

THE NAVY'S NEW AEGIS

The 2009 Defence White Paper has reiterated the importance of the three *Hobart* class Air Warfare Destroyers (AWD), which are to be delivered to the Royal Australian Navy (RAN) from 2014.¹ When eventually equipped with transformational weapon systems such as the SM-6 anti-air missile and a long-range land-attack cruise missile, these vessels will greatly extend the at sea and overland reach of the Australian Defence Force (ADF). Even on delivery, however, the AWD's will be among the world's most capable all purpose warships; effective across the full spectrum of joint maritime operations, from area air defence and escort duties, right through to peacetime national tasking and diplomatic missions.



Australia's Hobart class Air Warfare Destroyer (Defence)

The heart of any modern warship is its combat system and the *Hobart* class is to receive the most advanced technology and capability available with the seventh generation of the Aegis command and weapon control system. Developed by the United States (US) Navy in the 1970s and first deployed at sea in 1983, Aegis is a continuously evolving family of weapons systems, and is now fitted in almost 100 platforms in five navies. The world's first complete combat management system, Aegis seamlessly integrates powerful computers, radars and weapon systems to provide simultaneous defence against advanced air, surface and subsurface threats.

The AWD Combat System (ACS) consists of the integration of the Aegis Weapon System (AWS) with other combat system equipment including the Australian Tactical Interface (ATI). Five 'cornerstones' make up the Aegis capability:

- **Reaction Time.** Aegis processing is specifically designed to counter high speed 'pop-up' threats. It supports contact detection and tracking, threat evaluation, engagement decision support, and automatic queuing and firing sequences.
- **Coverage.** Multiple sensor arrays provide overlapping coverage, allowing for a 360° picture at beyond horizon range. This offers a single integrated tactical picture, significantly longer engagement ranges and protection against pop-up targets.

- **Firepower.** Fire control illuminators are only needed in a missile's terminal phase allowing for simultaneous engagement of multiple targets, automatically adjusted launch rates and scheduling of mixed weapons types and target/weapon pairing.
- **Environmental/Electronic Countermeasures (ECM) Immunity.** Weapon and fire control systems have special processing to deal with ECM targets and environmental conditions such as surface/rain clutter and ducting.
- **Continuous Availability.** All AWS equipment and auxiliary support systems are designed for redundancy, built for high reliability and include automatic fault detection and isolation.

The AWS to be fitted in the *Hobart* class is known as Baseline 7.1 Commercial-Off-The-Shelf (COTS) Refresh 2 (BL7.1CR2) and is based on the US Navy's Aegis Capability Baseline 2008 (ACB08) which is currently undergoing sea trials. The AWD program has continued the RAN down a path of open architecture and COTS procurement that will significantly change the way in which technology is introduced into the maritime military environment. With COTS refresh cycles occurring at faster and faster speeds, this Aegis architecture will allow major upgrades in capability to occur every 4 to 8 years without the need for extensive special refit opportunities.

The following 'core Aegis' components are contained in the ACS:

- Aegis Weapon System
 - Command and Decision (C&D)
 - Weapons Control System (WCS)
 - Aegis Display System (ADS)
 - Aegis Combat Trainer System (ACTS)
 - Operational Readiness and Test System (ORTS)
- SPY-1D(V) Radar
- Mk 99 Fire Control System (FCS)
- Mk 41 Vertical Launch System (VLS)

Other US Navy-based combat system elements to be integrated with AWS include:

- Mk 15 Blk 1B Phalanx Close-In Weapon System (CIWS)
- SPQ-9B Horizon Search Radar (HSR)
- Mk 160 Gun Fire Control System (GFCS)
- Mk 45 Mod 4 Light Weight Gun Mount (LWGM)
- Navigation Sensor System Interface (NAVSSI)
- Common Data Link Management System (CDLMS)
- Cooperative Engagement Capability (CEC)
- Global Command Communication System – Maritime (GCCS-M)
- Naval Fires Control System (NFCS)
- Identification Friend or Foe (IFF)
- WSN-7 Ring Laser Gyro Navigator (RLGN)
- Shipboard Gridlock System (SGS)
- Secure Voice System (SVS)

- Maritime Information Distribution System (MIDS) on Ships (MOS)
- Battle Force Tactical Trainer (BFTT)

From the outside, the AWD's most obvious Aegis feature will be the four SPY-1D(V) radar arrays mounted relatively high on the forward superstructure. SPY is a three-dimensional phased-array, fire control quality radar with hemispheric coverage that automatically and adaptively allocates resources to maximise efficiency and minimise horizon/above horizon search frame times. As a tracking and fire control radar, SPY concentrates its resources, as required, to detect and track targets, and support missile guidance. As an anti-ship missile defence radar, SPY provides rapid and timely search for sea-skimming targets. Radar resources are adaptively designated to counter a changing and hostile environment. Thus resources will be dynamically allocated between mission-specific activities, volumetric search and self-diagnostics. The SPY radar computer program is a flexible system design with automated doctrine features to enable rapid emission control and sectoring of RF (radio frequency) emissions according to user-defined parameters. The system's automatic electronic protection measures allow it to operate effectively in high clutter situations and the most challenging electronic warfare and environmental conditions.



The former Minister for Defence, Joel Fitzgibbon, pictured underneath one of HMAS Hobart's four SPY-1D(V) arrays at Lockheed Martin's Production Test Facility (Defence)

AWS automates many functions in the ship's operations room such as picture compilation, tracking, identification, target-weapons pairing, 'quick reaction' or 'late detect' procedures and tactical data link management. These automated functions reside within 'AWS Doctrine'; a set of standard operating procedures that allow the ship's command to adapt to changing operational situations with a series of user-defined 'doctrine statements'. AWS Doctrine is thus adaptable to various rules of engagement and compatible with different tactical control structures. Because the interface controls are easily understood, watchkeepers can adjust as necessary to best exploit the system's reaction time and firepower.

Aegis tactical doctrine can be implemented in either automatic, semi-automatic or manual modes. The first two modes reduce delays introduced by required operator

actions. Doctrine statements are essentially 'standing orders' to the ACS collated in different types of 'if <expectation>, then <action>' statements that are created/modified and activated/deactivated, one at a time or in sets, by authorised sub-modes. Doctrine statements combine operator and system automation strengths. Principal Warfare Officers and Combat System Operators will use them to allow the combat system to make tactical decisions under human supervision.

The Aegis system procured for the AWDs will also contain a Cooperative Engagement Capability (CEC) function. This generates a common and very high quality 'air picture' allowing the AWD to act as part of a wider 'grid' of sensor and weapon platforms. By fusing the track data of all participating units CEC allows any of those units (even one that has not actually detected the target) to engage targets.

CEC will fundamentally change the RAN's approach to air warfare, driving it from a within horizon air defence approach to a beyond radar horizon offensive counter air capability. The ramifications of implementing this technology, in cooperation with related equipment acquisition programs – notably the SM-6 extended range active missile, the F-35 Joint Strike Fighter and the Wedgetail Air Early Warning and Control (AEW&C) aircraft – will greatly enhance the ADF's force level air warfare capability, and require some significant reconsiderations of traditional environmental and Service boundaries.

SM-6 for example, uses the AWS, CEC and AEW&C systems to provide an integrated, extended range, detect to engage capability. Fully exploiting the potential of a networked system, SM-6 functions as a node on the net, being cued to a target that can come from the launch ship or a remote sensor (airborne, sea-based or land-based). Although, like earlier versions of the Standard Missile, SM-6 uses semiactive homing – requiring the AWD AN/SPG-62 radar (in the MK 99 Fire Control System) for terminal guidance – SM-6 also incorporates an active radar capability. It can thus be brought into a homing basket on the basis of CEC and then complete the engagement using its own active seeker, thereby allowing the operator to make best use of the SM-6's more than 200 nm range.



SM-6 combines the SM-2 warhead, the Standard Missile extended range airframe and the AMRAAM (Advanced Medium-Range Air-to-Air Missile) active seeker. (Raytheon)

Progress of building and testing the SPY1D(V) radar and Aegis system for the AWD is on track. Testing on the first AWD Aegis shipset is underway at the Lockheed Martin Production Test Centre in Moorestown New Jersey and is due to complete in November 2009.

1 Department of Defence, *Defending Australia in the Asia Pacific Century: Force 2030*, Canberra, 2009, p. 71.

