite successful completion of the production design review, no production contract for the supply of the radar systems had been signed by mid-November 2007.

ASMD final operational capability is anticipated to occur in 2017 with the completion of the upgrade on all eight ships of the Anzac class fleet.”

the CEAFAR radar which set it apart from conventional radar technology include:
• the ability to operate on battery power for a frigate self defence design;
• no external cooling for the array faces;
• no waveguides in the entire system;
• array faces need not be collocated and can be distributed around the ship;
• the ability to automatically detect and classify air targets.

The first shipboard installation of the CEAFAR system for the sea trial turned out to be no easy task and a number of challenges and integration issues had to be overcome during HMAS Arunta’s limited availability. Australian Maritime Technologies (AMT) was contracted to design the installation and integration of the CEAFAR system in HMAS Arunta as well as the installation work packages.

The results of the land-based and sea trials together with revised cost estimates for the options under this phase were submitted for government consideration by mid-2005. In September Defence confirmed that CEA Technologies had been selected to provide their CEAFAR E/F-band phased-array radar and associated CEAMOUNT H/J-band missile illuminator for the ASMD upgrade.

By late 2006 engineering development of the active phased-array radar system was being progressed and work was well underway on the design and development of the system architecture and the completion of design and test documentation. In January 2006 a $12 million contract was awarded to CEA by the DMO for further design and risk reduction work.

As a risk mitigator to protect the phased array production schedule, an order was placed in 2006 for some long-lead items for the first two CEAFAR and CEAMOUNT shipsets, together with printed circuit boards and power-supply units. Defence reasoned that should schedule delays from signature of the production contract emerge, the test regime could proceed using the first two shipsets of equipment. This suggests useful prescience on Defence’s part because, despite successful completion of the production design review, no production contract for the supply of the radar systems had been signed by mid-November 2007.

FOC

ASMD final operational capability is anticipated to occur in 2017 with the completion of the upgrade on all eight ships of the Anzac class fleet.

By August 2013, the Royal Australian Navy and the Defence Materiel Organisation were able to announce the completion of the ASMD’s final Operation Acceptance Trial which included a number of successful ESM firings from HMAS Perth at the PMFR. During the trials, the ASMD system was challenged by a number of demanding firing scenarios. These included successful missile engagements against multiple sea-skimming targets including, for the first time in the RAN, an engagement by an ESM against one of the world’s most advanced supersonic targets, the GQM-163 Coyote.

Both the RAN and DMO acknowledged that the success of the program had largely been due to the outstanding efforts and collaboration by Navy, the DMO, Canberra-based CEA Technologies, Saab Systems and the Defence Science and Technology Organisation. The ASMD upgrade project has indeed been a success story.  

Combat Management System

Another vital part of the ASMD upgrade had been to enhance the fully integrated combat management system performed by Saab’s 9LV 453 Mk 3E. These enhancements include:

• New 30-inch widescreen operator consoles, with large touch input displays operating commercial operating systems,
• redesigned operations room layout with 10 consoles to improve management and coordination of operations,
• large screen displays on the bulkheads showing intelligence, CCTV and status information,
• redundant Gigabit LANs for greater data capacity,
• new operator modes for fighter control, and
• utilisation of advanced control modes for the Evolved Sea Sparrow Missiles.

Saab announced that it would continue to support all variant’s of the 9LV system in the RAN until the rest of the ships were brought up to the ASMD standard.

By late 2011 the CEAFAR/CEAMOUNT radar system on HMAS Perth had been released for initial operational use, after it returned from successful cruise missile tests in the USN’s Pacific Missile Range Facility, Hawaii. The next step for the government involved a decision on whether or not to continue the upgrades through the rest of the Anzac Class. The following year the government approved the extension of the ASMD program to all eight of its Anzac class frigates at an estimated cost of between $600 - 650 million.

Combustion Management System

Another vital part of the ASMD upgrade had been to enhance the fully integrated combat management system performed by Saab’s 9LV 453 Mk 3E. These enhancements include:

• New 30-inch widescreen operator consoles, with large touch input displays operating commercial operating systems,
• redesigned operations room layout with 10 consoles to improve management and coordination of operations,
• large screen displays on the bulkheads showing intelligence, CCTV and status information,
• redundant Gigabit LANs for greater data capacity,
• new operator modes for fighter control, and
• utilisation of advanced control modes for the Evolved Sea Sparrow Missiles.

Saab announced that it would continue to support all variant’s of the 9LV system in the RAN until the rest of the ships were brought up to the ASMD standard.

By late 2011 the CEAFAR/CEAMOUNT radar system on HMAS Perth had been released for initial operational use, after it returned from successful cruise missile tests in the USN’s Pacific Missile Range Facility, Hawaii. The next step for the government involved a decision on whether or not to continue the upgrades through the rest of the Anzac Class. The following year the government approved the extension of the ASMD program to all eight of its Anzac class frigates at an estimated cost of between $600 - 650 million.