

SUBMARINE DESIGN, CONSTRUCTION AND SAFETY

9.1 The JCPAA was concerned that other major areas required further investigation, namely submarine design and construction and submarine safety. While the Committee was not in a position to follow up these areas in detail, information was sought from Defence in relation to a number of relevant issues.

Overall performance

9.2 The Oberon class submarines were designed as surface boats which can run submerged. In contrast, the Collins class submarines are designed to run submerged and surface infrequently to 'snort'.

9.3 The Collins class submarines are designed to be available for sea for some 80 per cent of the time, to cope with Australia's 23 000 kilometre coastal boundary and its wide variety of ocean conditions, and to achieve independent operation in a variety of 70 day missions. The submarines are designed for missions which include reconnaissance and surveillance, maritime strike and anti-submarine operations, mining and infiltration.¹

9.4 The Committee noted that it had received both positive and negative views on the capacity of the submarines and asked Defence for its comment.²

9.5 Defence told the Committee that while some areas of the Collins class submarine were being worked on, it could already demonstrate significantly superior performance in the Collins submarines compared to many areas of the existing

1 *Audit Report No. 34, 1997-98*, p. 5.

2 *Transcript, 5 March 1999*, p. PA 87.

Oberons or, indeed, any other submarine that was likely to 'come our way'.³

*From the point of view of the taxpayer and the question of where we are going with this submarine class, I am really very optimistic that the Royal Australian Navy is going to have an excellent submarine. We have got a few problems to work our way through, but already a very clear outcome can be agreed. The difficulty we have in the public arena is that to prove these claims one way or the other requires the disclosure of what we consider to be highly sensitive information.*⁴

9.6 Defence's view was that by the end of 1999, the only remaining difficulty in terms of specification would be likely to be in the combat system.⁵

S u b m a r i n e s a f e t y

9.7 The Committee drew Defence's attention to a reported incident concerning valve 31 in the main bilge system of HMAS *Collins* and asked Defence whether the problem with the valve could have had catastrophic consequences.⁶

9.8 Defence responded that the valve was operated by an actuator, which was designed to shut off at a certain depth:

During trials in, I think, late 1995—and these trials are very carefully controlled and monitored—it was found that the actuator was not in fact shutting this valve off at a particular depth. As with any valve on the main bilge system of a submarine, there are backup valves and isolating systems. These backup valves were operated; the actuator ... was corrected and that was the end of the problem....

I think this is one of those instances where there is a grain of truth that is taken up by the media and then amplified out

3 Mr Garry Jones, Deputy Secretary, Acquisition, Department of Defence, *Transcript, 5 March 1999*, p. PA 87.

4 Mr Garry Jones, Deputy Secretary, Acquisition, Department of Defence, *Transcript, 5 March 1999*, pp. PA 87-8.

5 Mr Garry Jones, Deputy Secretary, Acquisition, Department of Defence, *Transcript, 5 March 1999*, p. PA 106.

6 *Transcript, 5 March 1999*, p. PA 112.

*of all proportion ... It does not do anything for the people who serve in the submarines or the project or the contractors involved.*⁷

9.9 Defence stated categorically that there was no danger to the submarine or the personnel in it.⁸

9.10 The Committee asked Defence why it had disagreed with the Auditor-General's recommendation that there be a joint assessment with an independent third party to decide whether the Collins submarines contained safety-critical software and to verify that such software provided the appropriate level of safety.⁹

9.11 Defence replied that the reason for formally disagreeing with the recommendation was because Defence felt it was tackling the issue from a different perspective which would achieve ANAO's objective as Defence understood it to be. Defence stated:

What we have been doing is looking at the relevant software safety case, and the software development standards and associated standards, and one of these standards is a new Australian standard called DEF(AUST) 5679.

*What we are trying to assure ourselves of—and I am sure this was the aim of the ANAO comment—was that the software systems in the Collins class are not safety critical. We have conducted a range of assessments to date in respect of the propulsion and weapons systems, and these assessments have not indicated a change in previous advice with respect to these software safety aspects of the Collins class.*¹⁰

9.12 Defence said that it was doing additional software safety case studies covering the integrated ship control management and monitoring system, the ship information management system and the ship information system:

7 Cdre Eoin Asker, Director-General, Undersea Warfare Systems, DAO, Department of Defence, *Transcript, 5 March 1999*, pp. PA 112-13.

8 Cdre Eoin Asker, Director-General, Undersea Warfare Systems, DAO, Department of Defence, *Transcript, 5 March 1999*, p. PA 113.

9 *Transcript, 5 March 1999*, p. PA 115.

10 Cdre Eoin Asker, Director-General, Undersea Warfare Systems, DAO, Department of Defence, *Transcript, 5 March 1999*, p. PA 115.

These are software systems that are essentially used to control the submarine once it has dived and also to gather information for repair and maintenance purposes.

We have also engaged the support of the Defence Science and Technology Organisation and the University of Queensland's Software Verification Research Centre to support this safety case work...

We have also engaged the Naval Undersea Warfare Centre from the [United States Navy] to look at specific aspects of our combat system, both from a hardware perspective and a software perspective.¹¹

9.13 The Committee wanted to know whether Defence considered there was a case for getting an independent expert to provide some reassurance.¹²

9.14 Defence stated:

In answer to your question, I believe that with the Naval Undersea Warfare Centre, the University of Queensland and the Defence Science and Technology Organisation, we do have an independent assessment of the safety aspects of our software, not only of the combat system but also the platform system and other systems as well.¹³

Hull integrity

9.15 The Audit Report noted that submarine hull integrity and welding quality were critical to performance safety and submarine service life because of the stress cycles resulting from deep dive operations. The report stated:

... [In early 1990] Project Office quality audits at Kockums in Sweden revealed unsatisfactory work practices and an inadequate quality system. Both factors at the time cast

11 Cdre Eoin Asker, Director-General, Undersea Warfare Systems, DAO, Department of Defence, *Transcript, 5 March 1999*, p. PA 115.

12 *Transcript, 5 March 1999*, p. PA 115.

13 Cdre Eoin Asker, Director-General, Undersea Warfare Systems, DAO, Department of Defence, *Transcript, 5 March 1999*, p. PA 115.

*doubt on the quality of the pressure envelope of Collins, then known as Submarine 01.*¹⁴

9.16 The Committee noted that a number of allegations from people involved in the project in relation to the integrity of the hulls had come to the Committee's attention. The Committee asked Defence for its comment.¹⁵

9.17 In response, Defence acknowledged that variations in the welding standards had been experienced in HMAS *Collins*, in two sections which had been assembled in Sweden. Because of some vagaries in Kockum's records in relation to the welding standards, the sections had recently been subjected to a 100 per cent ultrasonic examination over and above the examination which had already occurred.

*We found a number of welds that require rework. The point that I would like to make here is that this rework has been considered necessary to ensure that the through-life hull characteristics are not compromised in any way. At no stage—and I have this formally from both Kockums and ASC—has there been any danger to any of the personnel in the submarines. There has not been any restriction on deep diving depth as a direct result of this examination or any shortcomings in the welding process.*¹⁶

9.18 In response to the Committee's inquiry, Defence stated that there were currently no restrictions for any other reason on deep diving or other performance characteristics. Defence also stated that no reduction in the life of *Collins* was expected as a result of any of the welds in the Swedish sections of the hull.¹⁷

9.19 The Committee asked whether there was any substance to the claim that two of the hull sections of *Farncomb* were adjusted using heat and sledgehammers.¹⁸

14 *Audit Report No. 34, 1997-98*, p. 83.

15 *Transcript, 5 March 1999*, p. PA 106.

16 Cdre Eoin Asker, Director-General, Undersea Warfare Systems, DAO, Department of Defence, *Transcript, 5 March 1999*, p. PA 106.

17 Cdre Eoin Asker, Director-General, Undersea Warfare Systems, DAO, Department of Defence, *Transcript, 5 March 1999*, pp. PA 106, 163.

18 *Transcript, 5 March 1999*, p. PA 107.

9.20 Defence responded that there were concerns about the alignment of those two sections and, as a result of a subsequent investigation, rework was carried out. Defence stated:

Because we are very risk averse and very conscious of our responsibilities, we checked and rechecked the alignment of those two sections, as we normally do. The quality of the welds that were undertaken was examined independently of ASC using Defence, Science and Technology expertise.... The outcome of that is that the strains that were thought to have been introduced have been relieved and that the long-term hull life in that particular area has not been compromised.¹⁹

9.21 ASC stated that the submarine was of very high integrity and very safe.²⁰ ASC also made the comment that product delivered from Europe and the US had generally been of lesser quality than was achieved in Australia:

The quality of our engineers and the quality of our tradesmen, the quality control and quality assurance systems that we adopt in building these submarines, have ensured that the Australian quality, by and large exceed the quality obtained from overseas.²¹

A c o u s t i c s

9.22 An issue which has emerged recently is the noise profile of the Collins class submarine. The Committee asked Defence to comment on claims that the submarines' acoustic signature was not meeting all the specifications.²²

9.23 Defence replied that at patrol-quiet state, the submarines were very superior performers. Defence stated:

19 Cdre Eoin Asker, Director-General, Undersea Warfare Systems, DAO, Department of Defence, *Transcript, 5 March 1999*, p. PA 107.

20 Mr Hans Ohff, Managing Director, ASC, *Transcript, 5 March 1999*, p. PA 153.

21 Mr Hans Ohff, Managing Director, ASC, *Transcript, 5 March 1999*, p. PA 163.

22 *Transcript, 5 March 1999*, p. PA 87.

... in some ways, at the patrol-quiet state, the quietest thing in the ocean is the submarine—the background noise is greater.

... the very low levels of noise we are trying to measure against the ocean background ... are so low that we are having extraordinary difficulty in measuring the amount of noise the submarine makes in the patrol-quiet state.²³

9.24 Defence emphasised that the patrol-quiet state was considered to be the critical acoustic design parameter of the submarine and the most difficult thing to achieve. Defence added that the results of trials were highly classified but that it was its clear view that the Collins class submarine was already a very quiet submarine by any standard and had no acoustic vulnerabilities:

We have a number of issues in areas we are working on where [the submarine] does not yet meet the specification we set—which, as I said earlier, was a very ambitious specification—but we have already achieved as much as any other country in the world has achieved with conventional submarines in terms of quietness.²⁴

9.25 The Committee asked when the acoustics problem had become an issue.²⁵

9.26 Defence replied that in 1996 when the submarine was tested at the noise range near the construction facility and the results analysed, shortcomings were found in some areas.²⁶ Defence stated:

We have been working on those problems since then to resolve them.²⁷

9.27 In response to the Committee's inquiry as to whether the Collins was as quiet as the Oberon at patrol-quiet

23 Mr Garry Jones, Deputy Secretary, Acquisition, Department of Defence, *Transcript, 5 March 1999*, p. PA 88.

24 Mr Garry Jones, Deputy Secretary, Acquisition, Department of Defence, *Transcript, 5 March 1999*, p. PA 88.

25 *Transcript, 5 March 1999*, p. PA 91.

26 Cdre Eoin Asker, Director-General, Undersea Warfare Systems, DAO, *Transcript, 5 March 1999*, p. PA 91.

27 Cdre Eoin Asker, Director-General, Undersea Warfare Systems, DAO, *Transcript, 5 March 1999*, p. PA 92.

state, Defence stated that the Collins was currently no noisier than the Oberon at patrol-quiet state.²⁸

9.28 The Committee asked whether there would be additional costs to meet the contracted acoustic specifications for the submarines.²⁹

9.29 Defence responded that it was expecting the contractor to deliver in terms of the submarines' noise performance:

It may be that, at the end of the day, we agree that [at the margins] some element of the specification for noise is not achievable in any practical way.... [in which case] we will have a concession.³⁰

9.30 ASC agreed that there were two or three issues being dealt with on the issue of submarine noise. ASC said while it was unable to go into detail in public, the three categories concerned propeller radiated noise, patrol-quiet state and snort noise. ASC stated:

I believe that we meet most of those requirements, with the exception of one, on which we are still working. We have a way forward on this and that will be entirely within the contract specification when the submarines are finally delivered.³¹

9.31 The Committee asked Defence whether Navy was concerned that the submarines were too noisy at speeds above the patrol-quiet state.³²

9.32 Defence replied that submariners would understandably want their submarines to be as quiet as possible at all times, including at high speeds.³³

28 *Transcript, 5 March 1999, p. PA 92.*

29 *Transcript, 5 March 1999, p. PA 112.*

30 Mr Garry Jones, Deputy Secretary, Acquisition, Department of Defence, *Transcript, 5 March 1999, p. PA 112.*

31 Mr Hans Ohff, Managing Director, ASC, *Transcript, 22 March 1999, p. PA 153.*

32 *Transcript, 22 March 1999, p. PA 161.*

33 Rear Adm. Christopher Oxenbould, Deputy Chief of Navy, Royal Australian Navy, Department of Defence, *Transcript, 22 March 1999, p. PA 161.*

9.33 Despite the Committee's intensive questioning, Defence would not discuss the extent or nature of acoustic problems for speeds above patrol-quiet speed.

Diesel engines

9.34 The Committee referred Defence to the issue of the submarines' diesel engines and asked whether any work remained to be completed on them.³⁴

9.35 Defence replied that the reliability of the diesel engine was not fully resolved but that Defence had no reason to believe that it would not be.³⁵

Committee comments

9.36 The Committee notes the view of the ANAO technical consultants that the output of the submarine project is impressive and a quantum jump on the 1950s Oberon class purchased from the United Kingdom since the 1960s. The consultants stated:

*The submarines have been constructed largely in Australia to an advanced specification by an ab initio company (ASC) and over 1400 Australian subcontractors. Innovations include Australian specified and produced steel for the pressure hull and Australian designed and produced anechoic tiles for the hull. In addition design concepts for the submarine systems management and combat systems were state of the art. In all the submarines have the potential to achieve the combat capability specified in the contract.*³⁶

9.37 The Committee is aware that the submarines' Integrated Ship Control Management and Monitoring System (ISCMMS) which provides automated control, monitoring and limited automatic management of major systems has resulted in the submarine requiring the world's smallest submarine

34 *Transcript, 5 March 1999*, p. PA 118.

35 Mr Garry Jones, Deputy Secretary, Acquisition, Department of Defence, *Transcript, 5 March 1999*, p. PA 118.

36 *Audit Report No. 34, 1997-98*, p. 11.

crew. ISCMMS is considered a major success and is meeting all expectations.

9.38 The Committee also acknowledges the advanced information systems which capture information on-board the submarines and download it ashore to the Ships Information Management System (SIMS) to support maintenance and provisioning requirements.

9.39 The Committee has taken *in camera* evidence on the submarines' capabilities in the areas of speed, range, detectability, dive depth and controls, snort frequencies, enemy contact tracking, target tracking, weapons release capacity and current operational capacity.

9.40 On the basis of assurances given by Defence, the Committee accepts that the submarines represent a major advance in conventional submarines, that they are safe, fast, generally quiet and have advanced information and control management systems. However, while the problems with the combat control system stay unresolved, the Committee will remain concerned about capability and cost issues.