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RUMOUR CONTROL

Wedgetail back up to flying speed

After seeming to stall and come close to crashing during 2006, the RAAF's Wedgetail Airborne Early Warning & Control (AEW&C) program, Project Air 5077, continues to recover flying speed and there's no sign of further slippage - though no room for complacency, either.

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Disclosure: The author visited Boeing facilities in the USA and Australia as a guest of The Boeing Company.



The first two operational Boeing 737 Wedgetail Airborne Early Warning & Control (AEW&C) aircraft will be delivered to the RAAF in early 2009; the remaining four will be in RAAF hands undergoing acceptance by the end of that year.

That was the bald promise in September 2007 of Boeing Integrated Defence Systems, which is working through the recovery plan it has developed in partnership with the DMO after announcing a two-year program slippage early last year. The first two aircraft were originally scheduled for delivery at the start of 2007.

Under Project Air 5077 - Wedgetail the RAAF will be the launch customer for six AEW&C aircraft based on Boeing's 737-700 IGW airliner. These will be fitted with Northrop Grumman's innovative MESA phased array radar, a comprehensive suite of datalinks and communications equipment and an Electronic Support Measures (ESM) and Electronic Warfare Self-Protection (EWSP) suite developed by BAE Systems Australia. They are designed to patrol the air space at over 30,000ft with the radar monitoring traffic and searching for intruders, including difficult-to-spot targets such as cruise missiles, over 400km away.

Boeing has plenty riding on this program, including satisfying the expectations of Turkey and South Korea, which have both also ordered the Wedgetail AEW&C system. Boeing's Program Manager Maureen Dougherty, who is also a vice president of the company's Integrated Defense Systems sector, exudes determination and confidence, but the DMO project director, Air Vice Marshal Chris Deeble is a little more circumspect.

In September 2007 he told Australian reporters at Boeing's El Segundo plant in the USA, "There's no doubt Boeing is committed to delivering a great warfighting capability. They've turned a significant corner on the program and they're sticking to their new schedule, but challenges lie ahead."

With much flight and functional testing still to come the cautious Deeble doesn't rule out incremental delivery of the full operational capability rather than achieving full functionality at the time of handover. But he said he was confident that, at the very least, 'appropriate levels of functionality' would be available to enable the RAAF to begin training in earnest on the Wedgetail system early in 2009.

Initial Operational Capability (IOC) for the Wedgetail is scheduled for mid-2010, with Full Operational Capability due about 12 months later. These milestones will be determined by the availability of Wedgetail aircraft to begin training flight crews, according to Deeble – crew proficiency is a critical component of operational capability. Hopefully this will commence in early 2009 but the DMO is also talking to Boeing about the potential need to deliver sequential levels of operational capability, depending on project delays.

Deeble also points out that the RAAF is taking on board an all-new capability: there are no benchmarks for things like outright capability, operator proficiency, the robustness of the logistics chain and overall operational capability. The RAAF will be feeling its way fairly gingerly

EX Trident Fury

Notwithstanding Deeble's caution, Boeing and the RAAF have been buoyed by the performance of aircraft number 2 in the US-Canadian air defence exercise Trident Fury, which took place in May 2007 off Vancouver Island, conveniently close to the Seattle where the Wedgetail flight test program is based. The Wedgetail, which had a RAAF crew aboard, wasn't an active participant in the exercise but it successfully detected and tracked air and ship targets, and demonstrated effective voice and data communications and the quality of its Human-Machine Interface (HMI).

While Boeing and the RAAF won't discuss the detail of the exercise, Dougherty reports the Wedgetail compared very favourably with a US Air Force E-3A AWACs which did take part in the exercise and provided a major boost to the project team. The RAAF operators said they would have enjoyed the opportunity to control USAF F-15s during the exercise because the tactical picture they were getting from the Wedgetail mission system would have enabled them to do this. It will be recalled that radar performance and communications issues were two of the factors contributing to the current delay – these are discussed in more detail below.

Exercise Trident Fury wasn't originally part of the test program – it was a 'snap' opportunity to test and evaluate the system, and also test its interoperability with the US and Canada. For example, the Link 16 data link between the Wedgetail, E-3A and other assets was tested.

In the final quarter of 2008 the Wedgetails will head to Australia for an Operational Test and Evaluation (OT&E) program with the RAAF's Regional Operations Centre at Williamstown and the Air Combat group's F/A-18 Hornets. According to Dougherty the

Wedgetail communications system will also support full connectivity with the RAAF's new Super Hornets, which are due for delivery in 2010, but the company will conduct a full test program in the US before delivery of the Wedgetail just to be certain.

The OT&E program will see the Wedgetail carrying out a series of exercises with Australian and allied assets to compare and benchmark its performance against US and British E-3s, US Navy E-2C Hawkeyes and other allied assets. Guiding these will be an Operational Doctrine that has already been developed in draft form.

As far as recent project milestones are concerned, as of early-2008 the last of four 'green' B737 airframes had been delivered to Boeing Australia Ltd (BAL) at Amberley for conversion; the first of these is close to completion.

Back in Seattle, aircraft number 1 had its full mission system installed and checked out and the aircraft recommenced flight testing in late-2007. Aircraft number 2 remains heavily involved in mission system testing, including the Electronic Support Measures (ESM) and Communications systems.

Testing of the ESM system was delayed by several integration issues and hadn't got under way at the start of 2007; by September of that year, however, Boeing was already into ESM calibration trials, while Dougherty reports that the communications suite, another integration stumbling block, is maturing also. Radar performance, as demonstrated during Ex Trident Fury, had also improved considerably.

As a measure of the growing maturity of the overall mission system, Dougherty pointed out that about two thirds of all radar flight test hours saw the sensor controlled by the mission computer itself rather than the test equipment installed on the aircraft for the purpose.

Last year Defence and Boeing acknowledged the need for minor radar modifications, based on flight test results so far; these didn't involve the antenna or the processor hardware, amounting instead to cables changes due to an impedance mismatch, and filter and software changes.

Aircraft number 3 is set to enter the flight test program from Amberley during the first quarter of 2008. Meanwhile, Thales Australia has installed the Wedgetail Operational Flight Trainer (OFT) at the Wedgetail AEW&C Support Centre (ASC) at Amberley. BAE Systems Australia has installed the hardware for the Operational Mission Simulator (OMS), and the AEW&C Support Facility hardware is largely completed also; this will require 1 million lines of code. Completion and commissioning of the Wedgetail ASC will naturally follow completion and certification of the airborne mission system and its software.

The first of four Turkish Wedgetails, built under the Peace Eagle program, made its maiden flight in late-2007. A further three are being modified by TAI in Ankara. BAE Systems Australia is providing some elements of the AEW&C Support Facility.

The US government has granted export approval for Korea's E-X AEW&C program and the Initial Design Review for Korea's Wedgetail system took place in late-2007.

There had been hopes that the first Korean Wedgetail would be modified by BAL at Amberley, but the current plan is that it will be done in Seattle, as the various bilateral agreements between the US, Korea and Australia to allow the work to be done in Australia aren't yet in place. It's not clear whether the US-Australia bilateral treaty signed in September will impact favourably on this situation.

Next up for Boeing is the United Arab Emirates, which put out a Request for Proposals for an AEW&C system in July 2007; the UAE Air Force is also considering purchasing Boeing's P-8A Poseidon and could link the two purchases. If it does buy Wedgetail it could also join a mooted Wedgetail International Users Group comprising Australia, Turkey and Korea, and likely to be led initially by Australia.

The big challenge now is just getting Wedgetail into the hands of those users.

Technical issues

The Wedgetail program bears an uncomfortable resemblance to the deeply troubled Collins-class submarine combat system program, but only in one respect: it has run into delays and technical difficulties. In every other respect the project is quite different.

For a start, the customer and supplier have maintained what appears to be a cordial and productive relationship, which the Collins project conspicuously lacked. They have acknowledged the problems, tried to identify their sources and solutions, and have jointly worked out a recovery plan with what looks like a realistic schedule. While the project's two-year delay is bad news for both parties, they are trying to get on with the job rather than 'blame storm' the problem and they haven't been afraid to present the bad news to the government and the Australian public.

Boeing's Maureen Dougherty briefed Australian journalists at Amberley in February 2007 that the first two Wedgetail aircraft will now be handed over to the RAAF in March 2009; the remainder will be delivered by the end of the year.

This represents a 26-month delay over the previous schedule: originally, the first two aircraft were due to be delivered in late-2006, but a strike in Seattle disrupted Boeing's 737 production program and delivery was pushed back a few weeks to January 2007. When news of the difficulties in the program broke in May 2006 the initial estimate was an 18-month delay; but following an intensive five-month re-base-lining effort which was completed in November 2006, Boeing's estimate of how long it would take to complete the program had grown to two years, Dougherty said.

"We took our whole plan apart and looked at every element of it with our suppliers and customer and said, 'Is this the best plan going forward? Is it solid, do we understand the

risks and opportunities? Are we applying the best practices we have in the Boeing company to make sure that we can deliver to the Commonwealth?”

There has been enough recent progress to provide confidence the resulting plan is solid, Dougherty believes.

“The delays were due to both software and hardware challenges and the overall systems integration of this very, very complex system,” she told reporters. “Each sub-system on the aircraft is a complex system in and of itself, whether it be the radar system, the EWSP, the ESM, the data links, the communications system. Then on top of that is the very complex integration of all those sub-systems into a mission system. As we were moving forward in the plan, clearly we were not maturing these sub-systems as quickly as we had originally planned.”

So what were the challenges? Dougherty listed several: “First of all, radar development. This is a critical system in our program; it is the first of its kind – the first fully active 360 degree scan airborne surveillance system: complex, challenging and the team has put together a good plan going forward.”

The original plan required the radar to be able to deliver full power in order to perform integration and testing of the other sub-systems, but the radar has not been able to do so on a reliable basis thus far in its development. Full-power testing on the ground would be impossible, it’s understood – it’s just too powerful for existing ground test facilities.

Furthermore, there had been difficulties integrating the radar’s two side-facing antennas and the fore- and aft-facing Top Hat antenna; this has required some radar hardware and software changes, though the antenna itself won’t require any modification.

So the integration and test plan had to be fundamentally altered, according to Dougherty: “What we really wanted to do was get all of our systems working to a certain level, get them functionally checked out and operational, integrate them as a system, and then continue to mature each sub-system’s performance per the operational requirements of our customer. So our new plan allows us to make forward progress in radar in parallel with the ESM, communications systems and the datalink.”

Northrop Grumman has plenty riding on this program also and, says Dougherty, has stepped up to the plate “in every way: developmental leadership, resources to the program, in executive focus on the program, to make sure we are getting the best plan going forward. We’ve already had significant progress in our flight testing activity in maturing the radar,” as a result, she said. Asked if Boeing would seek damages from Northrop Grumman, she said emphatically no: “We’re a team and we need to be a team or we won’t be able to deliver.” Radar development is scheduled for completion in 2008.

Another key problem was that integration of the datalink capability into the mission system was more complex than originally anticipated, according to Dougherty. “When you’re dealing with this kind of airborne surveillance system there are orders of

magnitude more messages that need to be transferred on any link on the datalink. This is a bigger job, based on the maturity of the software. We put together a way of incrementally delivering software to continue that systems integration maturation and it's a much more solid and executable plan."

The first two builds of datalink software have already been delivered and the first was under test in Boeing's systems integration centre by February 2007 – this helped build confidence in the new delivery plan, said Dougherty.

The ESM system presented other problems. This is the BAE Systems ALR-2001, developed originally for the P-3C Orion. It had to be upgraded and adapted to the B737 environment, and the software needed to be re-hosted.

Boeing also turned the microscope on itself: "We re-aligned the program organisation in a big way," said Dougherty. She came onboard herself in May 2006, replacing former program chief Pat Gill. Boeing also replaced several key team leaders, she said, and hunted down relevant talent across the entire Boeing company to put the right team in place. Some of the people drafted in to help recover the program brought vital expertise from Boeing's F-22, E-3 AWACS and UCAV programs.

The company put pressure on its suppliers to make similar efforts. And internal to the project, Boeing overhauled its risk management processes, conducted independent reviews and audits of the engineering solutions and processes, and developed a detailed integrated schedule network to manage the program. This includes so-called 'tripwire' indicators to provide early warning of potential problems.

So the current program status looks like this: aircraft number 1 has its full mission system installed and checked out and the aircraft recommenced flight testing in late-2007. Aircraft number 2 is heavily involved in mission system testing, including the ESM and Communications systems.

Over at Amberley, Aircraft 3 has had its MESA radar antenna fitted, along with its modified tail cone, ventral strakes and air-air refuelling receptacle. The remaining three aircraft will be completed and delivered by the end of 2009.

At Williamtown the Operational Flight Trainer has been installed by Thales and is currently undergoing certification. The majority of the AEW&C Support Facility hardware has been installed, along with the hardware for the Wedgetail Operational Mission Simulator (OMS) – the back-end simulator. This can't be completed, of course, until the final mission system software has been completed, integrated and tested.

The problems on the Wedgetail program have cost Boeing a lot of money. In 2006 it announced it had made provision for losses on the program of over US\$400 million; the February 2007 briefing at Amberley was scheduled to coincide with another announcement to the New York Stock Exchange of a further provision of US\$274 million – making a grand total of around AUD\$1 billion.

But the company also has good reason to invest in getting it right. As well as Turkish and South Korean orders, long-term projections suggest a potential global market for between 30 and 50 Wedgetail aircraft, so Boeing doesn't lack incentives to get this one right.

What about the implications for the RAAF of the project's 26-month delay?

The DMO's Wedgetail project director, Air Vice Marshal Chris Deeble, was formerly Director General Aerospace Development at the Capability Development Executive, so is acutely aware of what Wedgetail means for the RAAF and ADF more broadly.

Wedgetail will be a critical command and ISR (Intelligence, Surveillance and Reconnaissance) node for the RAAF and ADF and a key enabler of the networked air force of the future, he told reporters at Amberley. He and the RAAF are working with Boeing to identify the trigger point for the start of training, achievement of Initial Operational Capability (IOC) and then working up to full capability.

The timeline for achieving IOC is expected to be about 18 months from the time crews start training on the first aircraft; that will happen before delivery so, according to Deeble IOC should occur in early-mid 2010 with full operational capability 12 months later – “around the same time” as the retirement of the F-111, he said.

Is the schedule achievable? Deeble believes so: the focus of talks between the DMO and Boeing since mid-2006 has been on developing a robust and executable schedule. Now the project is back on the rails, at least in the sense that there's a clear understanding of the problems and of their solutions, the challenge is to manage the residual risks in radar, systems integration and software development, he said.

However, the delays to the program have disrupted severely the RAAF's workforce planning and development processes, resulting in unwelcome career changes for some aircrew and other specialists who had been anticipating a shift to the AEW&C world. The RAAF continues to post exchange officers to UK, USAF and US Navy AEW squadrons to build residual expertise in AEW&C prior to introduction of the Wedgetail. Developing the AEW&C expertise well in advance means the RAAF can develop concepts of operations, operational procedures and tactical procedures that will deliver an effective operational capability very quickly. And Deeble believes that the RAAF's 2 Sqn will be able to ramp up rapidly faced with delivery of six Wedgetail aircraft in less than 12 months.

And the wait will be worth it, Deeble says: “The flexibility of the open architecture which will allow it to be evolved and add new capabilities, new sensors, and take new data into that system, I think will be the key part of it. The advantage of the MESA radar over the mechanically scanned radar is that you can stop and focus on a specific area and still continue background scanning through 360 degrees. The ability to do those things and to be able to gather that information in a timely manner to be able to fuse it with other sensors and then to rapidly disseminate it to the various war fighters – JSF, Super Hornet,

F/A-18 – or to be able to push that down into the ground environment to either the maritime force or land force - I think that's going to be so fundamentally important. Are the P-3 Orion and 707-based AEW aircraft evolving too? Yes, but I don't think they've got anything like the growth potential we've built into the Wedgetail AEW&C aircraft. This is the next generation of AEW&C. There's no doubt in my mind this is a world beater.”

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