CEA - Defence industry’s new face
Almost immediately after CEA Technologies’ multi-function phased array radar is switched on, the previously blank display screen begins to populate with small green blobs and track symbols, indicating where the system has made a detection. The radar has beamed out and returned details on two aircraft, and all in a fraction of the time it would take a traditional radar to do a single rotation.

Kristian Hollins/CANBERRA

Hidden away in the Canberra industrial hub of Fyshwick is the Australian headquarters of domestic defence firm CEA Technologies. In less than 30 years, CEA has grown from a local industry startup to Australia’s largest majority owned defence company. With the outstanding results of HMAS Perth’s operational testing of the CEA designed and built anti-ship missile defence (ASMD) radar in both US and Australian trials, Project Sea 1448 Phase 2B a “great Australian success story – cutting edge technology developed right here in Australia by CEA Technologies.”

Walking through the Fyshwick facility, the domestic development aspect is plain to see. Much of the work building the new radar system is completed on site, with the remainder being completed at CEA’s other Australian facilities or outsourced to a select few local and international subcontractors. While the circuit boards are designed at CEA, the bare and unpopulated boards are manufactured at a number of locations including the US and in Europe. One particular board type is produced in nearby Queanbeyan, just over the NSW border from Canberra. The ASMD system’s electrical design and engineering is conducted in Canberra, while the mechanical engineering design is conducted in Adelaide.

Radar face production begins with printed circuit board solder paste, component attachment and testing. Each digital backend and tile is assembled and tested prior to assembly into the 16 tile face, and a large microwave anechoic chamber accommodates all but the largest faces for testing. The Fyshwick facility also includes a radar cupola mounted on top of the main building, into which each completed face is installed for functional performance testing for eight hours a day over a four to six week period. This testing also includes the missile control faces, which are run through a full range of verification evaluations, short of firing the Evolved Sea Sparrow Missile (ESSM). The completed and verified faces are then packaged for transport to the ships for installation.

For larger tests, CEA has a smaller, portable dual face stand-alone system and a purpose modified truck vehicle for transit to a dedicated outdoor range in nearby Bungendore, and other remote sites. The same dual faced system was utilised in sea testing prior to full installation on HMAS Perth.
The power assemblies for the ship installations are constructed in Melbourne and convert ship power to that required by the system. The entire control and power conversion system fits into a roughly 3 x 2.5m cabinet – a small footprint is an essential consideration when operating on ships, particularly the smaller frigates. What’s more, there is no additional requirement for shipboard generation of power to run the system. “In fact,” Croser said, “I think we gave some back.”

The software is also developed in-house, with array task managers, signal processing, graphical user interfaces and trackers put together by a dedicated team. Croser stressed that the software will be a key component in any future upgrades to the phased radar array.

CEA wasn’t always a growing powerhouse of the domestic defence industry. Founded in 1983 by two former RAN officers, the company started life as a small consultancy firm. Croser said while he learnt a lot of lessons from the Navy, it also provides motivation. “You see the good and bad technology, and it provides the drive to do something significant,” he said.

But while CEA has developed other technologies in the past, the company’s recent success did not come without any one particular breakthrough. Rather, the ASMD project was born through a trend towards developing and reusing technology and intellectual property across its range of programs.

“Many individual elements of technology and capability have led to the ability to build and deliver ASMD systems,” Croser explained. “These include antenna design, system modelling, real time highly parallel processing, thermal and mechanical packaging design. The ability to package the radar system into the faces is a fundamental enabling feature which is based on all of these combined capabilities.” He added that it is this re-use of hard won technical knowledge which enables the scalability and flexibility of the technology for future applications.

CEA now has 270 staff working across four permanent offices in Australia – Canberra, Adelaide, Melbourne, and Perth – and another office in San Diego operating under the CEA Technologies Inc banner. Another sales and support office has recently been established in Baltimore, to engage with international partners on other programs. And CEA’s home grown development is not just limited to the technology. The company recruits young graduate engineers and develops their skill sets in the field, eventually promoting them to management roles within the organisation. The process appears to be working well, with a number of CEA’s staff receiving awards for excellence in the industry.

**PAR EXPLAINED**

Extant radar systems sweep the horizon approximately 20 to 30 times a minute and have limited channels for interrogation and weapons fire control. The time delay suffered by traditional systems when switching between search and fire control functions when engaging anti-ship missiles or hostile aircraft – while marginal – could potentially mean the difference between life and death for the 163 crew members onboard an Anzac class frigate.

The US Navy’s Aegis radar system is arguably the radar/fire control benchmark for large displacement warships, and is currently in service on over 100 ships across five navies. But even this system can be overcome by a multitude of incoming threats, and while the system is on order for Australia’s three forthcoming Hobart class air warfare destroyers, it cannot be fitted to smaller classes of ship.

“One of the key strengths of the CEA-FAR array is it can be configured to suit any size of ship,” Croser said. “The system is so mouldable, it could be scaled back to even smaller ships.”

Multi-function active phased array radars (PAR) can search, detect, track and engage fire control concurrently. In recent sea testing, the CEA radar system on HMAS Perth was able to tackle a significant number of incoming targets – reportedly up to eight – which is an unprecedented feat for the relatively small Anzac class frigate.

One of the reasons CEA was able to evolve the active phased array radar is the simplicity of the architecture. “The advantage of this system is that the hardware is very stable,” Croser said. While a complex process, this stability provides room for further evolution of the system through software upgrades, rather than time consuming and expensive updates to instrumentation. While still currently in the design stage, the next upgrade package (the third so far) will offer more channels of fire and less interference. “And it’s all software,” Croser said. “It only takes around an hour to load the new software on to each face.”

The technology for the project was delivered in partnership between CEA Technologies and the Anzac Ship Integrated Material Support Program Alliance, consisting of the DMO, Saab Technologies Australia, and BAE Systems Australia. Working with the Alliance, Croser said, was a fundamental element of the success achieved.

Although CEA was not an official partner in the Alliance – rather, the company was responsible to the DMO for system delivery – Croser did note that the success of the ASMD so far was a direct result of the good efforts of all its participants. “Everyone in the Alliance was focused on achieving the
outcome,” he said. But on the potential of program alliances for other capability projects, he thinks “there is no set formula for how it should work. You need to look at each individual project and find a system that will achieve the outcomes for that project.”

The ASMD program was not without obstacles. Sea 1448 Phase 2B was added to the government’s Projects of Concern list in 2008 due to engineering and technical challenges. Rather than being a remedial measure, Croser said the POC list enabled the fundamental success of the program through interaction with DMO at a different, cooperative problem solving level.

“The list is complex and each project is on the list for different reasons,” he related. “In the case of the ASMD project it was not due to the failure to deliver the progress and capability of the technology, but due to the assessed high risk of the development and its integration into an existing operational platform. The results in the ASMD program were therefore not able to be fully assessed until the platform was at sea with the entire system fitted, and this represented significant investment in the future and particularly in the identified high risk environment.”

The project team responded to the POC listing by restructuring the program with the aim of demonstrating effective mitigation of risk. “We worked with both DMO and the Alliance to formulate a program of confidence demonstrations and to put in place the resources and capability to allow these to be used as significant progress assessment points against the cost schedule and technical capability,” Croser continued. “The challenge for the participants was to find the appropriate methods to progressively demonstrate and reduce risk such that following programmatic stages could be approved.”

One such demonstration was the at-sea display on HMAS Perth of two production faces in late 2008. “Overachievement at some of these demonstrations progressively helped build the stakeholder confidence and hence assisted the step by step approval process,” Croser said. Subsequent sea trials and capability demonstrations have been both successful and well publicised, and have further contributed to the ongoing evolution of the ASMD system.

“With the data that comes back after ship testing, you find things that you can use for other advantages.” While not giving further details, Croser noted the system performs “exceptionally well” against smaller vessels and even rigid hull inflatable boats (RIBs), citing the speed of beam revisits and doppler radar discrimination.

“The system was designed from day one to be scalable,” he said, saying that future platforms could go as large as 128 tiles, to be used for area defence. “There is a significant potential for this form of active phased array multi-function radar across maritime and land domains.”

The future for CEA looks bright. The system gained international attention following the hugely successful sea trials at the US Navy’s Pacific Missile Range Facility off Hawaii, with further demonstrations now being undertaken in the US. CEA is no stranger to the export market, and with larger international partners including US industry giant Northrop Grumman, seems well positioned to capitalise further on ASMD’s success.

“The future of active phased array radar is assured by the flexibility and multi-function capability it brings to the diverse operations of both peace and wartime scenarios,” Croser said in closing. “The success of the Anzac ASMD system has demonstrated the cost effectiveness of the particular form of digital active phased array technology embodied in CEAFAR and CEAMOUNT and this has created significant flow-on interest. CEA is therefore in a good position to achieve national and international work well into the future.

“And all right here in Fyshwick!”

Targeted by the CEAMOUNT, an Evolved Sea Sparrow Missile fires from HMAS Perth’s Vertical Launch System during testing off Jervis Bay in May 2011. Defence Photo