THE ANZAC CLASS UPGRADES – AN ANTI-SHIP MISSILE DEFENCE SYSTEM

Looking back, it is a little more than 20 years since the Royal Australian Navy (RAN) first ordered the ANZAC class ships to replace its River class destroyer escorts. The ships were built and commissioned into the RAN between 1996 and 2006, and are expected to stay in service until they are gradually replaced from 2024.

As completed, the ANZAC’s were generally described as gunboats or anti-submarine frigates, with their main surface armament being a lightweight five inch gun. The ships also had a helicopter and eight vertically launched short range Sea Sparrow missiles for air defence. While these were intended to defend against aircraft, they could not react quickly enough to deal with incoming missiles. As such, the only threat that the ANZAC’s could not reasonably counter was from sudden short range surprise attacks, which would probably be mounted by submarines armed with anti-ship missiles that were launched underwater. In the 1990s, no navy in Asia had such weapons available, so an anti-submarine frigate did not need expensive air defence.

Regardless, ships last a long time, and circumstances can change radically over a couple of decades. One way to insure against unexpected threats is to buy ships that are somewhat larger than necessary to carry their planned armament, leaving space and weight for the future – a technique that is sometimes described as ‘fitted for but not with’. This is exactly what was done when the ANZAC’s were conceived. Such a process saves money when the ships are built, but is much more important as insurance against an uncertain future.

For the ANZAC class vessels, that future is now. Several Asian navies either have, or will soon have, exactly the sort of pop-up missile that the ships, as they were initially built, simply could not counter.

The RAN is modernising all of the ANZAC ships with an advanced ASMD system, primarily to meet the increasing threat of missile attack. This is being done in two phases. In the first phase, ships receive the new Evolved Sea Sparrow missile in place of the earlier Sea Sparrow. This new missile has about twice the range of its predecessor, is far more manoeuvrable, and can be ‘quad-packeted’, meaning four missiles can fit into each vertical launcher cell. The ships also have space and weight reserved for another eight cells. They thus carry a total payload of 32 Evolved Sea Sparrows, and can be modified to carry an additional 32. HMAS Warramunga (II) of the ANZAC class was the first ship in the world to be fitted with the Evolved Sea Sparrow missile, which she fired for the first time in January 2003.

Another related upgrade to the ANZAC class is a radical change to the ship’s command and control system that dramatically cuts a missile’s reaction time. In the initial ANZAC vessels, a target was detected by the main SPS-48 air search radar, selected for engagement, and then passed to a completely separate fire control system. Typically, the fire control radar would spend further time scanning its own narrow beam over the arc defined by the search radar before locking on to the target. In other words, the ship would detect an incoming aircraft long before her Sea Sparrow could possibly be launched.

Issues could arise when an ANZAC ship faced a low flying anti-ship missile. Even a subsonic missile like the French Exocet or the Chinese Silkworm or C-802 that at about 10 nautical miles per minute. Considering the ANZAC ship’s horizon is little more than 10 nautical miles away, she would only have about a minute in which to react against a sea skimming missile. Ideally, she should be able to fire a missile of her own, decide whether it has succeeded and have time to fire again. That doesn’t leave much chance for the ship’s system to detect something, decide that it is a threat and work out its track before firing back.

Taking this into account, a big change in the first phase of upgrades is to redesign the ANZAC combat system so that it includes the missile fire control system rather than passing a target from one system to another. This is how the Aegis system in the new Hobart class air warfare destroyers (AWDs) achieves a very fast reaction rate, but on a much smaller scale.

In the initial phase of the ANZAC upgrades, the updated ships retained both of their original search radars – the long range SPS-48 and a shorter range higher precision Sea Giraffe. Ultimately, fire control requires some method of tracking the target so that the system can, for example, predict...
The second phase upgrade to the ANZAC class ships solves this problem. The difficulty with the current system is that it relies on radars that search the sky (and the horizon, in the case of the Sea Giraffe), and create computer tracks of incoming objects such as enemy missiles. In effect, they play connect the dots. If a radar detects the same target on two scans, then the associated computer can compare these positions and use the difference between them to decide how fast the target is moving and in what direction. If it keeps detecting the target on later scans, it can check its previous calculation and update it. This technique works, but only approximately, and the more the target manoeuvres, the less accurate it becomes.

The time gap between scans determines how well the system can handle a moving target. The Sea Giraffe radar, which attempts to detect low flying objects near the horizon, scans rapidly, once per second. Despite this, it takes several scans to be sure it has detected something as small as a sea skimmer, and the ship cannot launch her own missile until the course and speed of the approaching attacker has been determined. The less accurate this track, the more time that single fire control radar must spend finding and tracking the target so that the missile defending the ship can be guided.

Enter CEA Australia, an Australian-owned electronic system design company that has developed the revolutionary CEAFAR active phased array radar. Such a radar offers two great advantages over the earlier Sea Giraffe. The obvious one is that it scans far more rapidly since its computer controlled beam does not have to cover the entire horizon before focussing on a detected threat. CEAFAR automatically decides whether radar energy it has detected is a real target rather than just noise, and then returns almost instantly to that target to determine the direction it is taking. The radar can scan its beam vertically as well as horizontally, so an incoming attacker can be tracked in all three dimensions, rather than the previous two.

A second, more subtle advantage is that the CEAFAR six faced phased array antenna can be made larger than that of the rotating Sea Giraffe. Being able to ‘stare’ out over an entire coverage area, rather than revolving at the top of a ship, it does not have to fight inertia and the wind while turning. It can hence have a taller beam, which ultimately gives it greater precision. To guide the Evolved Sea Sparrow to the target, the upgrade also provides a separate four faced CEAMOUNT phased array that illuminates targets with radar energy for the missile to conduct terminal target homing. In a latter stage of the upgrade, four illuminators will each be enhanced to provide illumination of multiple targets simultaneously, enormously increasing the ANZAC frigates ability to deal with demanding future combat scenarios.

With Evolved Sea Sparrows, CEAFAR and CEAMOUNT active phased array radars, and a recast command and control system, ANZAC vessels are finally able to handle the anti-ship missile threat. An upgraded ANZAC ship can be seen as a small scale (horizon range) equivalent to the much longer range Aegis system onboard the Hobart class air warfare destroyers.

A separate upgrade project will provide the ANZACs with an enhanced ship-to-ship data link. – Link 16, or the Joint Tactical Information Distribution System (JTIDS). Without this link, the ship cannot begin to react to an attacker until they pop over her own horizon. In theory, an Evolved Sea Sparrow missile has the range to take it roughly to the vessel’s horizon, but much of that range cannot be used. Imagine a ship detecting a target at the horizon, around 10 nautical miles out. If the defending missile is fired instantly, it will intercept the target somewhere considerably closer – for example, if it is twice as fast as the attacker, this will occur about two thirds of the way out (6.7 nautical miles). If that does not work, and if the decision to shoot again is instant, the second shot interception is made four ninths of the way out. It is unlikely that the ship will get a third shot.

Another ship, however, might well detect the missile before it pops over the ANZAC vessel’s horizon. So might an airborne early warning aircraft, such as the Royal Australian Air Force’s Wedgetail. Either vessel could pass this important tracking information on to the ANZAC ship. Considering the Evolved Sea Sparrow missile relies on its autopilot as a guide, it can be fired even if a fire control system cannot be locked onto the target, provided the ANZAC ship knows where the attacking missile is. The target does, however, have to be over the horizon for the last few moments of the Evolved Sea Sparrow’s flight, because the missile still needs those final seconds of illumination on which to home. Regardless, there is an enormous difference between trying to intercept an incoming attacker at 10 nautical miles and being lucky to engage at 6.7 nautical miles or less. Unlike its predecessor, Link 11, Link 16 offers information precise enough to support just such an engagement.

In a future improved version, the Evolved Sea Sparrow is likely to acquire its own active seeker. With this capability, the missile will no longer need even a few moments of support from the ship’s fire control radar, and will hence be able to engage an attacker that the ship itself cannot see, but has rather been informed of by a separate ship or airplane.

To supplement the radars, the ANZAC ships are also being fitted with a new Sagem VAMPIR infrared search and track system. Other new capabilities include the Australian-developed Nuka missile decoy, which backs up the Evolved Sea Sparrow missile, as well as simpler decoy launchers. All vessels of the class now carry Harpoon anti-ship missiles, which complicate the task of any enemy ship attempting to strike.

Continued modernisation has also provided the ANZAC ships with a new Petrel Mine and Obstacle Avoidance Sonar system, and the Eurotorp MU90 lightweight torpedo. With eight vessels of the class expected to be in active service with the RAN well into the next decade, upgrades to the ANZAC vessels will continue throughout 2012. Following on from the upgrade of HMAS Perth and recent approval from the Australian Government, the RAN awaits installation of the ASMD system into the seven remaining ships by 2017. Making the announcement, Minister for Defence Stephen Smith said this was the latest weapon in Navy’s arsenal and meant the ANZAC frigates would be a lot more capable going into the future.