

The Auditor-General
Audit Report No.41 2008–09
Performance Audit

The Super Seasprite

Department of Defence

Australian National Audit Office

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of Australia 2009

ISSN 1036-7632

ISBN 0 642 81074 5

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Canberra ACT
17 June 2009

Dear Mr President
Dear Mr Speaker

The Australian National Audit Office has undertaken a performance audit in the *Department of Defence* in accordance with the authority contained in the *Auditor-General Act 1997*. I present the report of this audit and the accompanying brochure to the Parliament. The report is titled *The Super Seasprite*.

Following its tabling in Parliament, the report will be placed on the Australian National Audit Office's Homepage—<http://www.anao.gov.au>.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Ian McPhee', is positioned above the printed name and title.

Ian McPhee
Auditor-General

The Honourable the President of the Senate
The Honourable the Speaker of the House of Representatives
Parliament House
Canberra ACT

AUDITING FOR AUSTRALIA

The Auditor-General is head of the Australian National Audit Office. The ANAO assists the Auditor-General to carry out his duties under the *Auditor-General Act 1997* to undertake performance audits and financial statement audits of Commonwealth public sector bodies and to provide independent reports and advice for the Parliament, the Government and the community. The aim is to improve Commonwealth public sector administration and accountability.

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Contents

Abbreviations.....	8
Summary and Recommendations	11
Summary	13
Introduction	13
Audit objective	15
Conclusion	16
Key findings by chapter.....	18
Summary of responses	48
Recommendations	50
Audit Findings and Conclusions	55
1. Introduction	57
Introduction	57
Project phases	58
Contractual arrangements	61
Squadron commissioned to operate the aircraft	62
Procurement reform process	62
Audit approach	65
Report structure	68
2. Tender Evaluation and Contract Negotiation	69
Introduction	69
The tender process	69
Software development risks	72
Capability traded off	75
Deliverables under the Prime Contract	79
Protections to be provided by contractual arrangements	81
3. Financial Management.....	85
Introduction	85
Project expenditure	85
Expenditure against the Prime Contract	88
Cost schedule performance	91
Payment of critical milestones	93
Management of earned value method payments	97
4. Interim Capability Accepted	101
Introduction	101
ITAS development.....	102
Schedule slippage.....	105
Provisional acceptance	114
Progress towards full Capability.....	121

5. Aircraft Sustainment.....	126
Introduction	126
Capacity to address aircraft attrition	126
Management of the In Service Support Contract.....	128
Aircraft rate of effort	132
Availability of spare parts	138
Issues with materiel and maintenance manuals	143
6. Aircraft Certification.....	151
Introduction	151
The Airworthiness timeline for the Super Seasprite.....	151
The introduction of the ADF airworthiness arrangements	154
Contractual certification requirements	158
Special Flight Permit awarded and renewed	161
Type Certificate awarded	165
7. Systems and Software Safety.....	169
Introduction	169
System and software safety program	170
Approach to certification	176
AFCS induced hard-overs.....	182
Senior level review	190
8. Management of Deficiencies.....	196
Introduction	196
Outcomes of flight testing	197
Progress toward resolving deficiencies.....	206
Limitations and restrictions	211
Aircraft crashworthiness.....	225
Understanding of deficiencies.....	235
9. Navy Ceases Operating the Aircraft	239
Introduction	239
Type Certificate withdrawn.....	239
Recertification	242
Aircraft was not subsequently operated by Navy.....	250
10. Cancellation of the Project	253
Introduction	253
Projected capability achievement	254
Contractual uncertainty	263
Decision to continue with the Project in 2007	267
2008 decision to cancel the project.....	272
The 2008 Settlement Deed	273
Total cost of Project failure	278

Appendices 283

Appendix 1: Lessons 285

Appendix 2: Glossary..... 288

Appendix 3: Defences comments in response to audit recommendations 295

Appendix 4: Response to proposed Section 19 Report by Kaman Aerospace
International Corporation (the Prime Contractor) 298

Appendix 5: Responses from other parties with special interest in the report 327

Series Titles..... 346

Current Better Practice Guides 351

Abbreviations

ACPA	ADF Airworthiness Coordination and Policy Agency
ADF	Australian Defence Force
AFCS	Automatic Flight Control System
AMAFTU	Aircraft Maintenance and Flight Trials Units
AMARC	Aerospace Maintenance and Regeneration Centre
ASOR	Air Safety Occurrence Report
CANAG	Commander Australian Naval Aviation Group
CAR	Corrective Action Request
CASA	Civil Aviation Safety Authority
CCP	Contract Change Proposal
CEO	Chief Executive Officer
CDRL	Contract Data Requirements List
CMFD	Colour Multi Function Display
DACPA	Director - ADF Airworthiness Coordination and Policy Agency
DGTA	Director-General Technical Airworthiness
DMFP	Defence Management and Financial Plan
DMO	Defence Materiel Organisation
DSTO	Defence Science and Technology Organisation
FAA	Federal Aviation Administration (US)

FAR	US Federal Aviation Regulations
FFGs	Guided Missile Frigates
FMS	Foreign Military Sale
IMC	Instrument Meteorological Conditions
ISO	International Organisation for Standardisation
ISS	In-Service Support
ITAS	Integrated Tactical Avionics System
ITH	Interim Training Helicopter
KAISC	Kaman Aerospace International Support Centre
KES	Kaman Engineering Standard
LOT	Life of Type
NAPO	Navy Aviation Project Office
NASPO	Navy Aviation System Program Office
OPC	Offshore Patrol Combatant
PIRR	Publication Improvement Report and Reply
RAASM	Review of ADF Aviation Safety Management
RAN	Royal Australian Navy
RAST	Rotorcraft Alighting, Secure And Traverse System
RFT	Request for Tender
ROE	Rate of Effort
RPM	Revolutions Per Minute

RSD	Rapid Securing Device
SDSS	Standard Defence Supply System
SSHA	System Safety Hazard Analysis
TAMM	Technical Airworthiness Management Manual
US	United States of America
USN	United States Navy
VMC	Visual Meteorological Conditions

Summary and Recommendations

Summary

Introduction

1. Super Seasprite helicopters were acquired for the Royal Australian Navy (the Navy) for the purpose of enhancing the capability of the Navy's eight ANZAC class ships.¹ The tasks to be performed by the Super Seasprites included surface warfare, undersea warfare, boarding party operations, naval gunfire support, utility operations and conversion training.
2. The acquisition of the Super Seasprites occurred under Project Sea 1411 Phase 1 (the Project). The Project was approved in February 1996 with an original budget of \$746 million (December 1995 prices). Following a tender evaluation process, the Department of Defence (Defence) signed contracts with Kaman Aerospace International Corporation on 26 June 1997 for the acquisition (the Prime Contract) and in-service support (the ISS Contract) of the Super Seasprite helicopters.
3. Under the original Prime Contract the final helicopter was to be delivered in May 2002. It was apparent by mid 1999, that this schedule was at significant risk of not being achieved and the Project was under cost pressure. During 2000, consideration was given by Defence to provisionally accepting the Super Seasprites in an interim configuration. The Prime Contract was amended in early 2003 to allow this to occur. Between late 2003 and mid 2005 the Defence Materiel Organisation (DMO) provisionally accepted nine Super Seasprites in an interim configuration.
4. The provisionally accepted aircraft were operated by Navy between late 2003 and early 2006, but were subject to significant limitations including a prohibition on Navy operating the Super Seasprites from ships which applied from late 2004. In March 2006, flying of the aircraft by Navy was suspended due to concerns surrounding the aircraft's Automatic Flight Control System (AFCS). In May 2006, the Australian Military Type Certificate (Type Certificate) for the aircraft was withdrawn and the aircraft was not subsequently operated by Navy.

¹ The ANZAC class ships were delivered over the period 1996 to 2006 at a total cost of some \$6 billion (Dec 95 prices) and were designed to carry a helicopter.

5. The success of the Project was dependant on the performance of Defence, DMO and the Prime Contractor. The ANAO's focus in conducting this audit was on Defence's and DMO's administration of the Project, including DMO's key responsibility of managing contractor performance and ensuring the interests of the Commonwealth were appropriately protected when the Project encountered difficulties.²

6. The Project ran for more than 12 years and, when expenditure against the Project budget and other clearly related expenditure are combined, total expenditure related to the Super Seasprites exceeded \$1.4 billion.³ In March 2008, the Government cancelled the Project and DMO entered into a Deed of Settlement with the Prime Contractor which terminated both the Prime Contract and the ISS Contract, and put in place arrangements for the disposal of the helicopters, associated equipment and spares. As a consequence, additional time and investment will be required to provide the ANZAC ships with the helicopter capability that was intended to be fulfilled by the Super Seasprites.⁴

7. The Project was complex in nature and long running, and accordingly the decision to cancel the Project cannot be attributed to any individual factor. Rather a range of issues escalated over time and ultimately led to the decision to cancel the Project. These issues included the emergence of technical issues in

² The Project extended over a period of significant procurement reform in the Department of Defence. Following the establishment of DMO in 2000, restructuring saw the Project Office move from Canberra to Nowra NSW in 2002 to form part of the Naval Aviation Systems Program Office (NASPO). This move contributed to difficulties in recruiting and retaining appropriately qualified and experienced personnel to work on the Project. Personnel issues impacted on the capacity of the Project Office to provide contract and engineering oversight of the Project.

³ The Defence Portfolio Budget Statements for 2008–09 report that some \$953 million or 86 per cent of the Project budget of \$1.108 billion had been expended. The \$953 million expenditure on the Project does not include other expenditure related to establishing, maintaining and operating the Super Seasprite capability during the Project's life. This expenditure included \$201.13 million in expenditure on Penguin Missiles which no other ADF platform is capable of deploying; \$134.53 million in expenditure against the ISS Contract for the Super Seasprite; \$58.94 million in expenditure for spare parts procured outside the Prime Contract; \$0.6 million for modifications to the ANZAC Ships to cater for the Super Seasprite and modifications to the FFGs to provide interoperability; \$5.56 million in personnel and operating costs for APS and ADF staff located at the In-Service Support Centre; and \$46.9 million in costs for Navy's 805 Squadron which was commissioned in February 2001 to operate the Super Seasprite and then decommissioned in June 2008 following the cancellation of the Project.

⁴ The Defence White Paper released on 2 May 2009 reports that, as a matter of urgency, the Government has decided to acquire a fleet of at least 24 new naval combat helicopters to provide eight or more aircraft concurrently embarked on ships at sea. These new aircraft are to possess advanced Anti-submarine Warfare capabilities, including sonar systems able to be lowered into the sea and air-launched torpedoes, as well as an ability to fire air-to-surface missiles. *Defending Australia in the Asia Pacific Century: Force 2030*, Defence White Paper 2009, p. 72.

range of areas, difficulties in defining requirements and evaluating compliance with the Prime Contract, changed airworthiness arrangements within Defence and incidents which brought an increased focus on aviation safety within the ADF. It is sometimes the case when such issues interact, contracting parties find it difficult to agree on the underlying causes and the allocation of responsibility for resolution of such issues.⁵

8. The Chief Executive Officer (CEO) of DMO has informed the ANAO that he has undertaken two significant initiatives to increase the focus on helicopter management including establishing the Helicopters Systems Division in 2006 and seeking to ensure that the lessons learnt from the Super Seasprite were incorporated into the 2008 Defence Procurement and Sustainment Review (the Mortimer review).⁶

Audit objective

9. Given the significant expenditure associated with the Super Seasprites, and the problems that the Project had encountered over some time, the ANAO had commenced this performance audit prior to the Government's decision to cancel the Project. The focus of the audit was on Defence's and DMO's administration of the Project. In light of the Government's decision to cancel the Project, the objective of the audit was revised to place greater emphasis on those issues that resulted in the failure of the Project to provide the required capability, and highlighting project management lessons for major Defence acquisitions going forward. Accordingly the audit objective was to:

- identify those factors that contributed to the on-going poor performance of the Project;
- outline measures taken by Defence and DMO in seeking to overcome issues encountered by the Project, and key lessons arising from this project for the benefit of major acquisitions projects generally; and

⁵ There may also be implications for other parties that have an ongoing interest in the Project, such as sub-contractors to the Prime Contractor. These implications can be both financial and reputational. In conducting this performance audit, the ANAO focused on the activities of Defence and DMO in managing the Super Seasprite project, including their interactions with the Prime Contractor, and only focused on the activities of sub-contractors where their activities directly impacted on management of the Project. Accordingly, readers of this report should exercise care in drawing any inferences about the performance of sub-contractors.

⁶ 16 March 2009 advice from CEO of DMO to ANAO.

- determine the capability and cost implications of a project that failed to deliver to expectations.

Conclusion

10. The ANAO examined decisions taken at key points in the life of the Project to acquire the Super Seasprites, having regard to the information available within Defence and DMO at the time these decisions were taken, and reviewed the extent to which the implementation of these decisions contributed to project outcomes. This analysis revealed that decision making occurred in an environment of significant tension between the objective of providing Navy with the required capability, the fundamental obligation to meet ADF airworthiness requirements, and the inherent difficulties in managing a complex aircraft acquisition and associated sustainment arrangements. For the Project to be successful, these tensions needed to be managed and resolved. In the event, they were not, with the following factors contributing to the unsatisfactory Project outcome:

- the risks associated with the Project were increased by the decision to seek to incorporate extensive capability enhancements into a smaller helicopter than the ANZAC ship is designed to operate;⁷
- an adequate understanding of the significance of the risks associated with the acquisition was not attained through the requirement definition and tender evaluation processes;
- inadequacies in cost estimation resulted in a significant shortfall in the approved Project budget which was addressed by reducing the number of helicopters acquired, other cost saving measures that placed the delivery of the desired capability to Navy at additional risk, and through significant expenditure funded from outside the Project budget;
- financial leverage available through the Prime Contract was ineffectively applied in the early stages of the Project, allowing a large proportion of the funds to be expended despite evidence of schedule slippage and burgeoning risk;

⁷ The Request for Tender restricted the size of the helicopter in line with the requirements of an unapproved project instead of seeking to acquire a medium sized helicopter which the ANZAC ship is designed to operate.

- the Project Office experienced ongoing difficulties in attracting and retaining appropriately qualified personnel which inhibited its capacity to manage a large and complex project;
- software and system development activities undertaken by sub-contractors to the Prime Contractor were critical to project success, but DMO had limited contractual capacity to resolve risks as they emerged;⁸
- the decision to provisionally accept the Super Seasprites in an interim configuration did not deliver the desired outcomes, was poorly implemented and shifted much of the risk associated with the Project to DMO;
- Defence did not seek to amend the Prime Contract to reflect contemporary ADF airworthiness management practices creating a disparity between contractual and ADF certification requirements which Defence and DMO were ineffective in addressing; and
- poor contract management practices within Defence and DMO, over the life of the Project, contributed to ongoing contractual uncertainty.

11. The expenditure associated with introducing a capability into the ADF exceeds the direct acquisition costs, significantly in some cases. Where a project suffers ongoing schedule slippage, routine reporting on the project's performance does not provide transparency of mounting costs incurred outside the project.⁹ For the Super Seasprite, when expenditure against the Project budget and other clearly related expenditure are combined, total

⁸ It was beyond the scope of the audit to identify the relative responsibility of the Prime Contractor and its sub-contractors for the difficulties encountered in developing the Integrated Tactical Avionics System (ITAS). Accordingly, in developing this report, the ANAO did not seek to apportion responsibility for the difficulties encountered in developing the ITAS amongst the parties that continued to be involved in ITAS development at the time the Project was cancelled.

⁹ The Defence Annual Report, Portfolio Budget Statements, Portfolio Additional Estimate Statements and DMO's Major Project Report include the approved project budget and cumulative expenditure against that budget. This expenditure does not include project office salary, sustainment costs paid for using recurrent funding, the cost of linked projects and costs incurred by other areas of Defence and DMO associated with introducing, sustaining and operating the capability being acquired.

expenditure exceeded \$1.4 billion.¹⁰ This figure is 47 per cent greater than the expenditure against the Project budget alone of \$953 million.

12. It is not uncommon for major projects, including Defence projects, to experience cost overruns and integration issues. There is a tendency for initial estimates to be optimistic, contingencies to be too low, the severity of risks to be underestimated, delays to be more extensive than anticipated and the complexity of integration issues not to be fully appreciated. Where these factors accumulate, pressure is placed on the project budget, timetable and contracting arrangements, and as a consequence, the delivery of the contracted capability. In the case of the Super Seasprites all of these factors were significant, as explained in paragraph 10, and played a part in the eventual cancellation of the Project.

13. The ANAO recognises that major capital acquisition projects such as these are complex and demanding, and DMO's management approach for major projects has developed since the Project commenced in the mid 1990's, particularly following the 2003 Defence Procurement Review.¹¹ In addition, the ANAO is conscious that DMO is investing considerable resources into its approach to project management and the skills of its staff. This audit indicates that these steps being taken by the DMO are essential. Within the context of improving procurement practices and associated processes, there are some expensive lessons for Defence and DMO from this Project. Defence and DMO have worked with the ANAO to catalogue some of the key lessons (see Appendix 1) but if there is an overriding message from this Project, it is that risks to project outcomes need to be better managed and related accountability for managing project performance strengthened.

Key findings by chapter

Tender Evaluation and Contract Negotiation (Chapter 2)

14. The project to acquire the Super Seasprites was subject to budget constraints from the outset due to an underestimation of the costs used to

¹⁰ This figure is incomplete as it does not include all expenditure associated with introducing the Seasprite capability into service and the net outcome of settlement arrangements was yet to crystallise at the time of preparation of this report. Where a Project fails, expenditure may also be required to address any resulting capability gap. For the Super Seasprite Project this involves the redirection of \$10 million per annum in Super Seasprite sustainment funding to the Navy's Seahawk fleet in the short term.

¹¹ Also known as the Kinnaird Review.

derive the Project budget for Government approval. Rather than request an increase to the approved Project budget of \$746 million (December 1994 prices), Defence reduced the capability to be acquired by the Project. The primary capability reduction involved reducing the number of helicopters being acquired from 14 to 11. Savings were also derived by refurbishing existing airframes rather than acquiring new airframes, and moving the procurement of air to surface missiles for the Super Seasprite, which was originally within Project scope, to another project (Sea 1414). Defence was unable to provide evidence that approval was sought from then Government, the original approving authority, for these scope changes as was required under Defence Policy at the time. However, the then Minister was informed of this approach in a Ministerial Brief of January 1997 which also advised him of the selection of the Preferred Tenderer.

15. The ANZAC Ships are capable of operating a helicopter up to a medium size. However, the procurement of the helicopters under the Project was linked to an unapproved proposal for the development of an Offshore Patrol Combatant (OPC) vessel.¹² Consequently, the tender documentation constrained the size of the helicopters being sought for the ANZAC ships to an intermediate size to provide interoperability with the OPC. During the tender process there was ongoing uncertainty as to whether the OPC project would proceed. Concerns were also expressed surrounding the capability being sought from an intermediate sized helicopter. The OPC project was cancelled eight months after the Prime Contract was signed for the procurement of intermediate sized helicopters for the ANZAC Ships.¹³

16. One of the objectives of the Project was to allow the Super Seasprite helicopter to be operated by a crew of two, rather than the original configuration of a three person crew. The development of the Integrated Tactical Avionics System (ITAS) was fundamental to achieving this objective. The ITAS was to integrate the helicopters systems for avionics, navigation, weapons, communication and sensors. The final build of the ITAS was to be

¹² Also known as Offshore Patrol Vessels which can range in size from coastal patrol vessel boats or fast attack craft (about 500 tons) up to corvette or frigate-sized vessels (2 500 tons) *Janes Defence Weekly*, Volume 45, Issue 43, 22 October 2008, pp. 38-45.

¹³ In September 2008, Defence advised the ANAO that in hindsight, the subsequent cancellation of the OPC highlights the risk of linking the Seasprite to an unapproved project. However, at the time the OPC was before Government for approval, and until the final decision was made to cancel the OPC project, Defence procurement staff needed to continue to look at the most cost-effective option for the ANZAC ship and the OPC helicopters.

coupled to an AFCS which was to be enhanced through an upgrade of the flight control computer. Defence did not gain a complete appreciation, at the time of tender evaluation, of the risks associated with the Super Seasprite in relation to the development of the ITAS or the modifications to the AFCS. The development of the ITAS and AFCS were ongoing areas of difficulty for the Project and were factors that contributed to the decision to cancel the Project.

Financial Management (Chapter 3)

17. The Defence Portfolio Budget Statements for 2008–09 reported that \$953 million (86 per cent) of the approved project budget of \$1.108 billion had been expended.¹⁴ The largest proportion of this expenditure, \$895.4 million, related to the Prime Contract. The highest period of expenditure occurred between contract signature in June 1997 and mid 2001. During this period Cost Performance Reports indicated significant schedule slippage relative to expenditure, most notably in the development of the flight simulator and the ITAS. By mid 2003, a large proportion of the project funds had been expended but no helicopters had been accepted by DMO.

18. The Prime Contract did not include a liquidated damages provision. In negotiating the Prime Contract, the inclusion of critical milestones and an earned value management system were seen as alternative mechanisms to liquidated damages to promote performance. Under the Prime Contract, if a critical milestone was not achieved Defence was entitled to withhold all payments until such time as it was achieved. Notwithstanding the lack of progress in achieving the complete requirements of critical milestones in the Prime Contract, Defence either paid in full or part paid critical milestones or diluted them through contractual amendments. The last critical milestone was paid in August 2001, nearly seven years before the Project was cancelled in March 2008.

¹⁴ There was ongoing expenditure in late 2008 against the Project budget. Defence advised the ANAO in November 2008 that the difference between expenditure against the Project budget and the residual budget will be used to fund the Defence Capability Plan cost growth wedge. In December 2008 Defence informed the ANAO that Cabinet had agreed that the \$110 million Real Cost Increase would be funded from the 'Cost Growth Wedge'. Defence further advised that the Cost Growth Wedge refers to funding set aside in the Unapproved Major Capital Equipment Program to manage the risk of unanticipated cost increases in either approved (i.e. post-2nd Pass) or unapproved (i.e. pre-2nd Pass) projects. These increases include variations for price and exchange rates. Defence further advised that funding from the Cost Growth Wedge does not avoid the need to seek approval from relevant authorities to increase funding for post-2nd Pass projects.

19. Defence was required to validate the Prime Contractor's Cost Schedule Control System which supported claims for earned value method payments under the Prime Contract. In May 1998, an internal Defence minute recommended that earned value method payments could commence, notwithstanding that a validation review had identified eleven major weaknesses in the Prime Contractor's earned value management system. There was no contractual obligation on Defence to commence making earned value payments until the Cost Schedule Control System had been validated. Twelve months later, the Prime Contractor's Cost Schedule Control System was validated by Defence and subsequently accredited by the Deputy Secretary Acquisition. By the time the system was accredited, Defence had paid \$81 million in earned value method payments.

20. In 2001 there was concern within DMO surrounding the status of the earned value management system of one of the key ITAS sub-contractors and these concerns remained ongoing in 2003. Under the Prime Contract, the Prime Contractor was responsible to set in place mechanisms with sub-contractors for earned value management. The Prime Contractor was required to maintain compliance with Australian Cost Schedule Control System Implementation Guide, DEF(AUST) 5657 which imposes obligations on the Prime Contractor with respect to sub-contractors. Failure by the Prime Contractor to maintain a Cost Schedule Control System in accordance with DEF(AUST) 5657 entitled the Commonwealth to withhold all future earned value payments until the requirements were met.

21. During 2003, the Prime Contract was amended to remove earned value arrangements for all items, other than spares and stores. By this time annual expenditure against the Prime Contract had reduced significantly — payments peaked in 1998–1999 at \$189.4 million while payments in 2003–04 were only \$34.4 million.

Interim Capability Accepted (Chapter 4)

22. The ITAS emerged as an area of risk to the Project within five months of the Prime Contract being signed. The performance of one of the sub-contractors involved in the development of the ITAS was a key factor in this regard. Reviews conducted by Defence in 1998 and 1999 confirmed the risk ITAS development posed to the Project. In early 2001, DMO gave conditional approval for an alternative sub-contractor to be engaged for the development of the ITAS. In April 2001 the sub-contractor with primary responsibility for ITAS development was acquired by another Defence company.

23. In April 1999, the Deputy Secretary Acquisition had been informed that there was no scope for further schedule slippage if the contracted capability was to be delivered on schedule. In April 2000 it was proposed to, and accepted by the Naval Capability Management Board that the helicopter be accepted in phases as the successive builds of the ITAS became available. DMO briefs to the Under Secretary of Defence Materiel in March 2001 and late 2002 put forward options for action, including limited consideration of the option of cancelling the Project. In both briefs the acceptance of the helicopter in phases was put forward as the preferred option. By the time of the late 2002 brief, DMO had already signed a Statement of Principles with the Prime Contractor. The 2002 Statement of Principles established the basis for contractual negotiations to allow for the provisional acceptance of the Super Seasprites in an interim configuration (the Interim Training Helicopter).

24. The late 2002 brief to the Under Secretary of Defence Materiel included a copy of the 2002 Statement of Principles and a copy of a legal advice. This advice included a series of recommendations on how to approach the renegotiations of the Prime Contract. The brief to the Under Secretary of Defence Materiel canvassed a series of options for how to proceed with the contract. Subsequent to this brief, the Prime Contract was amended to insert the provisional acceptance arrangements for the Interim Training Helicopter without all the recommendations contained in the legal advice having been implemented. In late 2006, the recommendations of the 2002 advice were implemented, however, by this time many of the issues that the recommendations had sought to address had been exacerbated by the provisional acceptance arrangements and subsequent actions by DMO.

25. Under the February 2003 Contract Change Proposal the aircraft was intended to be operated with ITAS Build 1 for 18 months. ITAS Builds 2A, 2B and 3 were to be delivered later as part of the Full Capability Helicopter. The capabilities provided by the Interim Training Helicopter were well short of those to be provided by the Full Capability Helicopter. Flight testing conducted during 2004 indicated that deficiencies in the aircraft prevented the aircraft from fulfilling all the roles intended of the Interim Training Helicopter.

26. Over the period from October 2003 to June 2005, nine of the eleven aircraft were provisionally accepted by DMO in the interim configuration. The remaining two aircraft were never accepted. All aircraft were accepted with a number of unserviceabilities, deviations and Software Trouble Reports. Parts were borrowed to facilitate the acceptance of some helicopters. The ninth helicopter was accepted but was never flown by Navy after provisional

acceptance. Prior to the cancellation of the Project, the warranty had expired on all of the provisionally accepted aircraft.¹⁵ In September 2007, seven of the nine aircraft provisionally accepted were held in long-term preservation. None of the accepted aircraft were operated by Navy after May 2006.

27. The Prime Contract, as amended in 2003, provided that provisional acceptance of the aircraft in the Interim Training Helicopter configuration was subject to certain conditions being met. In respect of one of these conditions the Prime Contractor asserted that DMO had contributed to delays in meeting one of these conditions. In response to these claims, and a request for cash flow relief, DMO agreed in 2004 to make additional payments for services acquired outside the Prime Contract and to bring forward payments of \$1 million each for the subsequent five helicopters to be provisionally accepted. The last four aircraft provisionally accepted each attracted \$1 million in cash flow relief under these arrangements. The last helicopter subject to these arrangements was never accepted.

28. The Project experienced ongoing difficulty in developing the remaining aspects of the ITAS. A factor in this difficulty was DMO's limited contractual capacity to oversight the activities of the sub-contractors responsible for developing the ITAS. This had been an ongoing issue for the Project since the outset. Both the 2002 and 2004 Statement of Principles required a robust schedule to be developed and agreed. Under the contract amendment which followed the 2004 Statement of Principles a milestone payment for the last 10 aircraft being accepted in final configuration was scheduled to occur in November 2005. At the time the November 2005 milestone passed, Formal Qualification Testing of the ITAS required for the Full Capability Helicopter had not commenced.

29. In late 2006, DMO agreed to enter Formal Qualification Testing of the ITAS notwithstanding that some associated documents were not ready, and there were known software trouble reports in relation to system response times and spare capacity. In April 2007, this testing was halted as a number of issues precluded the completion of testing. Subsequently, DMO and the Prime Contractor were unable to agree on an approach to retesting the system. Issues surrounding system response times and spare capacity remained unresolved at

¹⁵ However, the warranty was yet to commence for the fitted sensors and weapon system as these were to be accepted as part of the final configuration.

the time the Project was cancelled. None of the Super Seasprites were ever accepted in the Full Capability Helicopter configuration.

Aircraft Sustainment (Chapter 5)

30. In parallel to the acquisition activities, DMO and the Prime Contractor needed to establish appropriate aircraft sustainment arrangements for when the Navy commenced operating the aircraft. The ANAO reviewed sustainment arrangements for the Super Seasprite and found ongoing challenges in the areas of linkages between the acquisition contract and ISS Contract, spares availability, achievement of the desired rate of effort and maintenance manuals.

31. In 1997, the Government agreed to procure seven used Seasprite airframes in addition to the 11 aircraft to be upgraded under the Super Seasprite Project. These airframes were procured in 1998 at a cost of US\$3.09 million. The original intention was to upgrade all seven of these airframes under later phases of the Project. Three of the aircraft were to provide the originally intended capability of 14 aircraft as well as four further aircraft as a contingency measure to address estimated aircraft attrition. These later phases of the Project were cancelled in 1999. None of the seven additional airframes were upgraded. In late 2006 a Business Case, which was prepared on the basis that the Super Seasprite would remain in service till 2025, indicated that a fleet of 11 helicopters could not provide the required six flights at sea for the ANZAC ships. Rather, the Business Case indicated that a fleet of 11 helicopters could only realistically achieve a maximum of four flights at sea. There was also no capability to address the possibility of aircraft attrition.

32. The ISS Contract involved a Ramp Up Fee during the establishment phase and an ongoing Management Fee supplemented by additional payments for work not covered by the Management Fee. Under the ISS Contract the Kaman Aerospace International Support Centre (the KAISC) was established adjacent to HMAS Albatross Nowra. The KAISC was opened in late 1999, with ramp up operations commencing in early 2000. No helicopters were provisionally accepted by DMO until October 2003.

33. There were inadequate linkages between the commencement of payments under the ISS Contract and deliveries of helicopters under the Prime Contract. This allowed payments of the Management Fee to commence notwithstanding that no helicopters had been accepted. From January 2000, DMO withheld a proportion of these payments. DMO obtained legal advice in

2002 that suggested that it may have been under no obligation to pay the Management Fee until the ramp up had been completed, but that by negotiating a lesser management fee DMO may have compromised its position in this regard. In early 2003, the ISS Contract was amended to include a revised milestone schedule with payments adjusted, for a limited period, to reflect the non achievement of milestones under the Prime Contract.

34. Following the suspension of flying in May 2006, payment of the Management Fee continued unadjusted. Legal advice obtained in October 2006 indicated that there was no contractual basis for ceasing payments but there was a basis for undertaking negotiations to seek a reduction in the Management Fee based on a significant reduction in the aircraft rate of effort. These negotiations were subsumed into broader renegotiations of the Prime Contract. Consequently, Management Fees under the ISS Contract were not reduced between May 2006 when the Type Certificate was withdrawn and early 2008 when the Project was cancelled.¹⁶ Over the life of the Project, DMO expended \$134.53 million under the ISS Contract and \$5.56 million on Defence staff located at the KAISC.

35. Generally, Defence major capital equipment projects are required to acquire three years worth of spare parts utilising the Project budget. In the case of the Super Seasprite Project, the capacity to acquire the spare parts recommended to meet this requirement was constrained by the shortfall in the Project budget. Consequently, in 2000–01 Defence commenced procuring spare parts using recurrent funding. At this time no aircraft had been accepted by DMO. By the time the Project was cancelled in March 2008, \$58.94 million had been spent on spare parts from sustainment funding. In some instances parts were cannibalised from other aircraft to meet requirements.

36. There were also a number of issues identified with the maintenance manuals including the documentation of Critical Maintenance Operations. Under the Technical Airworthiness Regulations Critical Maintenance Operations require independent maintenance inspections. Independent maintenance inspections were not mandated for the large number of Critical Maintenance Operations in Super Seasprite maintenance publications. Temporary arrangements were put in place through an Authorised

¹⁶ Over the period 2006–07 to 2007–08, which includes the period where the provisionally accepted aircraft were not operated by Navy but the Project was ongoing, \$24.9 million in Management Fees and price escalations were paid under the ISS Contract.

Engineering Technical Memorandum in 2003 to address this issue pending the update of these publications. Over the period December 2004 to September 2005, there were five reported maintenance issues associated with inappropriate conduct of Critical Maintenance Operations.

37. Also during this period a review of maintenance attitudes and practices within Naval Aviation, known as the Maintenance Reinvigoration Program was conducted. While the primary driver for this review was the Sea King Nias Island accident, other factors contributed to the decision to undertake the review, including a maintenance incident relating to a Super Seasprite. This review provided anecdotal evidence of inappropriate maintenance attitudes and practices across Naval Aviation and a program of rectification was initiated to address these issues.

Aircraft Certification (Chapter 6)

38. The ability of Navy to operate the Super Seasprite was contingent on the aircraft achieving and maintaining type certification. Certification activities occurred concurrently with acquisition and sustainment activities. Achieving and maintaining type certification was an ongoing area of difficulty for the Project.

39. During 1998 the ADF Airworthiness Management System was established. Navy transitioned to those arrangements during that year. However, the Prime Contract, having been signed in 1997, pre-dated the introduction of the ADF Airworthiness Management System. Accordingly, the Prime Contract specified the previous Navy specific certification arrangement as the applicable airworthiness regime against which the Prime Contractor was required to deliver the Super Seasprites. Defence decided not to update the Prime Contract to reflect the changed certification arrangements and instead opted to manage the difference within Defence. This created a risk that the Prime Contractor could deliver an aircraft which was contractually compliant but not able to meet the ADF's certification requirements. This shifted much of the certification risk to Defence, which became particularly evident in areas where the aircraft was modified to meet ADF requirements.

40. A Special Flight Permit enables an aircraft to be operated for specific purposes prior to being awarded a Type Certificate. In October 2003, the Super Seasprite was awarded a Special Flight Permit. The Special Flight Permit was renewed in June 2004, as the Project Office was not ready for an Airworthiness Board to consider the award of a Type Certificate. In renewing the Special

Flight Permit, the ADF Airworthiness Authority¹⁷ required that an Airworthiness Board be convened to review the regulation of the Special Flight Permit. The Airworthiness Board convened in September 2004 was informed that the Special Flight Permit was not fully compliant with the regulations and there had been limited independent review of operational airworthiness management. The Board was advised that contractual delays and political pressures had led to the complexities of phased acceptance of the Super Seasprite and these had contributed to a hybrid approach to the Special Flight Permit. The Board concluded that operations under the Special Flight Permit should not be prolonged. In March 2009, Defence informed the ANAO that, in hindsight, the breadth of the Special Flight Permit was too broad and subsequently changed the way in which Special Flight Permits were issued and reviewed.

41. Subsequently, in December 2004 an Airworthiness Board was convened to consider the award of a Type Certificate to the Super Seasprite. The Board was informed that the aircraft was a legacy design which did not necessarily comply with modern airworthiness standards, but that the aircraft had been extensively modified to provide additional capabilities sought by Defence. The Board was advised that this required a hybrid approach to design acceptance by assessing legacy aspects of the design against the Prime Contractor's standards, and the aircraft modifications against internationally recognised standards that were not a requirement set out in the Prime Contract. In recommending the award of a Type Certificate, the Board acknowledged that the extended duration of the acquisition process combined with the inherent legacy design meant that the Super Seasprite would always possess, to some extent, lower airworthiness standards when compared to contemporary airworthiness requirements.

System and Software Safety (Chapter 8)

42. The certification of the systems and software presented significant difficulties to the Project particularly with regard to the AFCS. Numerous concerns surrounding the approach to meeting systems and software safety certification requirements were raised with the Project Office by Director-General Technical Airworthiness (DGTA)¹⁸ staff over the life of the Project.

¹⁷ The Chief of Air Force is the ADF Airworthiness Authority.

¹⁸ DGTA performs the key roles of Technical Airworthiness Regulator and Technical Airworthiness Authority in the ADF Airworthiness Management System.

These concerns included a lack of confidence in the capacity of the Project Office to oversight the carriage of the software certification functions, a lack of correlation with internationally recognised standards and a lack of confidence in the development processes. In 2000, three years after the contract was signed, an external service provider was engaged by DMO to assist the Project Office in evaluating safety related software aspects of the Project.

43. A key difficulty for system and software safety certification for the AFCS, was the disparity between standards that were defined in the requirement of the Prime Contract and standards applied to aircraft certification activities. Two such standards that were used for certification but not defined in the Prime Contract included US Federal Aviation Regulation (FAR) 29 for the Certification of Transport Category Rotorcraft and RTCA DO-178B, which was developed to establish software considerations for developers, installers and users when an aircraft equipment design is implemented using microcomputer techniques. Neither of these standards was established as a requirement under the Prime Contract, yet were both applied in assessing compliance against certification requirements. Both standards predated the execution of the Prime Contract in mid 1997.

44. Demonstration of compliance of the Flight Control Computer against RTCA DO-178B within the AFCS became increasingly significant to the Project as it progressed. In March 2001 the Under Secretary Defence Materiel was informed that there was number of issues which needed to be resolved in relation to the Flight Control Computer within the AFCS. The Prime Contract did not align to DGTA's preferred certification basis which was RTCA DO-178B. The Under Secretary was informed that if the AFCS was unable to meet DGTA's requirements, an engineering change proposal valued at approximately \$1 million to \$2 million would be required to be implemented to provide an acceptable product. No such engineering change proposal was implemented. The failure by DMO to conclusively resolve this issue with the Prime Contractor was an ongoing area of difficulty for the Project; which was not resolved by the time the Project was cancelled. The Prime Contractor informed the ANAO that there is no doubt that the most significant factor was Defence's need to see RTCA DO-178B used for software development and, ultimately, Defence's failure to impose this standard made it impossible to complete the program and put the Super Seasprite into service.

45. Another key point of contention between Defence and the Prime Contractor was the Software Hazard Risk Index applied in the developing and testing of the AFCS. The Software Hazard Risk Index is derived from US

Military Standard MIL-STD-882C and is based on a matrix of control category and hazard category. Software exercising higher degrees of control and having more extreme consequences attract a higher Software Hazard Risk Index. The Prime Contractor applied a Software Hazard Risk Index of 'two' to AFCS development.

46. In March 2003 the Project Office wrote to the Prime Contractor arguing that the nature of the software should attract an Index of 'one'. The Project Office's March 2003 letter to the Prime Contractor stated that restrictions associated with the AFCS meant that the aircraft would not meet the operational requirements set out in the Prime Contract and that a higher level of safety integrity was warranted. One month prior to sending this letter, DMO had approved the Contract Change Proposal that introduced the provisional acceptance arrangements for the Super Seasprite in the Interim Training Helicopter configuration.

47. In recommending the award of a Special Flight Permit in October 2003, a DGTA minute acknowledged that the ability of the pilot to maintain safety in the event of an AFCS failure had not been fully assessed, tested and demonstrated in high pilot workload regimes. As a consequence, DGTA recommended that limitations on AFCS flight be imposed through the Special Flight Permit. A number of restrictions associated with the AFCS were also imposed through the Type Certificate and Service Release first issued in December 2004.

AFCS hard-overs

48. An AFCS induced hard-over is a potential failure condition resulting in a control input occurring that was not initiated or directed by the pilot.¹⁹ The risk of hard-over is generally mitigated by designing a system so that the likely occurrence is extremely low and by putting in place a process to control the outcome should a hard-over be experienced. The AFCS on the Super Seasprite comprised both legacy and new components, including a Digital Flight Control Computer, but retained its underlying legacy design philosophy known as 'pilot in the loop'. Under this philosophy the pilot was required to intervene to correct an AFCS malfunction. In April 2004, a draft Compliance

¹⁹ In April 2009, the Prime Contractor informed the ANAO that 'it should be noted that the AFCS is a limited authority system – at any given time, the roll, pitch, and directional actuator movements are limited to a smaller potential of overall travel.'

Finding Report²⁰ prepared by an external service provider indicated that the hazard mitigation of pilot intervention, in the event of an AFCS failure occurring without warning, was judged to be inadequate for critical flight conditions. The report stated that AFCS certification testing needed to be performed to assure compliance with the Certification Basis Description.

49. For the Super Seasprite an AFCS induced hard-over was a fault condition where the AFCS actuator moved to the extremity of its range and remained in that position, resulting in the aircraft diverging from its flight path in the direction of the hard-over. The onset of the hard-over could be abrupt and may require timely and deliberate intervention from the pilot to regain control of the aircraft. Two causes of hard-overs were regarded to be most significant for the Super Seasprite. The first was hard-overs occurring due to issues surrounding the interface between the AFCS and external data inputs such as the Air Data Computer and the inability of the system to adequately cope with corrupt data. The other related to the software not being designed to be flight critical and so minimise the chance for a fault to command a hard-over.

50. A Super Seasprite experienced an AFCS induced hard-over within two months of the aircraft being awarded a Special Flight Permit in late October 2003. This hard-over was attributed to an Air Data Computer failure, with the aircraft adopting a rapid nose-down pitch change with the failure of the AFCS to disengage being of serious concern. In August 2004, a Super Seasprite experienced a hard-over which was induced by pulling an AFCS Circuit Breaker to invoke a condition required for training purposes. A report based on test flying finalised in late 2004 indicated that a range of other issues exacerbated the potential impact of a hard-over such as space constraints in the cockpit.

51. In recommending the award of a Type Certificate to the Super Seasprite, the December 2004 Airworthiness Board noted that concerns with the AFCS were being partially addressed through a design change. The Airworthiness Board raised an Airworthiness Corrective Action Request which

²⁰ In March 2009, Defence informed the ANAO that this was the last complete draft compliance report but that compliance finding compilation continued until Project cancellation.

required a Deficiency Review Team²¹ to investigate a longer term solution to the system design issues associated with the Air Data Computer. The July 2005 Deficiency Review Final Report made a series of recommendations and findings relevant to the AFCS. These were broadly consistent with a March 2003 letter from the Project Office to the Prime Contractor that had indicated that the provisional acceptance of the aircraft was conditional on the AFCS concerns being addressed. By July 2005, when the final report of the Deficiency Review was issued, nine aircraft had been provisionally accepted by DMO.

52. A Super Seasprite experienced a further hard-over in March 2006. DMO advised the ANAO that the circumstances surrounding this hard-over were symptomatic of an Air Data Computer failure. Subsequent to this incident the Commander Australian Navy Aviation Group (CANAG)²² advised the Chief of Navy that the minimum obstacle clearance for operating the aircraft had been increased from 25 feet to 50 feet based on the outcome of AFCS low-speed hard-over flight testing. This advice indicated that the hard-over event was an undesirable but manageable event due to the risk measures in place at that time.

53. The Chief of the Defence Force directed through the Chief of Navy that a meeting of key airworthiness parties be convened to discuss the AFCS issue. This occurred on 27 March 2006 and involved CANAG and DGTA. The meeting was informed that there had been four hard-over events in approximately 1600 flying hours that had not been induced by flight testing. The aircraft design specification requirement was for a failure rate of one in one million hours for failures that may create a catastrophic outcome. DGTA expressed reservation about the ability of his staff to generate a credible order of magnitude of the likelihood of a hard-over occurrence in the Super Seasprite. In the absence of the ability to quantify the likelihood, the default likelihood was one in 500 hours. This meant that pending a design solution,

²¹ The establishment of the Deficiency Review Team was based on a recommendation by DGTA. Apart from considering the AFCS, the Deficiency Review Team was to consider other aircraft deficiencies and possible combinations of deficiencies which might impact on the safe operation of the aircraft. The Deficiency Review Team comprised personnel from the Project Office, Navy and DGTA. A Steering Committee comprising Navy and NASPO personnel oversighted the Deficiency Review.

²² The Commander Australian Navy Aviation Group is known as COMAUSNAVAIRGRP but for simplicity in this audit report the shorter acronym of CANAG, which is also in use in Defence, is used to refer to COMAUSNAVAIRGRP. For the Super Seasprite, the CANAG held the delegation of Operational Airworthiness Authority Representative which is a key role in the ADF Airworthiness Management System.

the ADF would be operating an aircraft with a failure rate assessed as being 2000 times greater than the accepted standard for the aircraft's design baseline, and 20 000 times greater than the Federal Aviation Regulation standards current at that time. On 29 March 2006, the then Minister for Defence was informed that Super Seasprite flying had been suspended based on CANAG advice.

AFCS remediation

54. Subsequently, DMO and the Prime Contractor developed an AFCS remediation program which involved two phases. Phase 1 was intended to remove obvious design flaws to support a restricted return to flying. Phase 1 was to be funded on a cost sharing basis, pending a determination on whether it was within the scope of the Prime Contract. DMO's share was to be funded through a previously approved Contract Change Proposal. DMO documentation from early 2007 stated that the approval of AFCS Phase 1 work on the basis of a Software Hazard Risk Index of 'two' was contractually problematic for DMO.

55. Phase 2 was to involve the redevelopment of the AFCS to meet identified design standards and safety objectives. Phase 2 work was to be funded out of a \$110 million real cost increase to the Project budget agreed by the then Government in May 2007. A Project Office estimate indicated that AFCS Phase 2 would cost in the order of \$50 million. Phase 2 was to be incorporated into the Prime Contract through a Deed of Variation. Agreement on this Deed was not reached prior to the Project being cancelled in early 2008.

56. Following the Government's decision to cancel the Project, a Negotiating Directive for the termination of the Project was approved by the CEO of DMO in March 2008. This directive indicated that AFCS Phase 1 remediation work had been tested by the Prime Contractor and Defence. The directive further noted that a report in respect to test flying was to be delivered in that month but that the preliminary view following testing was that the remediation work had not resolved all safety issues expected to be resolved through Phase 1. This contrasts with advice provided by the Acting Head Helicopter Systems to the then Minister some 10 months earlier in May 2007²³ which indicated that the testing of the AFCS software remediation Phase 1 had

²³ In May 2007, post production test flying of Aircraft 10 was conducted by aircrew employed by a sub-contractor and was undertaken at HMAS Albatross in Nowra under a CASA exemption.

been successfully completed in early 2007.²⁴ In March 2009, Defence informed the ANAO that, following further analysis of flight test data and subsequent testing by Defence in November 2007, DMO formed the view that Phase 1 AFCS remediation had not resolved all safety of flight issues.

Management of Deficiencies (Chapter 7)

57. During the period Navy operated the Super Seasprites under a Special Flight Permit, aircraft testing revealed a large number of deficiencies with the aircraft. A number of these deficiencies were considered to be unacceptable, including the AFCS issues outlined above, and correction was regarded as essential. The ANAO found that the resolution of a number of deficiencies was an area of ongoing difficulty for the Project.

Airworthiness Issue Papers

58. Airworthiness Issue Papers are the primary mechanism used within the Airworthiness Management System to record significant airworthiness deficiencies and processes intended to resolve or mitigate risks associated with these issues. ANAO analysis revealed limited progress towards resolution of these issues. In October 2003, there were 11 Airworthiness Issue Papers attached to the Project Office's submission prepared in support of the recommendation for award of the Special Flight Permit.

59. The November 2004 Design Acceptance Certificate listed 37 open Issue Papers. Of the 11 Issue Papers that were open at the time the Special Flight Permit was issued only two were closed by the time the December 2004 Airworthiness Board considered awarding a Type Certificate. However, there were ongoing concerns in 2008 surrounding the matters addressed by the two closed Issues Papers. Similarly all of the 37 Issues Paper included in the 2004 Design Acceptance Certificate remained open in early 2007. At that time 19 were listed as requiring resolution by the Prime Contractor and 18 were to be resolved by DMO.

60. Subsequent to the 2004 Airworthiness Board, a Deficiency Review Team was established to review the interrelationship between the deficiencies in the aircraft and the Issue Papers, and recommend priorities for rectification. At the time of the Deficiency Review, in early 2005, there were 57 open Issue

²⁴ Defence provided ANAO with copies of subsequent advice to the Minister in the form of a Question Time Brief and Question on Notice response, both from August 2007, each of which indicated ongoing issues surrounding AFCS Phase 1 although neither specifically sought to correct the May 2007 advice.

Papers. The July 2005 Deficiency Review Final Report classified 20 of the Issue Papers as requiring resolution for safety of flight, and three were regarded as being significant capability issues.

Deck handling system

61. One major deficiency related to the ship deck handling system known as the Rotorcraft Alighting, Secure and Traverse System (RAST). This system is used to secure the aircraft to the deck and to move the aircraft between the hangar and the flight deck via a probe fitted to the aircraft. Aircraft may either be hauled down into a Rapid Securing Device (RSD) on the flight deck by a cable, or the pilot may land the aircraft into the RSD. The Australian version of the Seasprite was the only version to be fitted with the RAST. The RAST was regarded as necessary in order for helicopter operations to occur up to the high end of Sea State 5. During flight trials the undercarriage was found to make contact with the RSD, notwithstanding that the probe was correctly positioned into the extremity of the RSD. While landing gear striking the RSD under these circumstances was not in accordance with the requirements of the Prime Contract, there were other circumstances where the undercarriage could strike the RSD about which there was contractual ambiguity. The DMO sought to address both circumstances and as a result introduced contractual uncertainty surrounding the RAST interface. This issue was never resolved.

Anthropometric restrictions

62. Another major deficiency related to space constraints within the cockpit which potentially prevented aircrew from exercising full control of the aircraft. This issue was known as anthropometric²⁵ restrictions and was particularly significant in circumstances when a Qualified Helicopter Instructor occupied the left seat and needed to intervene to correct student mishandling. Size restrictions on the aircrew occupying the cockpit were imposed with some aircrew having to leave 805 Squadron as they were anthropometrically unsuitable to operate the Super Seasprite. The potential for these restrictions was first identified in 1998 and then tested in 2001, with the issue then held in abeyance until 2004. This delay became contractually problematic. In 2006 Defence was considering regearing the cyclic to alleviate these restrictions. This was to be funded by a real cost increase to the Project budget agreed to by

²⁵ Anthropometry is the scientific study of the measurements of the human body.

the then Government in 2007. The Project was cancelled prior to this issue being resolved.

Increase in all up weight

63. Defence documentation indicated that a number of technical risks were impacted by increases in the all up weight of the Super Seasprite. There had been concerns surrounding the increase in all up weight since 1999. The 2005 Deficiency Review recommended that a concerted effort be put into reducing the all up weight. Briefs provided to senior Defence officers in early 2008 indicated that the increase in all up weight, combined with a lack of agility over the flight deck, would limit operations of the Super Seasprite at sea to Sea State 4. The 1995 Detailed Operational Requirement required that the aircraft be able to operate off an ANZAC Ship up to the high end of Sea State 5. The Prime Contractor informed the ANAO in April 2009 that 'Defence reasoning regarding the effect of increased all up weight and lateral cg [centre of gravity] is completely erroneous and neither characteristic, either taken individually or in concert, produces unacceptable handling qualities'.

Formation flying

64. The Special Flight Permit contained a number of operating limits intended to mitigate risks associated with aircraft deficiencies. However, there was a degree of uncertainty surrounding the scope of activities authorised under the Special Flight Permit. In particular there were divergent views within Defence on whether the Special Flight Permit authorised formation flying, which had been conducted in the Super Seasprite by Navy. The Airworthiness Board, which reviewed the Special Flight Permit in September 2004, formed the view that formation flying was beyond the intent of the Special Flight Permit but that the risk associated with this activity had been managed appropriately. Three months later, a subsequent Airworthiness Board²⁶ raised an Airworthiness Corrective Action Request due to concerns surrounding the impact of some control deficiencies on activities such as close formation flying.

Prohibition on intentional flight in Instrument Meteorological Conditions

65. On 16 December 2004, the Super Seasprite was issued with a Type Certificate and Service Release. Both the Type Certificate and Service Release

²⁶ This December 2004 Airworthiness Board recommended the issue of the Type Certificate and Service Release for the Super Seasprite.

contained a significant number of restrictions and limitations which were intended to mitigate known deficiencies. Among these were a prohibition on intentional flight in Instrument Meteorological Conditions. One of the contributing factors to the prohibition on intentional flight in Instrument Meteorological Conditions was due to occasional intermittent drift in the aircraft's navigation system. The navigation system had been updated for the Super Seasprite. Issues surrounding the navigation system were first identified in 2001 and were unresolved at Project cancellation. A factor contributing to the inability to resolve this issue was the absence of navigation system drift data required by the Prime Contractor. Seasprite operations were suspended before mechanisms could be put in place by DMO to record this data.

Scope of activities authorised under the Type Certificate

66. Another limitation contained in the Type Certificate issued in 2004 prohibited the Super Seasprite from participating in embarked operations. At the Airworthiness Board review of the Type Certificate in November 2005, Navy and the Project Office sought to have the prohibition on embarked operations moved from the Type Certificate to the Service Release. This would have allowed the ADF Airworthiness Authority to subsequently lift the prohibition on embarked operations without the requirement to first conduct an Airworthiness Board, if it could be demonstrated that certain issues which were regarded to be impediments to embarked operations had been overcome. The Chief of Navy had indicated a priority to get the Super Seasprite to sea.

67. Issues impacting on the embarked operation of the Super Seasprite included the RAST interface issue, undercarriage strength and AFCS issues. The July 2005 Deficiency Review Final Report expressed concern that identified deficiencies impacted on the ability to operate the aircraft at sea, and that a hard-over in the forward axis while over the flight deck could see the aircraft impact the hangar before the aircrew could reasonably be expected to react. A number of personnel involved in recommending to the November 2005 Airworthiness Board that the prohibition on shipboard operations be transferred from the Type Certificate to the Service Release had also been involved in the Deficiency Review. In line with a DGTA recommendation, the Airworthiness Board concluded that the issues that led to the prohibition on shipboard operations remained and it did not support the removal of this restriction from the Type Certificate.

68. The report of the November 2005 Airworthiness Board²⁷ stated that the restrictions and limitations imposed on the Super Seasprite through the Type Certificate and Service Release were onerous in comparison to other aircraft. The report stated that if the aircraft were operated in accordance with those restrictions, then there was a sufficient basis for airworthiness of the Interim Training Helicopter. One month after the 2005 Airworthiness Board review of the Type Certificate the Super Seasprite participated in a family day at 805 Squadron. This involved the carriage of 55 family members in a Super Seasprite.

69. Defence advised that no reference from a higher authority could be found which prevented the aircraft from participating in family day activities and that a detailed risk assessment had been undertaken by the officer that had authorised these activities. Within four months of the family day, flying operations of the Super Seasprite were suspended due to concerns surrounding the frequency of AFCS induced hard-overs. As noted above, concerns surrounding the AFCS were one of the reasons the Airworthiness Board did not agree to transfer the prohibition on embarked operations to the Service Release.

Crashworthiness

70. The 2005 Deficiency Review found that while individual safety related issues did not warrant the increased expenditure that would be necessary to improve crashworthiness, the Deficiency Review Team considered that, cumulatively, the likelihood of an incident or accident was such that an incremental improvement in crashworthiness was warranted. While the Seasprite was a 1960's design, and pre-dated modern crashworthiness standards, the aircraft had been heavily modified for Navy and as such the opportunity existed to improve the crashworthiness of the aircraft.

71. In 2006, a DMO crashworthiness review identified that the aircraft's crashworthiness was below the contemporary standard and that in some instances the modifications to the aircraft had caused the crashworthiness to regress when compared to the previous version of the aircraft.²⁸ The review

²⁷ The November 2005 Airworthiness Board recommended the renewal of the Type Certificate and Service Release initially granted in December 2004.

²⁸ The DMO report of this review was dated five months after the Type Certificate for the Super Seasprite was withdrawn. In April 2009, the Prime Contractor stated that 'the Super Seasprite was fully compliant with all crashworthiness requirements of the Prime Contract.'

indicated that the primary reason for the shortcomings in crashworthiness was a lack of focus on crashworthiness requirements for the helicopter, particularly the omission from the Prime Contract of a requirement for the aircraft to comply with a recognised crashworthiness standard. The review recommended that the replacement of the cockpit seats with energy attenuating seats would provide the single greatest return in improving the Super Seasprite's crashworthiness. The 2005 Deficiency Review drew a similar conclusion. Concerns surrounding the crashworthiness of the aircraft were a factor taken into consideration in the Government's decision to cancel the Project.

Renewal of the Type Certificate and Service Release

72. Notwithstanding the 2005 Deficiency Review, Defence did not have a full understanding of the airworthiness implications of the deficiencies in the Super Seasprite at the time the Type Certificate was reviewed in 2005. The Airworthiness Board reviewing the Type Certificate was informed by DGTA that the ADF should not continue to operate an aircraft with unknown or not agreed issues outstanding. DGTA indicated that in the event of an incident or accident, the ADF Airworthiness Authority may not be in a defensible position to argue the soundness of his decision to issue a Type Certificate.

73. DGTA recommended a review of the deficiencies, associated risk mitigation and, where required, timeframes and costs for design changes. This was supported by the November 2005 Airworthiness Board. A limited review was subsequently undertaken by staff within DGTA. This review indicated that there was no combination of Issue Paper deficiencies that presented a level of risk greater than that currently being accepted and/or mitigated by the extant Type Certificate and Service Release limitations. This review did not categorise aircraft deficiencies according to the DGTA recommendation to the 2005 Airworthiness Board.

74. In February 2006 the ADF Airworthiness Authority renewed the Service Release for the Super Seasprite based on a recommendation from the 2005 Airworthiness Board. In renewing the Service Release, the ADF Airworthiness Authority noted concerns surrounding maintenance procedures, the loss of confidence in the aircraft by aircrew and DGTA's lack of confidence in the integrity of the design. As a consequence of these issues, the ADF Airworthiness Authority renewed the Service Release for six months rather than the normal 12 months. This was intended to coincide with reporting dates for several Airworthiness Corrective Action Requests raised by

the November 2005 Airworthiness Board, and to allow the quick reduction or removal of restrictions on the operation of the aircraft.

Navy Ceases Operating the Aircraft (Chapter 9)

75. In March 2006, the Chief of Navy was advised by CANAG that a series of factors had generated a high risk airworthiness and capability management situation in relation to the Super Seasprite. These factors included a large number of unresolved Issue Papers; a significant number of restrictions in place; the possibility that the AFCS hard-over issue represented an unacceptable risk and may not be resolved; and the software for the Full Capability Helicopter was yet to be completed and represented an ongoing risk. CANAG also informed the Chief of Navy that the Type Certificate and Service Release for the aircraft might not be renewed at the next Airworthiness Board, which was due to take place in mid 2006. The CEO of DMO also informed the then Minister for Defence in March 2006 that the Type Certificate for the Super Seasprite was at risk of being withdrawn.

76. In May 2006, a brief to DGTA concluded that the balance of technical deficiencies, together with concern over previous certification activities, had provided a lack of confidence in the validity of the Type Certificate for the Super Seasprite. Issues regarded as presenting risk included the large quantity and serious nature of technical deficiencies on the air vehicle; the acceptance of legacy specification in the areas of AFCS and crashworthiness; minimal and, in some cases, no progress being made on the majority of technical deficiencies since the award of the Type Certificate; and no appreciation of the potential combination of technical deficiencies on the aircraft. DGTA subsequently wrote to the ADF Airworthiness Authority recommending the Type Certificate be withdrawn. On 19 May 2006, the ADF Airworthiness Authority wrote to the Chief of Navy and CEO of DMO formally withdrawing the Type Certificate for the Super Seasprite. Following the withdrawal of the Type Certificate Navy was unable to operate the aircraft without the aircraft being reissued with either a Special Flight Permit or Type Certificate.

77. The subsequent process to achieve recertification of the Super Seasprite was inhibited by weaknesses in previous certification activities. Audits conducted by DGTA and Navy Aviation System Program Office (NASPO) personnel between 2000 and 2006 had repeatedly identified weaknesses in the design acceptance processes and the engineering management system for the Project, which are fundamental elements of the technical certification process. The DGTA Submission to the November 2005 Airworthiness Board noted that

notwithstanding improvements in the engineering management framework provided by NASPO and the Prime Contractor, issues relating to refurbishment quality, quality of Original Equipment Manufacturer's advice and inconsistencies in fundamental design analyses had reduced the confidence of DGTA personnel in design and production since the Type Certificate was granted in December 2004.

78. A compliance finding is an engineering decision, based on relevant evidence that indicates whether an aircraft's design satisfies a design requirement. A 2006 NASPO audit identified that records of compliance findings were regarded to be poor and found discrepancies between the findings contained in compliance finding reports and the information recorded in the Certification Basis Description Database. The NASPO Crashworthiness Report from October 2006 found discrepancies between a compliance finding report for crashworthiness and the 2004 accomplishment summary prepared in support of Type Certification. The October 2006 report recommended a complete review of the compliance findings detailed in the submission in support of type certification.

79. A June 2007 presentation to the Project Manager Stakeholders Group was advised that the Project Office envisaged a series of expanding Special Flight Permits over the period from late 2007 to late 2010, and that the Full Capability Helicopter was expected to achieve type certification by late 2011. This would have been 14 years after the Prime Contract was signed, nine years after the contract was originally intended to be completed, and eight years after the Prime Contract was amended to introduce the provisional acceptance of the Interim Training Helicopter. At the time of this stakeholders meeting the status of the Certification Basis Description for the Interim Training Helicopter, which had previously supported the type certification of the aircraft, was not clear. This was four and a half years after the Interim Training Helicopter was awarded a Special Flight Permit and two and half years after it had been awarded a Type Certificate.

80. In September 2007, the ANAO sought clarification from Defence on the type certification process for the Super Seasprite. Defence advised that the number of open Issue Papers was a concern to the Technical Airworthiness Authority at the time the Type Certificate was awarded. At that time, in December 2004, the Project Office had indicated that the problems would be resolved in a matter of months. Defence advised that had the real closure time for the open Issue Papers been presented, it was unlikely that a Type Certificate would have been granted. This would have negated any potential

benefit associated with the Provisional Acceptance of the aircraft in an interim configuration. Following the withdrawal of the Type Certificate in May 2006, the Super Seasprite was not subsequently issued with a Special Flight Permit or Type Certificate.

Cancellation of the Project (Chapter 10)

81. In March 2005, the Project Director assessed the status of the Project against the 1995 Detailed Operational Requirements for the ANZAC Ship Helicopter. At that time, the Project Director assessed that the Prime Contractor had demonstrated achievement of 75 per cent of the essential requirements contained within contract. Achievement against the remaining essential requirements was still to be demonstrated.

82. The 2005 Deficiency Review²⁹ also used the Detailed Operational Requirements as part of its methodology in classifying issues. There were two versions of the July 2005 Deficiency Review Final Report, a Restricted version and a more highly classified Confidential version. The Confidential version contained an additional finding and recommendation not included in the Restricted version. This finding suggested that it was time to consider an alternate platform to fulfil the role of the ANZAC Ship Helicopter. In line with this finding, the report recommended that the Super Seasprite not be further pursued as the ANZAC Ship Helicopter.

83. The Restricted version of the Deficiency Review Final Report was circulated within relevant areas of Defence. However, DMO was unable to provide any evidence that the Confidential version of the report was provided to any relevant officers outside of the Steering Group that had overseen the Deficiency Review. All the members of this Steering Group had some level of direct involvement in the Project. Defence informed the ANAO in March 2009 that the Steering Group requested that the finding and recommendation be removed as it was beyond the terms of reference provided to the team but that the conclusion that led to this finding and recommendation was retained in the Restricted version of the report. Given the significance of the additional finding and recommendation, and the fact that the conclusion that led to these

²⁹ The Deficiency Review emanated from a recommendation by DGTA to the 2004 Airworthiness Board which awarded the Australian Military Type Certificate to the Super Seasprite. In this context the review had been intended to focus on airworthiness rather than capability considerations.

remained in the Restricted version of the Report, it is unclear why the Confidential version of the report was not provided to senior officers.

84. 10 days after the Deficiency Review issued its final report DMO provided a brief to the then Minister for Defence. This brief contained no reference to the Deficiency Review. The brief indicated that it was Defence's view that the Super Seasprite, although less capable than expected in some areas, would meet the minimum requirements specified in the Detailed Operational Requirements. Comments from personnel within CANAG recorded on a copy of this brief expressed reservations about this statement.

85. In February 2006, the Chief of Air Force in his role as Senior Aviation Advisor commented that the Deficiency Review report provided a worrying outlook for the progression of the Super Seasprite toward a capability fit for its intended purpose. The Chief of Air Force's comments referred to the Restricted version of the report. In late March 2006, CANAG indicated to the Chief of Navy that the time for considering the broader capability, personnel and financial impact of the Project was looming large. This was after the AFCS induced hard-over in March 2006 that contributed to the decision to withdraw the Type Certificate.

86. In May 2006, a Senior Officer review of the Project was undertaken involving the CEO of DMO, the Chief of the Capability Development Group, the Chief of Navy and the Chief of Air Force. A NASPO presentation to this review projected that the Super Seasprite would achieve 95 per cent of its Surface Surveillance Capability, 70 per cent of its Anti Surface Warfare Capability and 80 per cent of its Anti Submarine Warfare Capability. A brief provided to the then Minister for Defence by the CEO of DMO in May 2006 reflected these projections as did a DMO brief to the Parliamentary Secretary for Defence Procurement in January 2008. A statement of impairment relating to the Super Seasprite was signed by the CEO of DMO in October 2006. In that statement the CEO of DMO concluded that the Super Seasprite capability would be impaired by 10 per cent, irrespective of ongoing remediation work. However, this impairment figure was increased to 15.5 per cent by the Secretary of Defence and the Chief of the Defence Force, in consultation with the CEO of DMO,³⁰ and reported in Defence's 2005–06 financial statements.

³⁰ 16 March 2009 advice from CEO of DMO to ANAO.

87. At the time of the Senior Officer review in May 2006, the projected initial operational capability for the Super Seasprite was expected to be achieved in 2009. By January 2008, this had slipped to late 2011. In May 2006, the then Minister for Defence informed the media that he had asked the Chief of Defence Force to provide all options the then Government might consider with respect to the Project. These included continuing with the Super Seasprite, procuring Sikorsky 60R Seahawks or procuring Eurocopter NH90 helicopters.

88. In September 2006, a Minute from the Chief of the Capability Development Group to the Chief of Navy and the CEO of DMO advised that the Defence Capability Investment Committee had agreed that the Super Seasprite would only be capable of providing an interim capability, and that there would be merit in bringing forward Air 9000 Phase 8 which was to replace the Seahawks and Super Seasprites. The Chief of the Capability Development Group stated that the Defence Capability Investment Committee required an understanding of the options that might provide an interim capability from 2008. These included the Super Seasprite in-service till 2025; interim capability provided by a Seahawk/Super Seasprite mix; or interim capability provided by Seahawk alone.

89. The 2006 Business Case subsequently prepared for the option of maintaining the Super Seasprite in-service included a capability assessment of the Super Seasprite in general flying conditions. This assessment indicated that the Super Seasprite would achieve 90 per cent capability in Visual Meteorological Conditions subject to the rectification of the AFCS safety concerns, and 80 per cent capability in Instrument Meteorological Conditions.³¹ At the time, the aircraft was yet to demonstrate its capability to operate in conditions of poor visual reference. In terms of embarked capability, the aircraft was assessed as meeting 75 per cent of its capability with a central centre of gravity if the RAST interface issue was resolved. In the case of embarked operations with an asymmetric centre of gravity, a 30 per cent capability could be achieved. The aircraft was assessed as being potentially not

³¹ In April 2009 the Prime Contractor informed the ANAO that it disagreed with Defence's assessment of the Super Seasprites' capability in Instrument Meteorological Conditions stating that:

The SG-2G(A) was qualified by the Prime Contractor for operation in IFC [Instrumented Flight Conditions], or IMC [Instrument Meteorological Conditions] in accordance with Prime Contract requirements and military standard MIL-H-8501A, General Requirements for Helicopter Flying and Ground Handling Qualities.

recoverable to a flight deck with a single Penguin missile and minimum fuel which generated the worst centre of gravity issues.³²

90. DMO documentation from mid 2006 indicated ongoing contractual uncertainty which was exacerbated by arrangements being agreed outside the Prime Contract, and poor record keeping. In late 2006, the General Counsel of DMO recommended to the CEO of DMO that legal advice obtained in 2002 be implemented. This 2002 advice had been intended to improve contractual certainty and involved pursuing a negotiated solution on outstanding claims, conducting a more thorough investigation of the course of dealings between the parties and commencing formal dispute processes. At the time of this recommendation by the General Counsel, there were time constraints on the dispute process flowing from statutory limitations. In line with concerns about the statutory limitation period expiring, the DMO issued a Notice of Dispute to the Prime Contractor on 17 January 2007. The matters set out in the Notice of Dispute had been longstanding issues for the Project. In March 2009, DMO advised the ANAO that it had not issued a Notice of Dispute before this time as it was seeking a negotiated settlement with the Prime Contractor.

91. In late January 2007, the Director-General Naval Aviation Systems wrote to several senior personnel in DMO advising that the Prime Contractor was also interested in preserving its rights beyond the statutory limitation period. On 1 February 2007, a Deed of Standstill was signed between the Prime Contractor and the Commonwealth preserving any cause of action available to any party which might have otherwise have been precluded due to the expiry of the limitation period. Two days prior to executing the Deed of Standstill, key DMO documentation identified a degree of uncertainty surrounding the matters set out in the Notice of Dispute and raised other significant contractual issues.

92. In May 2007, the then Minister for Defence announced the Government had decided to continue with the Project, subject to satisfactory contractual arrangements being reached. Agreement on these contractual amendments was never reached. At the time the Project was ultimately cancelled, in March 2008, the former Minister for Finance at the time this decision was taken in 2007 issued a media release in his then role of Shadow Minister for Defence. In

³² In April 2009, the Prime Contractor informed the ANAO of its view that 'moving the single missile to the opposite stores station was found to completely correct this problem and that this had been proven through flight testing'.

that media release he stated that the then Minister for Defence had recommended in early 2007 to the National Security Committee of Cabinet that the Project be cancelled.³³ According to the media release, the National Security Committee of Cabinet had been concerned about the potential cost to taxpayers and sought more detailed advice from the Department of Defence on the Government's liability. This National Security Committee meeting was held shortly after the Notice of Dispute was issued and Defence advised that there was a significant degree of contractual uncertainty.

93. In deciding to continue with the Project, the then Government agreed to a \$110 million real cost increase to the Project budget. As noted above, the late 2006 Business Case and Statement of Impairment prepared by the DMO suggested that if certain issues were addressed the Super Seasprite would be able to meet a significant proportion of its intended capability. Elements of the project maturity score contained in the Acquisition Overview Report³⁴ provided to the Government in May 2007 did not adequately reflect the status of the Project in the areas of cost, technical difficulty, commercial and operation and support given the longstanding and ongoing issues in these areas. Nevertheless, the Project Office assessment in the Acquisition Overview Report did indicate that the Project was in significant difficulty and DMO advised the ANAO in April 2009 that the Super Seasprite Project was the only project showing all three traffic lights as red for cost schedule and capability.³⁵

94. In early 2008, a series of briefs were prepared for senior Defence personnel on the status of the Project. These briefs outlined a series of inadequacies in the Super Seasprite capability. Some of these inadequacies had been identified as early as 1998, and all issues were matters covered in the 2005 Deficiency Review, which had effectively recommended that the Project be cancelled. A brief to the Parliamentary Secretary in early 2008 on the status of the Project outlined further issues. Once again, these issues had been known for a number of years. On 5 March 2008, the then Minister for Defence announced that the new Government had decided to cancel the Project.³⁶

³³ Seasprite Cancellation, Media Release by the Shadow Minister for Defence – 5 March 2008.

³⁴ The Acquisition Overview Report is a high level status report produced for each of the projects being managed by DMO that is provided monthly to Government.

³⁵ The May 2007 Acquisition Overview Report for the Super Seasprite Project is replicated at Figure 10.2.

³⁶ In August 2008, DMO advised that addressing the resulting capability gap in the short term was to be achieved through redirecting \$10 million per annum in funding from Seasprite sustainment to Seahawk sustainment.

95. In the context of the history of the Project, it is clear that the Project was high risk from the outset and the scale of these risks escalated rapidly in the early stages and remained high prior to the Government's decision to cancel the Project. The issues encountered were fundamental to the Project's success and were not overcome during the 12 year life of the Project. From an accountability perspective, this leads to a question regarding how the Project was allowed to continue for so long at significant expense to Government. Factors contributing to this outcome include a degree of optimism surrounding the ability to achieve outcomes; a reluctance to make firm decisions based on the information available; and a lack of visibility of information to decision makers due, in part, to the Project's complexity and long history.

Settlement Deed with the Prime/ISS Contractor

96. In March 2008, DMO executed a Settlement Deed which terminated Prime Contract and the ISS Contract. A key aspect of the Deed was the transfer of title of 'equipment for sale'³⁷ from DMO to the Prime Contractor. Under the original Deed of Settlement, the transfer was to be effected on DMO receiving approval from the US Government for transfer of title of this equipment to the Prime Contractor. This approval was not granted in its original form, however it was achieved through a two part process following further consultation with the US State Department. Instead of allowing title to transfer, the US Government granted approval for the temporary importation of this equipment into the US by the Prime Contractor. As a consequence, in September 2008, the Settlement Deed was amended to provide for the transfer of possession to the Prime Contractor followed by the Prime Contractor seeking permission from the US Government for the transfer of title from the Commonwealth to itself. Transfer of title to the Prime Contractor occurred on 12 February 2009. Upon transfer of title occurring, the Deed of Standstill was terminated and the Notice of Dispute withdrawn.

97. Equipment transferred includes the 11 refurbished helicopters, the flight simulator, technical data and manuals, part task trainers, the Mission Planning System and Debrief Facility, the Software Support Centre, spare parts, support equipment and the seven airframes owned by DMO and stored in the US. Expenditure on this equipment was in the order of \$915 million. Some other spare parts acquired under the Project are to be retained by DMO,

³⁷ The 'equipment for sale' is described in paragraph 97.

with DMO indicating in September 2008 that these were valued at \$33.9 million. Under the Settlement Deed, DMO is entitled to receive minimum payments from the Prime Contractor totalling \$39.52 million. This amount is payable in an initial instalment of \$26.7 million in March 2011 and two further instalments of \$6.41 million in March 2012 and March 2013.

98. If the Prime Contractor secures a buyer of the equipment for sale, DMO is entitled to a stepped proportion of the net proceeds of sale with the \$39.52 million minimum payment outlined above offset against any amount payable. The net proceeds of sale will be derived from the sale price less a percentage as compensation for the Prime Contractor, agent's fees and reconfiguration costs. Under the Settlement Deed DMO may be liable for up to \$12.5 million under the ISS Contract close-out arrangements. By November 2008, DMO had expended \$6.85 million under the close-out arrangements for the ISS Contract.

99. Defence's 2007–08 financial statements included a write-down \$350.5 million for the helicopters, \$108 million for spares, \$273.8 million for assets under construction and \$228 million for the Penguin Missiles. The 2007–08 financial statements also include \$124.5 million in assets held for sale on the basis that a purchaser of the Super Seasprites can be identified and the estimated sale price is realised.

100. Defence's 2008–09 Portfolio Budget Statements indicate that \$953 million (86 per cent) of the Project budget had been expended as at May 2008. However, the full cost of introducing a capability to the ADF is significantly higher than the Project expenditure alone would suggest. These costs increase as schedule slippage occurs. For the Super Seasprite, when costs associated with related projects, in-service support and establishing and maintaining the capability within Navy to operate the helicopters are combined, the total cost associated with the Super Seasprite is in the order of \$1.4 billion. This figure is incomplete as it does not include salary costs for the Project Office and costs associated with work undertaken by the technical regulatory authorities and the Defence Science and Technology Organisation for the Project. At the time of preparation of this report the net outcome of settlement arrangements were not finalised.

101. Following the cancellation of the Super Seasprite Project, the Defence White Paper released on 2 May 2009 reports that, as a matter of urgency, the Government has decided to acquire a fleet of at least 24 new naval combat helicopters to provide eight or more aircraft concurrently embarked on ships at

sea. These new aircraft are to possess advanced Anti-submarine Warfare capabilities, including sonar systems able to be lowered into the sea and air-launched torpedoes, as well as an ability to fire air-to-surface missiles.³⁸

Summary of responses

102. The Department of Defence provided a response to the proposed report on behalf of Defence and DMO. The department's detailed response to the report's recommendations is replicated at Appendix 3. Defence and DMO's overall response to the report is as follows:

Defence acknowledges the significant project issues raised in the Australian National Audit Office report that outlines the Defence and Defence Materiel Organisation aspects of the cancelled Seasprite Project. Defence accepts the seven recommendations made in the report.

Since initiation of the Seasprite project in 1994, and contract signing in 1997, Defence has implemented significant reform in its capability acquisition and project management practices particularly since implementation of the 2003 Kinnaird Review two pass approval process. These reforms include a professionalisation program, improved contracting functions and improved governance systems across the Defence Materiel Organisation. The 2008 Mortimer Review was undertaken with the knowledge of the Seasprite project difficulties, and will further strengthen this reform.

The specific improvements flowing from these reviews include:

- the introduction of Gate Reviews for all projects;
- the creation of the DMO Institute for training staff in Project Management disciplines;
- the creation of a categorisation system of projects by complexity rather than cost, identifying the appropriate competence and rigour to be applied to each project;
- refinements to the ADF-wide airworthiness management system, providing improved rigour to aircraft safety and occupant survivability; and
- the introduction of a significantly improved contracting function including the implementation of a defined suite of enhanced contracting templates.

³⁸ *Defending Australia in the Asia Pacific Century: Force 2030*, Defence White Paper 2009, p. 72.

103. The Prime Contractor, provided detailed comments on the proposed audit report and these are replicated at Appendix 4. The Prime Contractor also provided the following summary response:

In summary, Kaman remains steadfast in its position that the Project deliverables, including the aircraft, other equipment, and documentation were in compliance with all Prime Contract and Project requirements. Kaman committed significant human and financial capital to the Super Seasprite Project above and beyond contract requirements in an effort to bring the Project to a successful conclusion. Despite the obstacles to completion, Kaman persevered, even to the extent of completing the remaining aircraft development tasks after the Project was cancelled. The result is an aircraft that reflects the outstanding safety and reliability characteristic of its SH-2 heritage and which has unmatched performance capability for its maritime missions. Kaman now looks forward to fielding the aircraft with other customers.

104. The ANAO also provided all or part of the proposed report to a range of other parties whom it was determined had a special interest in the report. Under recent amendments to the *Auditor-General Act 1997*, comments received from these parties are also required to be included in full in the report and are set out in Appendix 5. The comments of these parties cover a wide range of issues and perspectives and were considered by the ANAO in finalising this audit report. In some cases the comments received focus on areas which were beyond the objective and/or outside scope of the audit; accordingly, the ANAO is not in a position to comment on these matters.

Recommendations

The ANAO made seven recommendations encompassing various aspects of the Project which are set out below. While the recommendations are derived from the findings in relation to the Project they are not specific to the Super Seasprite Project. Instead, they focus on areas where ongoing management attention could improve project outcomes in general, particularly for major capital acquisitions that encounter difficulty.

Recommendation No.1

Para. 2.29

The ANAO recommends that where tendered prices proposed by tenderers significantly exceed the budget for the project approved by Government, Defence:

- (a) review the tender documentation to verify that the risk profile of the procurement is not higher than was anticipated during the process to obtain Government approval for the project;
- (b) ensure that where capability is traded off to constrain costs within an approved budget that the reduction in capability will not significantly compromise the overall capability to be provided by the equipment being acquired; and
- (c) ensure that where a material reduction in the overall capability to be acquired is negotiated, approval for the reduced scope is obtained from Government prior to contract negotiations being finalised.

Defence response: *Agreed.*

Recommendation No.2

Para. 3.23

The ANAO recommends that DMO:

- (a) only pay critical milestones where it has been demonstrated that all of the requirements of that milestone have been met; and
- (b) ensure that the financial leverage provided by critical milestones is not materially diluted where payment schedules are amended.

Defence response: *Agreed with qualification.*

**Recommendation
No.3**

Para. 4.48

The ANAO recommends that DMO improve acceptance arrangements for major capital equipment projects by:

- (a) reviewing its checking and verification procedures to ensure that they are sufficiently robust to identify, and where appropriate resolve, deficiencies prior to acceptance; and
- (b) employing appropriate contractual safeguards that seek to provide Defence with effective protection where issues affecting the capability are known at acceptance or are identified subsequent to acceptance.

Defence response: *Agreed.*

**Recommendation
No.4**

Para. 4.66

The ANAO recommends that, before amending a contract to change acceptance arrangements for a major capital equipment project, DMO, in consultation with the Capability Development Group and the relevant Service, ensure that:

- (a) changes in risk allocation between the contractor and the Commonwealth resulting from associated contract amendment(s) are clearly identified and evaluated within a risk management context;
- (b) the issue of any previously accrued rights of the Commonwealth, which may be affected by changes to the acceptance arrangements, is appropriately addressed such as through settlement arrangements or by preserving these rights to the extent practicable; and
- (c) amendments of this nature require the written approval of the CEO of DMO, the Capability Development Group and the relevant Service Chief.

Defence response: *Agreed with qualification.*

**Recommendation
No.5**

Para. 6.28

The ANAO recommends that DMO, in conjunction with the airworthiness authorities and preferred tenderers, develop appropriate plans for certification of airborne capabilities being acquired for the ADF and ensure that processes required to achieve certification are clearly established in the relevant acquisition and sustainment contracts.

Defence response: *Agreed.*

**Recommendation
No.6**

Para. 8.78

The ANAO recommends that the ADF Airworthiness Authority require that DMO seek approval from the Technical Airworthiness Regulator prior to any contractual amendments being processed, or modifications to an aircraft being undertaken, that may diminish the crash protection afforded to occupants of an aircraft.

Defence response: *Agreed.*

**Recommendation
No.7****Para. 9.22**

The ANAO recommends that, to further strengthen the processes supporting issue and renewal of airworthiness instruments, the ADF Airworthiness Authority require that:

- (a) when practical, Technical Airworthiness Regulator audits be timed to inform key decision making processes regarding the issue or renewal of airworthiness instruments;
- (b) where audits identify systemic weaknesses, sampling be undertaken to validate that documentation submitted in support of the award of airworthiness instruments can be reconciled to Compliance Finding Reports; and
- (c) the report of any such audit be submitted to the Airworthiness Board as an attachment supporting the Technical Airworthiness Regulator's recommendation to issue or renew a Type Certificate.

Defence response: *Agreed.*

Audit Findings and Conclusions

1. Introduction

This chapter provides an overview of Project Sea 1411 Super Seasprite and the audit approach.

Introduction

1.2 The ANZAC Ship Project³⁹ was a joint project undertaken with New Zealand. The ANZAC Ship Project delivered eight ANZAC-class ships to the Navy from 1996 to 2006 at a total cost of some \$6 billion (December 1995 prices). The ANZAC ships are designed to carry helicopters to enhance their capabilities. The 1995 Detailed Operational Requirements for the ANZAC Ship Helicopter Project linked the delivery of the helicopter to the introduction into service of the ANZAC Ships. The ANZAC Ships were expected to commence being commissioned in 1996; the helicopters were not expected to be available until 1999. The eight ANZAC Ships were commissioned from May 1998 to August 2006.

1.3 Phase 1 of the Project was to procure 14 helicopters to meet the ANZAC ship flight requirement. The aircraft was to be operated by an aircrew of two, have a safe life for 10 000 flying hours, and be supportable for a period of 25 years. The tasks that were intended to be performed by the aircraft included:

- *Surface warfare* – including surveillance, reconnaissance, provide target direction by day and night, and maritime strike.
- *Undersea warfare* – including undersea warfare search and attack.⁴⁰
- *Boarding party operations* – including visit, board, search and seizure.
- *Naval Gunfire Support* – including locating and targeting contacts and battle damage assessment.
- *Utility Operations* – including maritime search, over land search, rescue operations including rescues from combat situations, carrying stores externally from ship to ship or ship to shore, winch transfers, aero medical evacuations and public relations exercises.

³⁹ The ANZAC Ship Project included not only surface combatants but also associated shore facilities and integrated logistics support.

⁴⁰ The ANZAC Ship Helicopter was not required to include underwater sensors.

- *Conversion training* – including initial or refresher aircrew training by day or night, instrument training and deck landing training.

1.4 While primarily part of the ANZAC Ship weapon system, the aircraft was intended to be able to be used on other air capable ships, including the Guided Missile Frigates (FFGs).

1.5 In June 1997, Defence signed contracts with the Prime Contractor for the supply and in service support of SH-2G(A) Super Seasprite helicopters as the ANZAC Ship Helicopter.⁴¹ Significant challenges were experienced in achieving type certification⁴² of the aircraft necessary to enable the Navy to operate the helicopter. During the period from late 2003 to early 2006, the Navy operated the aircraft in an interim configuration with significant limitations and restrictions. In March 2006, flying of the Super Seasprite was suspended and the Type Certificate was withdrawn. The aircraft was not subsequently operated by Navy.

1.6 In March 2008, nearly 11 years after the Prime Contract was signed, the Government announced that it had decided to cancel the Project. At the time, no Super Seasprite had been accepted in its final configuration. The Defence Annual Report for 2007–08 noted that the longer term preparedness targets for frigate support had been affected by the unavailability, and now cancellation, of the Super Seasprites Project.⁴³

Project phases

1.7 Phase 1 of the Project was approved in the context of the 1995–96 Budget with funding of \$746 million (December 1995 prices). Phase 1, as originally approved, was to acquire:

- 14 intermediate size helicopters for maritime operations;

⁴¹ Under the original Prime Contract, the milestone for the final assembly of the first aircraft was scheduled to be paid in September 2000; the milestone for assembly of the eleventh aircraft was scheduled to be paid in January 2002. The contracted delivery date for the first aircraft was in March 2001 and the final aircraft in May 2002. Under Amendment Seven to the Prime Contract, the milestone for the final ten helicopters in full configuration was scheduled to be paid on 11 November 2005, with contract completion to occur on 5 June 2006.

⁴² An Australian Military Type Certificate (Type Certificate) formally attests that an aircraft is airworthy if it conforms to a specific type design; is operated in accordance with approved operating instructions; is maintained in accordance with approved instructions for continuing airworthiness; and is operated within approved and defined roles.

⁴³ Defence, *Annual Report 2007–08*, p. 57.

- an integrated weapons system capable of employing the Penguin air to surface missile;
- a Flight Simulator;
- aircrew and maintainer part task trainers;
- a software support centre; and
- a comprehensive through life support package.⁴⁴

1.8 Phase 2 of the Project was approved in December 1997. Under Phase 2, a further seven used Seasprite airframes were purchased from the US under Foreign Military Sale (FMS) arrangements. These helicopters were intended to be converted into Super Seasprites during Phase 3A of the Project or be used for in-service attrition under Phase 3B. Phases 3A and 3B were cancelled in July 1999. At the time the Project was cancelled in March 2008, the seven helicopters procured under Phase 2 continued to be held in the US at a long term desert storage facility.

⁴⁴ The Project was also to fund the necessary modifications to the ANZAC ship to accept an intermediate helicopter. The ANZAC ship was capable of operating the medium sized Seahawk Helicopter. Modifications were required to the ANZAC ships to operate the Super Seasprite which is a smaller intermediate sized helicopter. The basis for the decision to procure the smaller helicopter is outlined in Chapter 2.

Table 1.1

Key Project Dates

Timeframe	Issue
Apr 1995	A Project to acquire 14 Helicopters for the ANZAC Ships was announced as part of the 1995-96 Budget.
Oct 1995	Request for Tender (RFT) released on 18 October 1995.
Feb 1996	Project budget of \$746 million approved (December 1995 prices).
Mar 1996	Original Tender closing date of 20 February 1996 extended for 30 days at request from prospective tenderers. Two proposals tendered.
Oct 1996	Defence Efficiency Review announced by the then Government.
Apr 1997	Defence Reform Program commenced on the basis of the report of the Defence Efficiency Review.
Jan 1997	Preferred tenderer selected.
Jun 1997	Acquisition and In-service Support (ISS) Contracts signed on 26 June 1997.
Dec 1997	Cabinet approved Phase 2 of the Project to purchase a further seven second hand airframes.
1998	Navy adopted the tri-service ADF airworthiness arrangements.
Feb 1998	Government decides not to proceed with the Offshore Patrol Combatant ^A .
Sep 1999	The In-Service Support Centre was opened.
June 2000	The then Minister approves the establishment of DMO.
Mar 2001	Original contracted delivery date of first aircraft.
May 2002	Original contracted delivery date of final aircraft.
Feb 2003	Contract amended to introduce provisional acceptance of the aircraft in the Interim Training Helicopter configuration .
Sep 2003	Defence Procurement Review report ^B recommendations broadly accepted by then Government.
Oct 2003	Special Flight Permit issued for Interim Training Helicopter.
Oct 2003	Delivery of the Full Capability Helicopter slips to December 2004.
Oct 2003	Provisional Acceptance of the first Interim Training Helicopter.
June 2004	Special Flight Permit renewed.
Dec 2004	Australian Military Type Certificate awarded for the Interim Training Helicopter configuration.
Dec 2004	Contract Change Proposal amends contract schedule with the last ten helicopters to be accepted in final configuration in November 2005.
June 2005	DMO becomes a Prescribed Agency under the <i>Financial Management and Accountability Act 1997</i> .

June 2005	Provisional Acceptance of the ninth Interim Training Helicopter. The last helicopter provisionally accepted.
Nov 2005	Australian Military Type Certificate for the Interim Training Helicopter configuration renewed.
Mar 2006	Flying suspended.
Mar 2006	The then Minister for Defence commissioned a review of the Project.
May 2006	Australian Military Type Certificate withdrawn.
May 2007	The then Government announced, that following a review the Project will continue.
March 2008	The Government announces decision to cancel the Project.
March 2008	Settlement Deed signed to terminate the acquisition and ISS Contract.

Notes: ^A This was unapproved proposal for a joint project with Malaysia to introduce Offshore Patrol Combatants (OPCs) through Project SEA 1427. Project SEA 1411 was the approved project to acquire helicopters for the ANZAC Ships. A single Equipment Acquisition Strategy was developed to acquire helicopters for both the unapproved Project SEA 1427 and the approved Project SEA 1411 through a competitive tender process to pursue a low risk program of acquiring an intermediate helicopter to be operationally compatible with both the ongoing ANZAC-class Ships and the OPC. See paragraph 2.6.

^B In response to concerns about the procurement process for major Defence acquisitions, the then Government announced, in December 2002, the appointment of a review team, chaired by Mr Malcolm Kinnaird AO, to examine and report on issues associated with major capital acquisitions in Defence. The review team's report, the *Defence Procurement Review* (DPR),⁴⁵ was published in August 2003. The report made ten major recommendations and a number of additional points for consideration.

Source: ANAO analysis of Defence and DMO documentation

Contractual arrangements

1.9 The request for tender was released on 18 October 1995. Tenders closed on 20 March 1996 with two tenders received. Both tender bids significantly exceeded the approved budget for the Project. To reduce the tender price to within the budget approved by the then Government in 1996, the number of helicopters to be procured for the ANZAC ships was reduced from 14 to 11 (see paragraphs 2.21 to 2.22) and a separate project was established to acquire missiles for the ANZAC Ship helicopters which were originally intended to be procured by the Project (see paragraphs 2.23 to 2.24).

1.10 The Prime Contract was signed with Kaman Aerospace International Corporation on 26 June 1997. The Prime Contractor's bid was based on

⁴⁵ This is also known as the Kinnaird Review.

supplying SH-2G(A) Super Seasprite helicopters, which were a unique variant of the SH-2G, then in service with the US Navy.

1.11 Under the original Prime Contract the last aircraft was to be delivered by May 2002. By the time the Project was cancelled in March 2008, nine of the 11 aircraft to be delivered under the Prime Contract had been provisionally accepted by Defence in an interim configuration, but no aircraft had been delivered in the final configuration and the contractual schedule had lapsed.

1.12 An In-service Support (ISS) Contract was also signed with Kaman at the same time as the acquisition contract. The contract was originally due to expire in December 2010 but was subsequently extended to 30 November 2012.

Squadron commissioned to operate the aircraft

1.13 The Super Seasprites were to be operated by the 805 Squadron based at HMAS Albatross in Nowra on the South Coast of New South Wales. The 805 Squadron was recommissioned⁴⁶ in February 2001 to operate the Super Seasprites as they were accepted into service by the Navy.

1.14 The Squadron peaked at approximately 90 personnel⁴⁷ during the period the aircraft was able to be used by the Navy from late 2003 to early 2006. With the withdrawal of the Type Certificate for the Super Seasprite in May 2006, the Squadron was reduced to 40 personnel performing ongoing maintenance and administration activities.

1.15 Following cancellation of the Project by the Government, the Chief of Navy took the decision to decommission the 805 Squadron, which occurred on 26 June 2008. Defence advised the ANAO that the cost to operate the squadron from 2001 to 2008 was \$46.9 million.

Procurement reform process

1.16 The Defence Efficiency Review, announced in October 1996, made a series of recommendations which ultimately led to the establishment, in June 2000, of DMO. With the establishment of DMO, integrated System Program Offices having a whole-of-life focus replaced the previous arrangements of separate acquisition project offices and support units. The System Program

⁴⁶ The 805 Squadron was previously decommissioned in 1982 following the retirement of the aircraft carrier HMAS Melbourne.

⁴⁷ These personnel operated and maintained the aircraft.

Offices were to be located near their ADF customer, which entailed relocating civilian and military project staff from Canberra to regional areas throughout Australia.

1.17 Under these arrangements the then Navy Aviation Project Office, which was managing the ANZAC Ship Helicopter Project, was to be transferred from Canberra to Nowra in late 2001 to form part of the Navy Aviation System Program Office (NASPO). An early 2001 Minute from the then Director of the Navy Aviation Project Office to the Head Aerospace System Division in DMO advised that there were expected to be significant personnel departures due to the move, particularly staff with engineering and integrated logistics support skills. At the time, this was seen as having an immediate impact on activities in support of certification of the Super Seasprite and might expose DMO to claims of excusable delay from the Prime Contractor. The Head Aerospace System Division agreed to a request from Director of the Project Office that the relocation of the Project Office to Nowra be deferred until mid 2002.

1.18 The August 2002 Monthly (ProMIS) Report for the Project stated as follows:

The current DMO restructuring process has had the effect of reducing the workforce in NAPO [Navy Aviation Project Office] considerably, as staff look for jobs that will remain in Canberra. To help overcome shortfalls in NAPO's capacity to do work, Professional Service Provider support is in place and part time support from 805 Squadron and NALMU [Navy Aviation Logistic Management Unit] staff, as well as the employment of reservists and temporary APS staff when available. Parallel recruitment of staff has been approved and this has in a very limited sense helped to limit further reductions in staff numbers and permit the transfer of corporate knowledge. Recruitment action is ongoing, but extremely slow due to a lack of suitable applicants especially for engineering positions. The Project Office is not completing work in a timely manner in accordance with contract requirements, and to an appropriate standard which may have an impact on project schedule and cost.

1.19 In September 2003, the then Government released the report of the Defence Procurement Review. The report made ten major recommendations and a number of additional points for consideration. The then Government broadly accepted the report's recommendations with the exception of the recommendation the DMO should become an executive agency under the *Public Service Act 1999*. The CEO of DMO was appointed in February 2004 and

DMO became a Prescribed Agency under the *Financial Management and Accountability Act 1997* in June 2005

1.20 In June 2004 the Project Director, in an e-mail response to concerns raised by the Commander Australian Navy Aviation Group (CANAG)⁴⁸ regarding aircraft certification, identified concerns surrounding Project staffing. In this e-mail the Project Director outlined that at that time, every uniformed engineer in the Project Office had resigned or was contemplating resigning.

1.21 The August 2004 Rotary Wing Governance Board Report stated as follows:

The Defence Materiel Organisation restructuring and decentralising process had the effect of reducing the workforce in the Navy Aviation Project Office considerably, as many Canberra based staff did not move to Nowra when the Project Office moved in September 2002. To mitigate this shortfall in the Project Office's capacity to do work, contractor support was engaged and support from 805 Squadron, the Navy Aviation Systems Program Office, reservists and temporary APS staff were engaged when required. Recruitment action for engineering positions is ongoing, with contractor support being used to fill gaps. The project currently has adequate staff resources although staff turnover has resulted in areas of low levels of experience.

1.22 A report to the Aerospace Systems Domain Assurance Board in April 2007 identified that slightly more than one third of the 30 positions within the Project Office were vacant. That report indicated that, in the event that then Government decided to continue with the Project,⁴⁹ a further eight positions needed to be filled to bring the Project Office to near full complement. The then Government announced in May 2007 that, following a review, it would continue the Project.

⁴⁸ The Commander Australian Navy Aviation Group is known as COMAUSNAVAIRGRP but for simplicity in this audit report the shorter acronym of CANAG, which is also in use in Defence, is used to refer to COMAUSNAVAIRGRP. For the Super Seasprite, the CANAG held the delegation of Operational Airworthiness Authority Representative which is a key role in the ADF Airworthiness Management System.

⁴⁹ As noted in Table 1.1, the then Minister for Defence commissioned a review of the Project in March 2006.

Lesson No.1

Defence major capital equipment procurement is a complex long term venture that is heavily reliant on the skills of personnel employed within DMO. Careful consideration is required in the planning of major capital acquisition projects to confirm that personnel with the requisite skills will be available, in sufficient numbers, to facilitate the smooth conduct of procurement and technical activities required to support capability delivery.

1.23 In the context of lessons learnt by DMO from the Super Seasprite Project, DMO informed the ANAO in March 2009 of the following:⁵⁰

It was the CEO of DMO assessment in 2006 that helicopter projects in the DMO were of such significance (including ARH⁵¹ and MRH90⁵²), that a dedicated division was required in order to provide focussed management attention. He obtained Ministerial approval and the Helicopter System Division was formed.

By having the Head Helicopter System Division assisting Mr Mortimer with his review, the lessons learnt from the Seasprite were included in the Mortimer Review.⁵³

Audit approach

1.24 The ANAO initially intended to commence this audit in late 2006. In September 2006, the Chief Operating Officer for DMO wrote to the ANAO in relation to the proposed audit stating:

Defence recognises that SEA 1411 is a significant project and supports your audit of the Project. However, the proposed timing of the audit creates particular difficulties. An audit commencing in October 2006 would divert

⁵⁰ 16 March 2009 advice from CEO of DMO to ANAO.

⁵¹ The Armed Reconnaissance Helicopter is being procured under Project Air 87.

⁵² The Multi Role Helicopter is being procured under Project AIR 9000 Phase 2.

⁵³ The Government announced the Defence Procurement and Sustainment Review (also known as the Mortimer Review), to be chaired by Mr David Mortimer AO in May 2008. The Review report provided to the Government in September 2008 made 46 recommendations aimed at addressing the five principal areas of concern identified by the Review: inadequate project management resources in the Capability Development Group; the inefficiency of the process leading to Government approvals for new projects; shortages in DMO personnel; delays due to inadequate industry capacity and difficulties in the introduction of equipment into full service.

On 2 May 2009, Defence released the response to the Mortimer Review. Defence agreed to 42 recommendations, agreed in part to a further three recommendations and did not agree to one recommendation (this concerned the establishment of DMO as an executive agency under the *Public Service Act 1999*). Defence's response to the Mortimer review, together with providing Defence's detailed responses to the Review report's recommendations, also sets out the key elements of the reform program for the capability development areas in Defence, the DMO and for enhancing the DMO-Defence relationship as a whole.

resources away from managing complex project issues, and it would be very difficult for senior managers to devote required time and attention to a performance audit. Consequently, we request that the planned audit of SEA 1411 not commence until February or March 2007.

1.25 The ANAO agreed to this request and subsequently wrote to the Secretary of Defence and the CEO of DMO in April 2007 advising of the intention to commence the audit. Fieldwork for the audit was planned to commence in May 2007. However, following a further request from the CEO of DMO, the Auditor-General agreed to delay the commencement of this fieldwork until July 2007 to allow a DMO review of the Project to be completed.

Audit objective

1.26 Given the significant expenditure associated with the Super Seasprites and the problems that the Project had encountered over some time, the ANAO had commenced this performance audit prior to the Government's decision to cancel the Project in March 2008. The focus of the original audit was on Defence and DMO's administration of the Project. In light of the Government's decision to cancel the Project, the objective of the audit was revised to place greater emphasis on those issues that resulted in the failure of the Project to provide the capability being sought by Navy. Accordingly the audit objective was to:

- identify those factors that contributed to the on-going poor performance of the Project;
- evaluate the effectiveness of measures intended to overcome issues encountered by the Project; and
- determine the capability and cost implications of a project that failed to provide the desired capability.

Audit methodology

1.27 The audit was conducted against the following broad audit criteria:

- (a) the tender selection process should involve the rigorous analysis of options against clearly defined requirements to ensure that value for money is achieved;

- (b) risks should be clearly defined at all stages in the capability development lifecycle and processes should be in place to monitor and respond to risks as they emerge;
- (c) contract management processes should be in accordance with internal defence procedures and contractual provisions;
- (d) appropriate project governance, financial controls, and reporting mechanisms should be in place;
- (e) delivery and acceptance arrangements should assure conformance with technical regulatory requirements; and
- (f) in-service support should be aligned to ongoing capability requirements and provide value for money.

1.28 In examining the tender process, the ANAO focussed on those aspects of the tender process that later became significant to the Project. In terms of audit effort, (b) and (e) above emerged as the most significant.

1.29 Audit fieldwork was initially conducted from July 2007 to February 2008 with further documentation gathered following the cancellation of the Project in March 2008, and as a result of discussions in July 2008. The audit team met with: the Project Office; ADF Airworthiness Coordination and Policy Agency (ACPA); Director-General Technical Airworthiness (DGTA); Capability Development Group; CANAG; Head Helicopter Systems Division DMO; Prime Contractor Personnel; Defence Policy Development Division; DMO Legal Services; 805 Squadron; Aircraft Maintenance and Flight Trials Unit (AMAFTU); and the Civil Aviation Safety Authority (CASA).

1.30 In June 2008, five Issues Papers surrounding airworthiness certification were provided to DMO as advance copies prior to finalisation. A further five Issues Papers dealing with tender evaluation and contract negotiation, financial management, aircraft acceptance, aircraft sustainment and project cancellation were provided to DMO as advance copies in early August 2008, for the same purpose. On 8 August 2008, the complete set of Issues Papers was provided to Defence and DMO for comment. Defence's written comments on the Issues Papers, discussions held at the Exit Interview on 10 September 2008 and further discussions with Defence and DMO were taken into account in drafting the proposed report.

1.31 On 27 March 2009 the proposed audit report was provided to Defence and the DMO for comment as provided for under Section 19 of the *Auditor-General Act 1997*. Copies of the report were also provided to the Prime

Contractor, the then Minister for Defence and the former Parliamentary Secretary for Defence Procurement. Taking into account a request from the Prime Contractor, the proposed Section 19 report was not provided to other parties for comment until mid April 2009. On 14 April 2009 a complete version of the report, which was unchanged from the 27 March 2009 version, was provided to two former Ministers for Defence, the former Chief of Navy, the former Chief of Air Force, the former Under Secretary Defence Materiel and the Head Aerospace System Division within the DMO. Also on 14 April 2009 relevant extracts from the Section 19 proposed report were provided to four of the Prime Contractor's sub-contractors, one sub-contractor to the DMO, the former Minister for Finance and 14 former or currently serving employees of the Department of Defence.

1.32 This audit was conducted in accordance with ANAO Auditing Standards at a cost to the ANAO of \$540 000.

Report structure

1.33 The report comprises 10 chapters encompassing different aspects of the Project. The issues examined in the remaining nine chapters are summarised in Figure 1.1

Figure 1.1

Report outline

The Super Seasprite

Chapter 2 – Tender evaluation, contract negotiation execution.

Chapter 3 - Financial management of the Project.

Chapter 4 - Management of aircraft acceptance and ITAS development.

Chapter 5 – Management the aircraft sustainment arrangements.

Chapter 6 – The ADF airworthiness arrangements.

Chapter 7 – Resolution of issues with the aircraft.

Chapter 8 - Certification of software and systems focussing on the AFCS.

Chapter 9 – Withdrawal of the Type Certificate.

Chapter 10 – Cancellation of the Project.

2. Tender Evaluation and Contract Negotiation

This chapter examines processes leading up to the execution of both the Prime Contract and the ISS Contract for the Super Seasprite.

Introduction

2.1 This chapter focuses on those aspects of the tender evaluation and contract negotiation processes that later became significant to the Project. The chapter is structured as set out in Figure 2.1.

Figure 2.1

Chapter outline

Tender Evaluation and Contract Negotiation

- The tender process
- Software development risks
- Capability traded off
- Deliverables under the Prime Contract
- Protections to be provided by contractual arrangements

The tender process

2.2 A single Equipment Acquisition Strategy was developed to cover the acquisition of helicopters for the ANZAC Ships under Project SEA 1414 and an unapproved proposal for a joint project with Malaysia (Project SEA 1427) to construct Offshore Patrol Combatants (OPCs).⁵⁴ The section commencing at paragraph 2.6 discusses the implications of the decision to link the two projects in this way.

2.3 The broad strategy set out in the Equipment Acquisition Strategy was for a competitive tender process to pursue a low risk program of acquiring an

⁵⁴ Also known as Offshore Patrol Vessels which can range in size from coastal patrol vessel boats or fast attack craft (about 500 tons) up to corvette or frigate-sized vessels (2500 tons) *Janes Defence Weekly*, Volume 45, Issue 43, 22 October 2008, pp. 38-45.

intermediate helicopter to be operationally compatible with both the ANZAC-class Ships and the OPCs. The RFT was released to industry on 18 October 1995 with a closing date of 20 February 1996, later extended to 20 March 1996.

2.4 Two tenders for the complete helicopter package were received. Both of the prices tendered significantly exceeded the approved Project budget of \$746 million (December 1994 prices). The Source Evaluation Report attributed the difference between the Project budget and the tendered prices to a number of factors including:

- the Project budget having been calculated using values provided by prospective tenderers, which were based on an incomplete understanding of the capability being sought;
- insufficient awareness by Project personnel of the cost implications associated with differences in the systems offered, and those required to meet the operational requirements; and
- under-estimation of the impact that a reduction in the number of helicopters to be procured would have on the average helicopter cost.

2.5 Defence established seven Tender Evaluation Working Groups to evaluate the tenders. These Working Groups covered the areas of operations; engineering; integrated logistics support; contracting; management production and finance; Australian industry involvement; and quality assurance. In drafting the Source Evaluation Report, the Tender Evaluation Board took into consideration the assessment reports prepared by each of the Working Groups.

Project requirements linked to an unapproved project

2.6 The requirements set out in the tender documentation for the ANZAC Ship Helicopters constrained the size of the helicopter to fit the requirements of the unapproved proposal to introduce OPCs. The OPCs were expected to operate up to an intermediate size helicopter (under 13 500 lbs maximum take off weight) but be capable of limited operations of a medium sized helicopter (13 000 to 26 000 lbs maximum take-off weight). As a result, the 1995 Detailed Operational Requirements for the ANZAC Ship Helicopter Project imposed a weight limit on the helicopter to be procured of 13 000 lbs in order to ensure that the helicopter procured could operate from both platforms.

Unsolicited bid

2.7 The Detailed Operational Requirements also indicated that the ANZAC Ships had been modified from the original Meko 200 design to operate the S-70B-2 Seahawk (Seahawk), an aircraft in service with Navy at the time. In August 1996, the manufacturer of that aircraft wrote to Defence indicating its intent to submit an unsolicited bid for the ANZAC Ship Helicopter Project offering the Seahawk. The letter stated that the manufacturer had previously withdrawn from the tender process as it considered the development price too high and the financial risk too great. The letter advised that the unsolicited bid was submitted on the basis of uncertainty surrounding the OPC project and in the expectation that the Commonwealth now had a better understanding of the risks associated with the Project.

2.8 A Minute from a Navy representative on the Tender Evaluation Board in August 1996 to a number of senior officers within Defence, noted that if the OPC Project continued to be delayed, or not be approved, the ANZAC Ship requirement may need to be reviewed. In November 1996, a Project Office Minute to several senior officers within Defence concluded that the proposal was not of tender quality. The Minute recommended that the proposal be set aside, that is that no further action should be taken in regard to the bid. A subsequent minute to the Director-General Naval Policy and Warfare from the Director-General Force Development (Sea) indicated a view that 'irrespective of whether the OPC Project went ahead, a naval intermediate helicopter ANZAC solution was preferred'.

Decision to select the Super Seasprite

2.9 In January 1997, the then Deputy Secretary Acquisition advised the then Minister for Defence that Kaman had been selected as the Preferred Tenderer and that the helicopter offered was the SH-2G(A) (Super Seasprite), which was an upgraded version of the Seasprite SH-2G aircraft that was in service with the United States Navy at that time. The brief to the Minister stated that the helicopter was intended to operate off both the ANZAC Ship and the OPC, and, accordingly, the size of the helicopter had been restricted to an intermediate category.

2.10 The Source Evaluation Report noted that the Tender Evaluation Board understood a decision on whether to proceed with the OPC Project was possible as part of the May 1997 Federal Budget considerations. The Minutes of the Defence Source Definition Committee meeting held in March 1997 indicated that a decision was yet to be made in terms of that Project. The OPC

project (Project SEA 1427) was cancelled in February 1998, eight months after the Prime Contract was signed to procure intermediate sized helicopters for the ANZAC Ships. In September 2008, Defence advised the ANAO as follows:

In hindsight, subsequent cancellation of the OPC highlights the risk of linking the Seasprite to an unapproved project. However, at the time the OPC was before Government for approval, and until the final decision was made to cancel the OPC project (February 1998) Defence procurement staff needed to continue to look at the most cost-effective option for the ANZAC ship and the OPC helicopters.

Issues arising from the selection of an intermediate sized helicopter

2.11 During the tender process, concern was expressed by the then CANAG in relation to implementing an option that involved significant airframe, engine and performance development risks based on an airframe which was proposed to be stretched to around 130 per cent of the original airframe's maximum all up weight. It was considered that the Navy was seeking to obtain, through the Project, a very significant capability into a platform size that had not been previously tried. However, the risks identified in the Source Evaluation Report do not clearly indicate that the risks identified by CANAG were fully analysed and understood during the tender selection process. Increases in the maximum all up weight of the aircraft was an area of ongoing difficulty for the Project.

Lesson No.2

Due to long term planning requirements, it may not always be possible to avoid linking an approved major capital equipment procurement to a project that is yet to be approved by Government. However, care should be exercised to avoid allowing any such linkages to increase the risk profile of the procurement under way such that the primary objective of that procurement is potentially compromised. Where linkages to an unapproved project do exist, they should be regularly reviewed to confirm that the benefits intended to be provided remain valid from a risk management and value for money perspective.

Software development risks

2.12 The tender evaluation process for the ANZAC Ship Helicopter Project identified that Defence was seeking a highly capable integrated systems helicopter, with a strike capability for which there were no off-the-shelf candidates. A full appreciation of the risks associated with software and systems development aspects of this Project was not achieved until after the tender evaluation process had made its recommendation, the Preferred

Tenderer had been selected and the Prime Contract had been executed. Software development proved to be a significant impediment to the successful completion of the Project; most notably the development of the ITAS and the development of the AFCS.

ITAS Complexity

2.13 The ITAS was a key component of the Super Seasprite's Integrated Weapons System, which was to integrate the helicopters systems for navigation, weapons, communications and sensors. The ability of the aircraft to achieve its desired capability with a two person crew was predicated on the successful delivery of the ITAS. The ITAS comprised three major components being: the Mission Data Processor; Smart Display Unit; and Colour Multifunction Displays.

2.14 The Source Evaluation Report noted that the Preferred Tenderer's Integrated Weapon System would require the development of approximately 100 000 lines of code. The Engineering Tender Evaluation Working Group Report had rated the development risk as medium. The Engineering Tender Evaluation Working Group Report noted that the Preferred Tenderer's approach involved extensive use of existing hardware and software from other military programs, which was regarded as reducing the level of risk, timescale and cost factors. Table 2.1, prepared by the Project Office in November 1996 supported the conclusions of the Engineering Tender Evaluation Working Group.

Table 2.1

Project Office November 1996 evaluation of code re-use in the ITAS

Component	New lines of code (per cent)	Modified lines of code (per cent)	Re used lines of code (per cent)
Mission Data Processor	61	2	37
Smart Display Unit	1	-	99
Colour Multifunction Display	33	3	64

Note: Defence advised that the source of this data was the Preferred Tenderer and that this level of re-use proved optimistic as the contractor progressed through the development tasks.

Source: DMO documentation

2.15 The minutes of the December 1996 Defence Source Definition Committee, that considered the Tender Evaluation Board's recommendations contained in the Source Evaluation Report, included the following statement:

ACMAT-N [Assistant Chief of Materiel – Navy] advised that the key elements for integration represent about 120,000 to 150,000 lines of code, and that this was not a significant issue, noting that the Collins Class Submarine project involved developing 2 million lines of code. He said that the software modules to develop were manageable, and within the capability of Australian Industry. FASSP [First Assistant Secretary Science Policy] considered both integration proposals are strong and, although the software development task was smaller in scale than other recent projects, it still attracted a moderate risk due to its scope

2.16 In April 2009, the Prime Contractor informed the ANAO that:

As the features of the software were being developed it became evident that the original estimate for the size of the software operational program, and functions it would perform, had grown far beyond the software design conceived at contract signing. Eventually the software for the Mission Data Processor (MDP) grew from an estimated 64,000 lines of code at contract signing to 460,000, and the software for the Colour Multifunction Displays (CMFD's) had grown from 52,000 lines of code to over 130,000.

2.17 The ITAS in its final configuration was never accepted by DMO. In September 2008, Defence advised the ANAO as follows:

Defence acknowledges that the tender evaluation of the Seasprite development task, which was highly complex, and the associated technical risks, which were poorly understood at the time, was less than optimal. The tender's, proposed schedule, amount of code reuse, and risk assessment were overly optimistic. In turn, the Defence assessment of these factors was also optimistic. Defence has learned the lesson and improved this process by undertaking far more risk assessment and risk reduction activities during procurement processes, and acquiring more off-the-shelf solutions to meet capability needs where appropriate.

AFCS evaluation

2.18 The Source Evaluation Report stated that the AFCS offered by the Preferred Tenderer was a dated analogue system that would have difficulties in successfully completing most of the mission profiles outlined in the Statement of Requirements. The report indicated that a digital system, if coupled with the navigation system (ITAS Build 3), would substantially reduce pilot workload and improve safety and operational effectiveness.

2.19 A digital version of the analogue flight control system was offered by the Preferred Tenderer as an un-costed option. While development in this area was regarded as an area of risk, the Engineering Tender Evaluation Working Group assessed that the Preferred Tenderer's experience in the development of flight control systems was a risk mitigating factor. Development of the AFCS to meet aircraft certification requirements was an area where the Project encountered significant ongoing difficulties. Safety concerns surrounding the AFCS contributed to the decision to withdraw the Type Certificate for the Super Seasprite in May 2006 (See Chapter 9).

2.20 In September 2008, Defence advised the ANAO as follows:

The Seasprite Project was a developmental program using a fixed price contract. Through lessons learned in several similar contracts, DMO has learned the lesson that fixed price contracts in a development environment are high risk. The Kinnaird review found that developmental programs should only be used when no alternate exists and that a viable commercial or military off-the-shelf option should be presented to Government as a first pass option whenever possible.

Lesson No.3

Where a project's success is dependent on systems and software development and integration activities, independent analysis of the risks associated with this development activity is highly desirable. This should include identification of the extent to which the systems and software solution offered comprises proven technology and the record of the contractor(s) in undertaking the development of similar software and systems. This analysis should form a key input to tender selection and contract negotiation processes.

Capability traded off

2.21 A significant issue during the tender evaluation process was the desire to reduce the tender price to within the budget approved by the then Government in 1996. The Source Evaluation Report indicated that the Project price, including the baseline offer, contingency, options, and other project costs, exceeded the project budget by over \$189 million. Consequently, the Source Evaluation Report proposed a series of capability trade-offs to constrain expenditure to within the Project budget.

Reduction of the number of helicopters procured

2.22 In March 1997, the Defence Source Definition Committee agreed to a proposal to reduce the number of helicopters to be procured for the ANZAC Ships from 14 to 11. In May 1996, the then Government agreed to the activation

of four Seahawk attrition helicopters under Project Sea 1431 to address delays between when the first ANZAC ships would be available and when helicopters were planned to be delivered under the Project. In May 1997, it was proposed to amend the scope of Project Sea 1431 to provide two non-concurrent Seahawk detachments for the ANZAC Ships due to the cost-capping of the Project.

Project splitting

2.23 Originally, the Project was to include the procurement of Air to Surface missiles under Phase 1. During the tender evaluation process a range of missile types were considered, with a decision taken to procure the Kongsberg Penguin Mark 2 Mod 7 Air to Surface missile. In December 1997, and March 1998, the then Government approved the procurement of missiles in two separate phases for the Super Seasprite under a separate project, Project Sea 1414. The combined budget for these two phases was \$202.77 million (December 2004 prices). In June 2002, Defence informed the Parliament that about \$170 million of the budget for Project Sea 1414 had been spent, but that Defence had entered into an arrangement with the supplier to slow down deliveries due to delays in the delivery of the Super Seasprite helicopters.

2.24 DMO advised that \$201.13 million had been expended as at 31 July 2008 against Project Sea 1414. As no other Australian military aircraft can currently deploy a Penguin Missile, consideration was given to modifying Navy's Seahawk Helicopters. Defence documentation prepared in early 2008 stated that integration of the Penguin to the Seahawks would be technically high risk and the estimated cost was in the order of \$130 million. In light of this, the decision was taken not to proceed with integration into the Seahawk.

Procurement of refurbished airframes

2.25 The Preferred Tenderer's offer was based on refurbishing former US Navy airframes.⁵⁵ The Source Evaluation Report indicated that the price to acquire new airframes was \$31.8 million (December 1995 prices) over and above the Preferred Tenderer's offer. The report indicated that the new airframe option was not seen as necessary for technical or operational reasons,

⁵⁵ A 1999 internal audit report conducted by Defences' Management Audit Branch suggested that the refurbished airframe option may have substituted upstream savings for downstream costs.

and was only recommended if there was a need to defuse potentially sceptical public perception or if inspection of the selected airframes showed they were unacceptable or unsuitable for upgrade to the Super Seasprite.⁵⁶

2.26 The airframes were procured by Defence in May 1997 from the US Government through an FMS Case. Under this FMS Case, 14 second hand SH-2F airframes and one second hand SH-2G airframe were procured at a total cost of US\$14.94 million. These aircraft were provided to the Prime Contractor as Government Furnished Materiel. The Source Evaluation Report stated that a decision on whether to procure new airframes should be made after the strip down and detailed examination of existing airframes. Table 2.2 sets out the airframe history of the 11 aircraft upgraded to Super Seasprite configuration under the Project.

Table 2.2

Airframe history

Aircraft number	Original build date	Number of times previously upgraded	Accepted by US Navy in SH-2F configuration	Number of hours flown in SH-2F configuration	Number of landings in SH-2F configuration
01	1985	0	27 February 1985	5 043.7	8 118
02	1963	4	24 October 1973	10 742.2	18 237
03	1964	3	26 October 1974	10 354.8	3 761
04	1964	3	29 May 1975	9 717.7	3 528
05	1965	3	22 October 1975	9 570.3	31 990
06	1965	2	18 January 1974	9 526	32 837
07	1965	3	31 January 1975	11 095.3	24 827
08	1986	0	6 February 1986	5 621.5	9 434
09	1986	0	13 March 1986	6 291.7	12 067
10	1963	2	1 September 1973	10 123.7	16 235
11	1988	1	1 May 1988	3 610.9	6 219

Note: There were 8 model types of the Seasprite Helicopter prior to the Super Seasprite.

Source: Defence tender evaluation supporting documentation.

⁵⁶ The report stated that the sceptical public perception had been based on media reports on other procurements of used US equipment.

2.27 At the time of the tender evaluation, the SH-2G Seasprite was planned to be withdrawn from service by the US Navy in 2005, although contemporaneous discussions indicated that the US Navy might extend the service life beyond that time. The Integrated Logistics Support Tender Evaluation Working Group noted that the US Navy's plan to withdraw the Seasprite from service may present issues for the long term supportability of the aircraft. The US Navy subsequently retired the Seasprite from service in May 2001, approximately two and half years prior to Australia provisionally accepting the first Seasprite helicopter in the Interim Training Helicopter configuration. At the time of the audit, only three other countries⁵⁷ operated a limited number of Seasprite Helicopters. All of these were in different configurations to the Super Seasprite.

Approval for scope reductions

2.28 Defence's Capital Equipment Procurement Manual, at the time, stated that 'as a general rule, real variations due to changes in scope are to be referred to the original approving authority unless such a variation is minor in nature'. The approving authority for this Project was Cabinet and the extent of scope change was significant. Defence was unable to provide any evidence that this scope reduction was referred to Cabinet for consideration. In a December 1996 meeting of the Defence Source Definition Committee, it was suggested that 'changes in Project scope should not be seen as an acceptable means of meeting Project Approval'.⁵⁸ The January 1997 Minute to the then Minister advising of the selection of the Preferred Tenderer also advised the Minister that the Force Structure Policy and Programming Committee had considered 'how the Project could be brought back within Project Approval'. Scope reductions outlined in the Minute included the reduction in the number of helicopters to be procured to 11 and deferral of the procurement of missiles to a later phase. The then Minister was made aware and noted this approach in a January 1997 ministerial brief.

⁵⁷ These countries are New Zealand, Egypt and Poland.

⁵⁸ In this context, the term 'Project Approval' refers to the budget for the Project approved by Cabinet.

Recommendation No.1

2.29 The ANAO recommends that where tendered prices proposed by tenderers significantly exceed the budget for the project approved by Government, Defence:

- (a) review the tender documentation to verify that the risk profile of the procurement is not higher than was anticipated during the process to obtain Government approval for the project;
- (b) ensure that where capability is traded off to constrain costs within an approved budget that the reduction in capability will not significantly compromise the overall capability to be provided by the equipment being acquired; and
- (c) ensure that where a material reduction in the overall capability to be acquired is negotiated, approval for the reduced scope is obtained from Government prior to contract negotiations being finalised.

Defence Response

2.30 Defence agreed to the recommendation and stated as follows:

Recommendations (a) and (b) are standard practice in undertaking a Defence tender evaluation process. Recommendation (c) is consistent with existing Defence processes.

Deliverables under the Prime Contract

2.31 On 26 June 1997, a \$661.85 million (December 1996 prices) contract was entered into with the Preferred Tenderer. The Prime Contract involved the provision of:

- 11 operational SH-2G(A) intermediate helicopters;
- air to surface missile capability;
- four airframes for reduction to provide spare parts;⁵⁹
- a Flight Simulator;
- a software support centre; and
- a three years logistics support package.

⁵⁹ The 15 airframes were procured by Defence under an FMS case from the US Government and provided to the Prime Contractor as Government Furnished Materiel.

2.32 Under the original Prime Contract, a number of sub-contractors were to provide different aspects of the helicopter and supporting systems. Sub-contractors responsibilities encompassed the areas such the engines, the RAST System,⁶⁰ flight simulator development, training and integrated logistics support, assembly of the aircraft in Australia and ITAS development.

Contractual options

2.33 At the time of contract signature, there were a number of options offered by the Prime Contractor that needed to be exercised within 90 days to enhance the basic Seasprite capability, while exploiting the cost advantages of fitment of aircraft during production. These options included a second weapons pylon to allow an additional missile, depth charge or torpedo to be carried; enhancements to the Link 11 data link capability; enhancement to the AFCS to allow the crewman to have limited authority over the aircraft during winch operations; and the fitting of an instructor seat hard point immediately behind the crew seats to facilitate crew mission training. Over the period from June 1997 to February 1999, these options were taken up as price increases to the Prime Contract as outlined in Table 2.3.

Table 2.3

Contract price increases following acceptance of options

Date of approval	Description	Price basis	Contract Price increase \$ million <small>Note 1</small>
22 Dec 1997	Link 11 and AFCS enhancements	Dec 1997	0.93
6 Jun 1998	Instructor seat and hard points	Dec 1997	0.53
19 Feb 1999	Second weapons pylon	Dec 1998	8.15 <small>Note 2</small>

Note 1: There was a further small cost increase in December 1997 of \$0.63 million (December 1997 prices) to address inconsistencies in agreed prices between the Contractor and Defence.

Note 2: The \$8.15 million was funded from the Project contingency budget.

Source: Defence Minute and Inspector-General's internal audit report.

⁶⁰ This system is used to secure the aircraft to the deck and to move the aircraft between the hangar and the flight deck via a probe fitted to the aircraft.

Protections to be provided by contractual arrangements

2.34 The June 1997 Contract Negotiating Report provided to the Deputy Secretary Acquisition stated that liquidated damages were not included in the draft contract. The report outlined that the Preferred Tenderer had sought to restrict the application of liquidated damages and damages overall. The report stated as follows:

Whilst liquidated damages provisions theoretically facilitate access to a remedy for non performance they are historically difficult to enforce. They have not been included because they would be applied at an inappropriately low level and on a restricted basis which would not provide better cover than access to common law remedies they stand as a substitute for.

2.35 The Contract Negotiating Report set out a package of performance assurance measures in the draft contract. The key measures identified included:

- the financial guarantee deed having a component for performance;
- a deed of novation whereby the parent company was obliged to stand in the stead of the Prime Contractor if the Prime Contractor did not perform;
- well developed specifications;
- a Cost Schedule Control System with earned value method payments; and
- identified key contract milestones, with cessation of all payment when critical milestones were not achieved.⁶¹

Earned value method payments and critical milestones

2.36 In May 1997, Defence sought legal advice on what protections there were against late delivery to the Commonwealth in the draft contract other than liquidated damages. This advice indicated that within the Prime Contract the entitlement to be paid milestones and earned value method payments depended on the Contractor's achievement of milestones. Advice provided by the Deputy Secretary Acquisition to the then Minister in June 1997 identified

⁶¹ Other protections outlined related to target and contract delivery dates within the draft contract. In 2003, a Contract Change Proposal was agreed that introduced the concept of provisional acceptance of the Interim Training Helicopter and the delivery schedule was amended. In late 2004, the schedule was further amended.

that liquidated damages had not been included in the Prime Contract, but that the Prime Contract required a Cost Schedule Control System to be in place, linked to earned value and contract milestones.⁶² The effective management of earned value method payments and contract milestones were therefore significant in managing contractor performance. The management of these payments is examined in Chapter 3.

2.37 The contract negotiating report set out a series of critical milestones. Critical milestones are such that if they are not achieved payment of that milestone, and all subsequent payments, can be withheld pending their achievement. The ANAO compared the critical milestones included in the Contract Negotiating Report to those included in the Payment Schedule to the original Prime Contract. The ANAO found that some of the critical milestones set out in the Contract Negotiating Report were not reflected in the original Prime Contract as critical milestones. One of the critical milestones specified in the Prime Contract had no monetary value.

2.38 Table 2.4 provides a comparison of critical milestones in the Contract Negotiating Report to those included in the original Prime Contract.

⁶² Earned value method payments are payments payable to the Contractor in accordance with the Contract to reflect the expenditure by the Contractor of a level of effort in accordance with Cost/Schedule Control System Cost Performance Reports. A milestone is a payment based on the achievement to the reasonable satisfaction of the Project Authority of a task or the occurrence of an event or series of events as specified in the Contract.

Table 2.4**Critical milestones in original Prime Contract**

Critical milestones identified in Contract Negotiating Report	Critical milestones in Prime Contract	Value (US\$ million)	Due date of milestone
Quality Management System Certification	Yes	Nil ^{Note 1}	12 Dec 1997
Aircraft Preliminary Design Review	Yes	7.43	22 May 1998
Systems Preliminary Design Review	Split between a critical and a key milestone	4.45 (Critical milestone only)	22 May 1998
Preliminary Design Review	Yes	1.86	1 Jun 1998
Flight trainer Preliminary Design Review	No such milestone	-	-
Aircraft Critical Design Review	Not a critical milestone	4.26	18 Nov 1998
Systems Critical Design Review	Not a critical milestone	7.43	26 Nov 1998
Flight trainer Critical Design Review	No such milestone	-	-
First flight prototype	Yes	0.80	23 Jul 1999
Design test and evaluation	Yes	0.45	27 Jul 2000

Note 1: As this was a critical milestone, DMO could withhold all subsequent payments under the Prime Contract until the requirements of the milestone were met.

Source: Defence negotiating report and original Prime Contract.

2.39 The Critical Design Reviews were not critical milestones in the original Prime Contract, instead they were key milestones. The difference between a critical milestone and key milestone was that failure to meet a critical milestone allowed DMO to withhold all subsequent payments until that milestone was met whereas key milestones only allowed for payment of that specific milestone to be withheld. As set out in Chapter 3, by the time of these Critical Design Reviews, there were clear indicators that the Project was in significant difficulty.

Vesting arrangements

2.40 The Contract Negotiating Report also outlined arrangements for the financial guarantee. Under these arrangements, the level of guarantee was to be varied during the contract but maintained at a level above the amount of

non-vested payments⁶³ during the period of greatest perceived risk; that is from the period of Critical Design Review to first flight of the prototype.

2.41 The original Prime Contract set out a requirement for the Prime Contractor to provide a security in the amount of US\$99 million within two days of the Prime Contract's effective date, or on presentation of a claim for payment, whichever occurred earlier.⁶⁴ An attachment to the Prime Contract included a Deed for the financial security dated 26 June 1997. The Deed set the maximum amount that could be claimed by the Commonwealth at US\$49.45 million. An attachment to a July 2003 amendment to the Prime Contract contained a vesting schedule. That schedule indicated that over the period June 1997 to March 1999 the cumulative unvested milestones peaked at US\$102 million and did not reduce below US\$49 million until April 1999.

⁶³ Non-vested payments are those payments where rights of ownership are not accrued thereby requiring alternative forms of security.

⁶⁴ The effective date for the contract was 26 June 1997. The Prime Contractor's first claim for payment was dated 27 June 1997. By the end of June 1997, Defence had paid \$66.19 million against the Prime Contract.

3. Financial Management

This chapter examines expenditure against the Project budget and the Prime Contract.

Introduction

3.1 The payments made under the Prime Contract represented a significant proportion of overall expenditure on the Project. In negotiating the Prime Contract, earned value method payments and critical milestones were regarded as an alternative to liquidated damages, which were not included the Prime Contract. Consequently, the effective management of these arrangements was of significant importance in influencing contractor performance and controlling the financial risk to the DMO. This chapter examines expenditure against the Project Budget and the management of payments under the Prime Contract as outlined in Figure 3.1.

Figure 3.1

Chapter Outline

Financial Management

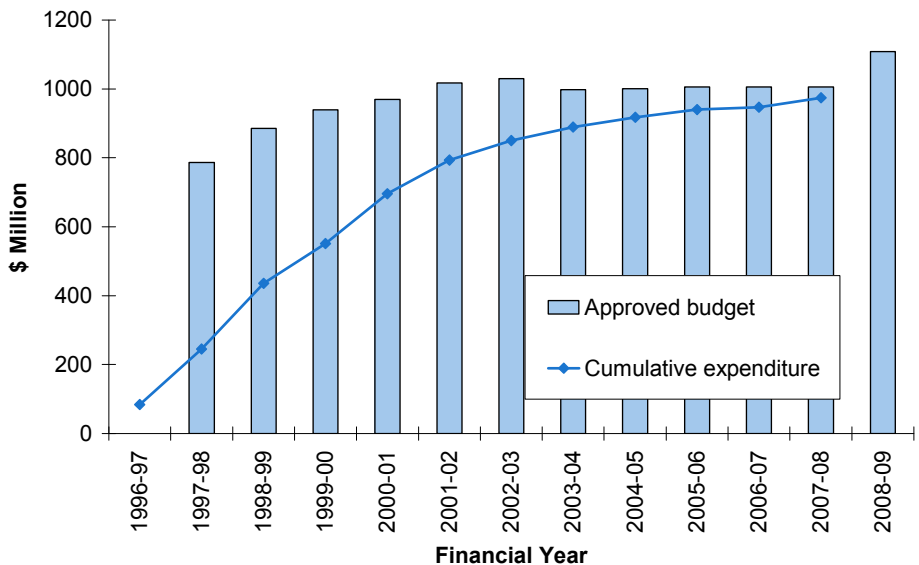
- Project expenditure
- Expenditure against the Prime Contract
- Cost schedule performance
- Payment of critical milestones
- Management of earned value method payments

Project expenditure

3.2 Figure 3.2 compares the Project budget as set out in Defence’s annual Portfolio Budget Statements to actual expenditure set out in the Defence Annual Reports. The figure shows that by 2002–03, a large proportion of the budget had been expended.

Figure 3.2

Cumulative expenditure of Project funds (nominal)



Source: Defence and DMO Portfolio Budget Statements and Annual Reports.

3.3 Figure 3.2 also shows a 10 per cent increase in the Project budget between the 2007–08 Portfolio Budget Statements and the 2008–09 Portfolio Budget Statements. This relates to a decision in 2007, by the then Government, to continue with the Project at a real cost increase of \$110 million (January 2007 prices). DMO advised that the Project’s budget comprised the elements as set out in Table 3.1.

Table 3.1

Composition of the Project budget (January 2008 Prices)

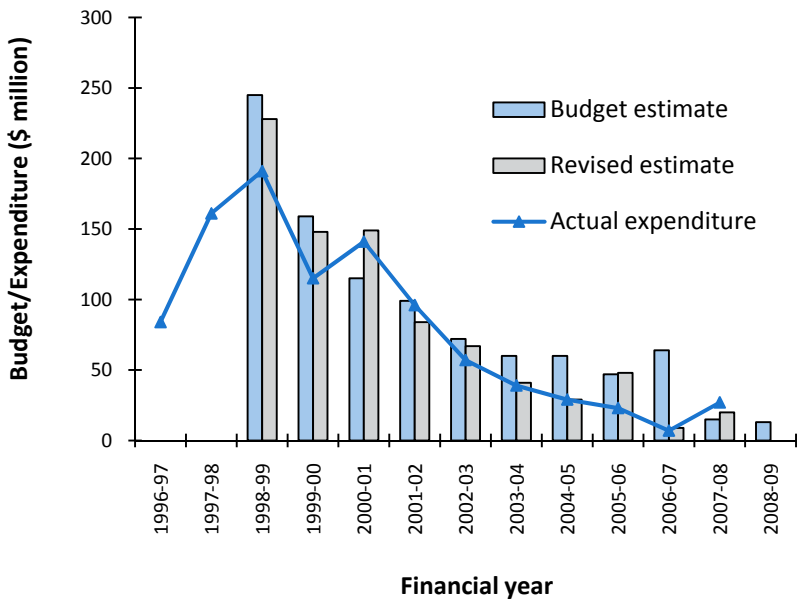
Description	Amount (\$ million)
Original Project approval	745.60
Price movements	100.96
Exchange movements	157.17
Real cost increases	104.56
Total	1 108.30

Source: Defence response to ANAO request for information.

3.4 Figure 3.3 compares the annual expenditure to the initial and revised budget estimates for each financial year. A large proportion of payments in 1996–97 and 1997–98 were advance payments made in late June 1997 and early July 1997. Expenditure during 1998–99 and 1999–2000 was less than both the initial and revised estimates, suggesting schedule slippage. The first helicopter was not provisionally accepted in the Interim Training Helicopter configuration until late 2003, by which time expenditure against the Project budget had tailed off as the Project budget had been largely depleted.

Figure 3.3

Comparison of annual budget to expenditure (nominal)



Source: Defence and DMO Annual Reports and Portfolio Budget Statements

Contingency budget expenditure

3.5 The April 2007 meeting of the Aerospace Systems Domain Advisory Board was informed that the Project had not maintained a contingency log⁶⁵, but that the contingency budget had been closely monitored since December 2006. The report to that Board indicated that in 2001 the contingency budget was \$97.54 million. DMO Finance Instruction 1/2005 titled *Management*

⁶⁵ A contingency log is used to record expenditure of the contingency budget.

of *Contingency Budgets in Major Capital Acquisitions* dated 10 February 2005, having effect immediately, required Projects to establish and maintain a Contingency Budget Log. Defence provided a written briefing to the ANAO dated April 2007 which confirmed that a contingency log had not been maintained but that the Project Office were re-constructing a contingency log based on the records contained in Defence's financial management system (ROMAN). That briefing indicated that the residual contingency budget was \$6.75 million at the time of the 2007 Budget Estimates. In September 2008, Defence provided the summary of expenditure against the contingency budget to the ANAO as set out in Table 3.2 .

Table 3.2

Recorded expenditure against Project contingency budget

Expenditure Category	Value (\$ million)
Contract Change Proposals	29.47
Second weapon capability	8.15
Indexation and exchange updates to the Prime Contract	23.16
Professional Service Providers	9.92
Legal expenses	2.44
Engineering support services and advice	0.88
Simulator installation	0.23
AFCS mode reversion	2.11
Other plant and equipment	3.14
Specialist Military Equipment	2.95
Other Project costs	0.73
Project Office travel, training and other costs	2.04
Total	85.22

Source: Defence response to ANAO Issues Papers.

Expenditure against the Prime Contract

The bulk of the planned expenditure for the Project was made against the Prime Contract as set out in Table 3.3. The table shows that expenditure against the Prime Contract comprised 15 per cent advance payments; 32 per cent milestone payments; 40 per cent earned value method payments;

and 12 per cent price escalations.⁶⁶ Total expenditure against advance payments, milestone payments and earned value method payments, but excluding price escalations, was \$785.3 million (nominal). This exceeded the original Prime Contract value of \$661.85 million by \$125.45 million. DMO informed the ANAO that this amount largely related to foreign exchange rate adjustments. DMO indicated that without the foreign exchange component, the expenditure was \$628.13 million, which is less than the original contract price (value).

⁶⁶ The price escalations were applied to advance payments paid in 1997–98 and milestones and earned value method payments made over the duration of the Prime Contract.

Table 3.3

Prime Contract expenditure and foreign exchange adjustments – August 2008 (\$ million)

Payments	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	Total
Advance	66.2	66.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		132.7
Milestone	0.0	90.2	71.9	18.5	21.0	16.5	32.4	19.7	8.2	5.8	1.1			285.3
Earned value	0.0	0.0	92.6	84.0	98.1	55.7	10.4	6.4	7.4	6.1	0.2	0.6		361.5
Price escalation	0.0	3.5	24.9	12.2	18.2	16.9	10.9	8.3	7.1	6.9	0.8	0.4		110.1
Risk reduction ^{Note 1}	-	-	-	-	-	-	-	-	3.9	1.5	0.4			5.8
Total	66.2	160.2	189.4	114.7	137.3	89.1	53.7	34.4	26.6	20.3	2.5	1.0		895.4
Supplementation for foreign exchange adjustments	0.1	11.4	29.5	17.2	32.0	25.0	12.7	1.9	-0.1	0.1	0.0			129.8

Note 1: Risk reduction measures were introduced through a Contract Change Proposal (CCP) 94 agreed in late 2004.

Note 3: Some totals may not add due to rounding.

Source: Spreadsheet provided by DMO updated to reflect DMO's response to the ANAO's Issues Papers.

3.6 A further \$4.9 million was paid to the Prime Contractor using Project funds but outside the original Prime Contract. This amount included:

- \$2.4 million — Expanded System Safety Program;
- \$1.5 million — AFCS Mode Reversion Testing;
- \$0.2 million — AFCS Phase 2 Modification Test costing;
- \$0.3 million — CCP preparation costs;
- \$0.4 million — various including spares and hire of test equipment; and
- \$0.1 million — training.

3.7 Table 3.3 also sets out foreign exchange adjustments. The original Prime Contract included payments in a number of currencies including US\$458.04 million and smaller amounts in New Zealand Dollars, UK Pounds and the Norwegian Krone. Through exchange rate fluctuations since 26 June 1997, the effective date of the Prime Contract, a foreign exchange rate adjustment of A\$129.8 million has occurred requiring budget supplementation.⁶⁷

Cost schedule performance

3.8 The cumulative expenditure outlined in Table 3.3 shows that 86 per cent of expenditure against the Prime Contract occurred over the period 1996–97 to 2001–02. The ANAO reviewed a sample of Cost Performance Reports prepared during this period. These reports show that, notwithstanding the high level of expenditure, there were a range of issues emerging that suggested that the Project was encountering difficulty.

3.9 For example, by late 1998 Cost Performance Reports were indicating significant slippage in the areas of ITAS development and the Flight Simulator. A Cost Performance Report in early 1999 indicated that a number of key

⁶⁷ Under the *Australian Government Foreign Exchange Risk Management Guidelines* (September 2006), Government agencies are not able to employ any arrangements that attempt to reduce foreign exchange risk (hedging). The Department of Defence (together with the Department of Foreign Affairs and Trade and the Australian Trade Commission) is exempt from this general policy falling into a category where the Government may adjust the departmental appropriations to offset any foreign exchange gains or losses. This presents a 'no win, no loss' situation in regards to the Department of Defence's management of Foreign Exchange Risk. See Department of Finance and Administration (2006), *Australian Government Foreign Exchange Risk Management Guidelines*, September, pp. 4, 14; see also Department of Defence (2008), *Portfolio Budget Statements 2008–09*, p. 163.

elements of the Project were experiencing considerable slippage, as indicated in Table 3.4.

Table 3.4

Key areas of project slippage identified in an early 1999 assessment

Description	Slippage (weeks)
Propulsion system	11.3
Auxiliary equipment	15.3
Avionics systems	18.8
Weapons system integration	9.6
Logistics engineering and maintenance planning	31.6
Flight Simulator	30.0

Source: January 1999 Cost Performance Report.

3.10 The early 1999 Cost Performance Report also outlined the performance of the sub-contractors. Key amongst these was the performance of a sub-contractor developing the ITAS. This Cost Performance Report clearly indicated that this aspect of the Project was experiencing significant difficulties in terms of the available budget relative to completion, and was likely to be up to eight months late. By late 1999, sub-contractor documentation indicated that the parent company had provided additional funding of US\$30 million over the remainder of the program.

3.11 An October 1999 Inspector-General of Defence internal audit report noted that two principal sub-contractors had been late in delivering Cost Schedule Control Reports, and that this had reduced the ability of the Project Office to monitor certain aspects of the Project. That audit report noted that there had been 12 months slippage in the schedule for the Flight Simulator and four to six months slippage for the various builds of the ITAS. At the time, the lack of direct visibility of sub-contractor activity was regarded as making assessment of future schedule slippage difficult. When the Project was cancelled in 2008, neither the Flight Simulator nor the ITAS, in its final configuration, had been accepted by DMO.

3.12 A mid 2000 Cost Performance Report indicated that the contract was assessed as being 70 per cent complete with 89 per cent of the contractor's allocated budget spent, and the management reserve had been completely consumed. By late 2000, the contract was assessed as being 76 per cent complete while 97 per cent of the contractor's allocated budget had been spent.

Payment of critical milestones

3.13 As noted in Chapter 2,⁶⁸ critical milestones were one of the mechanisms in the Prime Contract that provided alternatives to liquidated damages. A number of critical milestones were included in the original Prime Contract's Payment Schedule (see Table 2.4). Under the Payment Schedule for the original Prime Contract there were six critical milestones, the last of which was payable in July 2000. The relevant provisions of the Prime Contract provided that where the contractor failed to complete a critical milestone identified in the Payment Schedule on or before the relevant date, the Commonwealth shall be entitled to withhold, at its discretion, the whole or part of the claim and all subsequent payments until the critical milestone was achieved.⁶⁹ In September 2008, Defence advised the ANAO that the entitlement exists under the Prime Contract to withhold payments if necessary, however the decision to withhold project payments is made on a case by case basis.

Achievement of first critical milestone

3.14 The first critical milestone was due to be achieved on 15 December 1997 and related to the implementation of International Organisation for Standardisation (ISO) 9000 Quality Certification Standards. ISO 9000 is a family of standards encompassing quality management practices. ISO 9001 is a set of standardised requirements for a quality management system.

3.15 This milestone had a nil value, but the Source Evaluation Report, which outlined the outcome of the tender evaluation, noted the importance of the Prime Contractor transitioning to ISO 9001. The Prime Contractor was accredited to ISO 9001 in December 1997. A Design Authority Surveillance audit of the Prime Contractor conducted by the Project Office in May 2001 stated that the scope of the Prime Contractor's ISO 9001 accreditation covered the scope of the Project, without software design and development. Software design and development was an area of ongoing difficulty for the Project over its life.

⁶⁸ See paragraphs 2.34 to 2.37.

⁶⁹ Original Prime Contract Clause 3.4.5

Preliminary Design Review Critical milestones

3.16 Under the Payment Schedule attached to the original Prime Contract, a series of critical milestones were to be paid over the period from May 1998 to July 1998 following the achievement of the various aspects of the Preliminary Design Review. The ANAO compared the amount included in the Prime Contract's Payment Schedule, to the amount actually paid against these milestones. This analysis revealed that a partial payment of 40 per cent was made against one milestone, and 80 per cent against another milestone. These payments occurred some three months after the due date set out in the Payment Schedule. The description of the milestone that was paid to 40 per cent was narrowed in late 1998 from being referred to as 'Litton⁷⁰ Preliminary Design Review' to 'Litton Preliminary Design Review Hardware' through an amendment to the Payment Schedule. The Payment Schedule was also adjusted to reflect the reduced payments made against both these milestones.

3.17 The contractual amendments in late 1998 also changed the description of the third critical milestone relating to the Preliminary Design Review from being 'Preliminary Design Review Closeout' to 'Preliminary Design Review Software'. In August 1998, a series of issues were raised by the Project Office with the Prime Contractor concerning the readiness to proceed with a Software Preliminary Design Review, particularly in the area of ITAS requirements stability.⁷¹ Notwithstanding this concern, the Project Office agreed to proceed with the Preliminary Design Review. In September 2008, Defence advised the ANAO that the Project Office, the US Resident Project Team⁷² and the Prime Contractor reviewed and compared data; evaluated and discussed risks; and the pros and cons for proceeding with the Preliminary Design Review and decided that there was more to be gained than lost by proceeding with the review.

⁷⁰ The Prime Contractor used a range of sub-contractors to deliver key components of the Project. Litton Guidance and Control Systems was the sub-contractor originally responsible for development of the ITAS. In February 2001, DMO wrote to the Prime Contractor providing conditional approval for alternative sub-contractors to be contracted to complete the ITAS following a mediation settlement between the Prime Contractor and the original sub-contractor.

⁷¹ This Preliminary Design Review was for Build 1 ITAS and not the full ITAS configuration.

⁷² The Resident Project Team comprised DMO Project Office Personnel located at the Prime Contractor's premises in the US.

3.18 In September 1998, following the Preliminary Design Review, Defence indicated to the Prime Contractor that further work was needed to provide a stable Preliminary Design Review for the ITAS and the AFCS. Notwithstanding, this critical milestone was paid in full in October 1998. The ANAO notes that the Minutes of the Preliminary Design Review–Software meeting, which were a deliverable under the Prime Contract, were not issued by the Prime Contractor until after this milestone was paid and that requirements to close-out the Preliminary Design Review were still the subject of ongoing discussion between Defence and the Prime Contractor in December 1998.

Critical Design Reviews were not a critical milestone

3.19 The Preliminary Design Review milestones were followed by a series of Critical Design Review milestones which were scheduled to be achieved in late 1998. The Contract Negotiating Report stated that Critical Design Review milestones were to be critical milestones; however the original Prime Contract's Payment Schedule designated these milestones as key milestones. Under the original Prime Contract, where the Prime Contractor failed to complete a key milestone, on or before the due date, the Commonwealth was entitled to withhold, at its discretion, the whole or part of the claim for that key milestone until it had been achieved but not subsequent payments as was the case for a critical milestone.

3.20 A Critical Design Review occurred in early 1999 and considered Hardware and Software Designs. At the conclusion of this review, hardware design was regarded as relatively mature in most areas, while software design was regarded as not meeting Defence's requirements. Both Critical Design Review milestones for hardware were paid in full by late March 1999, three months after the date in the Payment Schedule. The two milestones for the Critical Design Review of software were to be paid in December 1998. These milestones were split into two equal parts and were paid in May 1999 and August 1999.⁷³

3.21 Cost Performance Reports repeatedly identified the Critical Design Review as a point where the sub-contractor would need to identify the degree

⁷³ It should be noted that through contractual amendments additional Preliminary and Critical Design Review Milestones were inserted into the Payment Schedule to the Prime Contract for ITAS Builds 2A, 2B and 3. None of these were designated as critical milestones.

of slippage in ITAS development. A report on the Critical Design Review identified that the ITAS represented the greatest risk to the Project in terms of schedule and delivering an operationally capable weapons platform. At that time, Defence considered that the first production aircraft could be delivered with limited ITAS functionality by late 2000.

Payment of remaining critical milestones

3.22 Subsequent to the Preliminary Design Review, there were two further critical milestones in the original Prime Contract Payment Schedule. One of these was removed from the contract through a contractual amendment.⁷⁴ The other related to the First Flight Prototype. This milestone was paid in full in August 2001, two years after the due date in the Original Prime Contract. In September 2008, DMO advised the ANAO that the aircraft first flew in October 1999, however the milestone was withheld until August 2001 when a later version of the ITAS Build 1 Software was flown. This milestone represented the last critical milestone in the Prime Contract.

Recommendation No.2

3.23 The ANAO recommends that DMO:

- (a) only pay critical milestones where it has been demonstrated that all of the requirements of that milestone have been met; and
- (b) ensure that the financial leverage provided by critical milestones is not materially diluted where payment schedules are amended.

Defence Response

3.24 Defence agreed to the recommendation with the following proviso:

Recommendation (a) is consistent with existing Defence contracting templates which requires milestone entry and exit criteria to be met before a milestone can be achieved. However, templates permit acceptance of a milestone to occur where only minor aspects of the milestone requirements remain outstanding. Suggest recommendation (a) be revised to read '... all the key requirements ...'

⁷⁴ The Critical Milestone removed was the Development Testing and Evaluation Milestone which was to be paid on 27 July 2000 for US\$475 386 under the original Prime Contract.

ANAO Comment

3.25 A critical milestone provides significant contractual leverage to DMO. The payment of a critical milestone should not only have regard to the requirements of the specific element of the critical milestone, but overall contractual performance and risk. In circumstances where a contract is in difficulty, and not all requirements of a critical milestone have been met, serious consideration should be given to withholding payment of the critical milestone to maintain existing rights and promote the contractual interests of the Commonwealth.

Management of earned value method payments

3.26 The Defence Procurement Policy Manual describes earned value management as a performance measurement and management methodology based on a set of best practice project management principles. Earned value management integrates cost, schedule, technical and risk aspects of performance. As noted in Chapter 2,⁷⁵ the Contract Negotiating Report identified that a Cost Schedule Control System with earned value payments was one element of a package of performance measures included in the draft contract.⁷⁶ As indicated in Table 3.3, earned value method payments represented 41 per cent of the total amount paid against the Prime Contract.

3.27 In August 2008 the Joint Committee of Public Account and Audit issued Report 411 *Progress on equipment acquisition and financial reporting in Defence*. That report stated as follows:

Taken together, the Committee is satisfied from the evidence that Defence is taking steps to tighten its contract management practices. For example, the Committee heard that Defence has placed an increased emphasis on ensuring that contracts contain greater numbers of payments being linked to milestones, or contracts containing a mix of milestones and EVMS, rather than largely on EVMS alone. As Dr Gumley states:

...Earned value management is not a bad system but if it is used in isolation quite often the milestones do not get met...We are finding out that the better system is a combination of earned value management and milestones. If they do not meet the milestones the earned value payments stop.

⁷⁵ See paragraph 2.35.

⁷⁶ The Payment Schedule to the original Prime Contract included a number of milestones that substituted for earned value method payments, pending validation of the Cost Schedule Control System.

...A number of our difficult contracts from the 1990s were structured around the older techniques and now we are looking to get a better commercial balance moving forward in the new contracts.⁷⁷

3.28 Under the provisions of the Prime Contract, an Integrated Baseline Review was required to be conducted within four months of the effective date of the Prime Contract. The purpose of the Integrated Baseline Review was to ensure that the Prime Contractor had established a reliable performance measurement baseline that fully integrated cost, schedule and technical objectives. An Integrated Baseline Review can be used to validate a previously established earned value management system or to accredit a system which has not previously been validated. An Integrated Baseline Review was conducted in October 1997 on the Prime Contractor's earned value management system.⁷⁸ That review concluded that the Prime Contractor's baseline was not mature enough to commence making earned value method payments.

3.29 A key aspect of an earned value management system is a Cost Schedule Control System. Under the provisions of the original Prime Contract, if the Prime Contractor's Cost Schedule Control System could not be validated within 365 days after the effective date of the Prime Contract, Defence was entitled to withhold all future earned value method payments until validation was achieved. Subsequent to validation, failure to maintain a Cost Schedule Control System in accordance with Australian Cost Schedule Control System Implementation Guide DEF(AUST) 5657, also entitled Defence to withhold all future earned value method payments until validation was achieved.

3.30 A validation readiness assessment was conducted on the earned value management systems of the Prime Contractor, and three key sub-contractors, in May 1998. This assessment resulted in 18 discrepancy reports, three of which related to sub-contractors. Eleven of the discrepancy reports were regarded as major weaknesses. However, based on this assessment, a recommendation was made to commence earned value method payments, notwithstanding that the system was yet to be validated. The commencement of payments prior to validation of the system was considered to be relatively

⁷⁷ Joint Committee of Public Account and Audit Report Number 411 – August 2008 *Progress on equipment acquisition and financial reporting in Defence* par 4.40.

⁷⁸ The Integrated Baseline Review identified that the AFCS was a key technical and schedule risk. In 2006, issues with the AFCS contributed to the decision to withdraw the Type Certificate for the Super Seasprite. Issues surrounding the AFCS were not resolved prior to the Project being cancelled in 2008.

low risk on the basis that the Resident Project Office could verify the claims. Cost Performance Reports subsequent to this recommendation identify an ongoing decline in project completion relative to Contractor's expenditure.

3.31 In October 1998, a further review of the Prime Contractor's earned value management system was conducted. That review identified 13 discrepancy reports, commented adversely on the systems of two of the three major sub-contractors, and was unable to confirm an adequate system for the third major sub-contractor, as insufficient information was provided.

3.32 In March 1999, Defence conducted a narrow scope deficiency review focussing on existing discrepancy reports. This review concluded that all discrepancy reports raised in October 1998 had been addressed, including those relating to the sub-contractors. The deficiency review team did not conduct site visits to two of the three sub-contractors. In September 2008, DMO advised the ANAO that the discrepancy reports relating to these sub-contractors were closed through a review of documentation provided for one; and the assessment of the findings of a Prime Contractor earned value review, and documentation provided, for the other.

3.33 In April 1999, the Prime Contractor was informed that its Cost Schedule Control System had been assessed as compliant with Australian Cost Schedule Control System Implementation Guide, DEF(AUST) 5657, some ten months after the deadline for this set out in the Prime Contract. The Prime Contractor's Cost Schedule Control System was accredited by the then Deputy Secretary Acquisition on 19 May 1999. The ANAO calculated that prior to this date, Defence had made \$81 million in earned value method payments.⁷⁹

3.34 There were three key sub-contractors responsible for the development of various aspects of the ITAS. By 2001, DMO reports indicated that one of the

⁷⁹ Joint Committee of Public Account and Audit Report Number 411 – August 2008 *Progress on equipment acquisition and financial reporting in Defence* paragraph 4.21 states as follows:

The Committee was made aware of a number of examples of poor contract management across both the FFG Upgrade Project and ARH Project Air 87. For example, an issue of particular concern to the Committee related to payments being made under the earned value management system prior to that system being approved. Specifically, in a briefing to the Committee, the ANAO reported:

The project's [FFG Upgrade Project] earned value management system's Performance Measurement Baseline was approved in mid 2000, with the payment of two milestones. However, during the period December 1999 to June 2000, ADI was paid \$88.9 million in earned value payments. The earned value management system did not receive specification compliance certification until November 2001, by which time more than \$200 million had been paid in earned value payments.

three key sub-contractor's earned value management systems was regarded to be suspect. A review of this sub-contractor's earned value management system was to be undertaken, however documentation indicates that this did not occur because contractual negotiations were underway between the Prime Contractor and DMO seeking to shift to a purely milestone based contract.⁸⁰ A review of the earned value management system for this sub-contractor was conducted in 2003. Documentation indicates that this review was not completed as the Prime Contractor had limited access to the sub-contractor's schedule data which was required to complete this review.

3.35 Under the Prime Contract, the Prime Contractor was responsible to set in place mechanisms with sub-contractors for earned value management. The Prime Contractor was required to maintain compliance with Australian Cost Schedule Control System Implementation Guide, DEF(AUST) 5657 which imposes obligations on the Prime Contractor with respect to sub-contractors. This Guide provides that a reviewer can hold open a review in the event that a Prime Contractor fails to discharge their obligation with respect to sub-contractors. Failure by the Prime Contractor to maintain a Cost Schedule Control System in accordance with DEF(AUST) 5657 entitled the Commonwealth to withhold all future earned value payments until the requirements were met. It was not apparent that DMO sought to utilise the provisions within DEF(AUST) 5657 to address concerns surrounding the sub-contractors' earned value management systems⁸¹. The ANAO notes that the ITAS was not accepted by DMO in its final configuration prior to the Project being cancelled in 2008.

Lesson No.4

Where a project's success is contingent on software and systems development activities, significant effort should be focussed on retaining financial leverage over the contractor until the project has demonstrated, through formal review processes, that the development activities will deliver software and systems that meet both contractual and technical regulatory requirements.

⁸⁰ In early 2003 the Prime Contract was amended to remove earned value payment for all items other than spares and stores.

⁸¹ In March 2009, Defence informed the ANAO that the Prime Contractor discontinued earned value method payments to one subcontractor in mid 1999, who was subsequently replaced in April 2001. The Resident Project Team located in the US commented monthly that sub-contractors were either supplying data late or not at all. The Project Office was aware that sub-contractors were behind schedule and reasoned that alternative methods of monitoring were being pursued to leverage sub-contractors.

4. Interim Capability Accepted

This chapter focuses on DMO's management of the Prime Contract with a particular emphasis on aircraft acceptance arrangements. It focuses on the development of the ITAS which was essential to achieving the desired capability.

Introduction

4.1 By mid 2002 nearly 90 per cent of the Project budget, at that time, had been expended.⁸² At this point, no helicopters had been accepted. A key area where the Project was encountering difficulty was the development of the ITAS.⁸³ The success of the Project was contingent on the completion of the ITAS. By 2000, Defence was considering the phased acceptance of the helicopter due to schedule slippage. In early 2003, a contract amendment introduced arrangements for the provisional acceptance of the Interim Training Helicopter which incorporated a limited ITAS Capability. This chapter examines these issues along with aircraft acceptance arrangements and issues encountered in developing the remaining aspects of the ITAS as outlined in Figure 4.1.

Figure 4.1

Chapter outline

Interim Capability Accepted

- ITAS development
- Schedule slippage
- Provisional Acceptance
- Progress towards full capability

⁸² Defence Annual Report 2001–02, Table 3.1, p. 189.

⁸³ It was beyond the scope of the ANAO's audit to identify the relative responsibility of the Prime Contractor and its sub-contractors for the difficulties encountered in developing the ITAS. Accordingly, in developing this report, the ANAO did not seek to apportion responsibility for the difficulties encountered in developing the ITAS amongst the parties that continued to be involved in ITAS development at the time the Project was cancelled.

ITAS development

4.2 The Integrated Weapons System on the Super Seasprite was to bring together the navigation, communications, sensors and weapons suites in a glass cockpit environment. The heart of the Integrated Weapons System was the ITAS. The ITAS was intended to exchange data between the Integrated Weapons System subsystems and provide enhanced navigation, communications, tactical solutions, and self-protection features while executing automatic flight profiles and monitoring all flight, power train, and other aircraft systems and parameters. A key aspect to ITAS development was the integration of Human Machine Interface principles into the design of the system to enable two crew to efficiently control, manage and display the multitude of information available from the avionics and air vehicle systems.

4.3 Information was to be displayed in the cockpit on two Smart Display Units and four Colour Multi-Function Displays (CMFDs). Control of the ITAS was through the two Smart Display Units located in the cockpit lower centre console, programmable 'soft-keys' on each CMFD, one Multi-Slew Controller and Hands On Collective and Stick controls (see Figure 4.2). The Multi-Slew Controller was located in the lower centre console, and was used to control the weapons sensors, including manipulation of the tactical picture, as were the Hands On Collective and Stick controls on the collective lever.

Figure 4.2

The Super Seasprite cockpit



Source: Department of Defence

4.4 Predefined data from the Super Seasprite’s onboard systems were to be maintained by the ITAS Mission Data Processors and recorded by the Mission Data Loader/Recorder onto Personal Computer Memory Cards. These cards were to enable mission data to be downloaded to the Mission Debrief Facility for analysis; and to enable the production of files suitable for input to the Flight Simulator for training and the software support centre for functional testing.

4.5 The ITAS was to be developed in three builds as set out in the Table 4.1. The original Prime Contract required the delivery of a helicopter with ITAS software at Build 2B in November 2000, with Build 3 to be delivered later.

Table 4.1

ITAS Software Builds

Build	Description
1	Aircraft flight and communication requirements
2A	Sensor control and weapons capability
2B	Sensor, weapon and tactical display integration
3	Automatic Flight Control System integration with ITAS

Source: Defence documentation

ITAS development risks

4.6 In November 1997, a System Requirement Review⁸⁴ was conducted. That review indicated that the ITAS was an area of risk, and that significant work was required to achieve schedule. An August 1998 risk assessment focussed on ITAS development. This risk assessment identified four major risks as set out in Table 4.2.

⁸⁴ The System Requirement Review is conducted to ensure that all system and performance requirements derived from the function and performance specifications are defined and consistent with cost, schedule, risk and other system constraints. The review seeks to ensure consistency between the system requirement and the preferred system solution and available technologies.

Table 4.2**Risks to ITAS development (August 1998)**

Risk	Level and assessed risk Note 1
Lack of requirement stability for the ITAS. ⁸⁵	High risk
Traceability of the contracted design documents to ITAS requirements: <ul style="list-style-type: none"> • Interface Design Description; • Software Design Description; and • Database Design Description 	High risk
Inconsistency between Prime Contractor's and Sub-contractors' Systems Engineering and Software Engineering Processes	Significant risk
Lack of ITAS System/Subsystem Design Description Documentation ^{Note 2}	Significant risk

Note 1: High risk was defined as requiring detailed research and management planning at senior levels. Significant risk was defined as requiring senior management attention.

Note 2: The Minutes of the Preliminary Design Review for Software in October 1998 indicated that the System/Subsystem Design Documentation had not been delivered to Defence at that time.

Source: Defence documentation

4.7 Associated documentation indicated a disparity of views between the Project Office and the then responsible sub-contractor⁸⁶ on the risks identified in Table 4.2 in terms of readiness for the Preliminary Design Review for the ITAS, and fulfilment of contractual obligations. Both parties acknowledged the risk of requirements instability, although the sub-contractor rated the risk as moderate rather than high.

4.8 In August 1998, the then Project Director wrote to the Prime Contractor stating that the ITAS Build 1 Preliminary Design Review was at risk of failure, but agreed to staff from the Project Office attending the Review in late August 1998. A report on the Preliminary Design Review for ITAS Build 1

⁸⁵ The risk analysis quoted the following text from the sub-contractor's documentation:

The goal is to spend as much effort as necessary to generate precise, consistent, and testable software requirements because errors in software development cost time and money. According to Department of Defense (DoD) [US DoD] studies, 50% to 70% of software defects are caused by inadequate requirements. An error made in software requirements analysis costs 10 to 100 times to fix when found after the system goes to field.

⁸⁶ In July 1997, the contract for the development of the ITAS was awarded by the Prime Contractor to Litton Guidance and Control System Division. In February 2001, DMO wrote to the Prime Contractor providing conditional approval for alternative sub-contractors to be contracted to complete the ITAS following a mediation settlement between the Prime Contractor and the original sub-contractor. See paragraph 4.18.

indicated that more work was required to achieve a stable preliminary design for the ITAS and that more attention was required in the areas of capturing software requirements, safety hazard analysis and in allocating resources .

4.9 In early 1999, a series of Critical Design Reviews were conducted including one for software. A report prepared by the Deputy Director Maritime Aviation on the Critical Design Review for software was provided to the Head, Capability Division by the Director-General Acquisition Policy. This report indicated the outcome of the Critical Design Review was regarded as disappointing, with slippage across all software builds and further slippage considered likely. The report identified that requirement traceability was regarded as proceeding well, at the detailed design level, but the traceability above the System Requirement Level to other contract specifications and documents was not regarded to be good. This was considered to be an indicator that software design work had progressed in isolation of a robust structured system design.

4.10 A brief prepared for the Chief of Navy in April 1999 indicated that the Critical Design Review for software had been completed in March 1999. That brief indicated that due to the progress and state of some design work some software had been moved to later software builds rather than slipping the timeframe. The brief stated:

Given the criticality of software in this aircraft, a delay in software equals a delay in full operational aircraft delivery.

4.11 There was also concern that the Crew/Vehicle Interface Specification was not clearly tied to the relevant System Requirement Specification. The Crew/Vehicle Interface Specification reflected the Human Machine Interface developed through a Human Engineering Working Group. It was considered that if the System Requirement Specification had been agreed without incorporating Crew/Vehicle Interface Specification requirements, then subsequent testing may assure compliance to the System Requirement Specification despite not matching human engineering requirements. This was regarded as having potential implications for the two person crew philosophy.

Schedule slippage

4.12 In April 1999, the Deputy Secretary Acquisition was informed by the Project Director that there was no further scope for schedule slippage in ITAS development if the aircraft were to be delivered with the contracted capability on schedule. The brief indicated that it was a distinct possibility that the first

several aircraft would be delivered without ITAS Build 2.⁸⁷ In April 2000, the Naval Capability Management Board was briefed by the Project Office on the difficulties being encountered. The status of the Project, at that time, was outlined to the Board as follows:

- the program was assessed as being 60 per cent complete;
- ITAS development was well behind schedule, with Build 2B being up to two years late; and
- the Flight Simulator was at least 14 months behind schedule and was dependent on ITAS development.

4.13 Two options for proceeding with the Project were proposed to the Board:

- (a) continue with the existing training, and mandate the use of aircraft with ITAS in Build 2B configuration; or
- (b) develop a start up plan which uses the capabilities available through each ITAS software build.

4.14 The brief to the Board indicated that the preferred option was to progressively utilise the capability as it became available under option '(b)'. The brief stated that issues causing the delayed delivery of the ITAS had been addressed by the Prime Contractor and sub-contractor. The Board was advised that the phased acceptance option was seen as reducing adverse perceptions resulting from having aircraft stored in country, waiting for ITAS Build 2B to be made available.

4.15 It was also acknowledged in the brief that the delivery of Penguin Missiles prior to the delivery of the Super Seasprite might create adverse perceptions; would have an opportunity cost; and would erode the shelf life before the missiles could be used. In June 2002, Defence advised the Senate Foreign Affairs and Defence and Trade Committee that the delivery of the Penguin Missiles had been slowed to preserve shelf life. At that time some \$170 million had been paid for the procurement of the Penguin missiles. No other aircraft in the ADF has been modified to use the Penguin Missile.

⁸⁷ As noted in Table 4.1, ITAS Build 1 provided aircraft flight and communications requirements. ITAS Build 2A was to provide sensor control and weapons capability while sensor, weapon and tactical display integration were to come in Build 2B. It was not until Build 3 that integration of the Automatic Flight Control System with ITAS was to be achieved.

4.16 The April 2000 brief to the Naval Capability Management Board also identified that phased acceptance of the aircraft would have implications for the ISS Contract. Under the ISS Contract, support for the Super Seasprite operations was due to commence in July 2000. By provisionally accepting the aircraft with Build 1/2A ITAS, the Project Office considered that the ISS Contract could commence operating as planned. During the period from 2003 to early 2006, in which the aircraft was being operated in its interim configuration, the rate of effort was well below the planned levels. See Figure 5.2 in Chapter 5.

4.17 In June 2000, the Chief of Navy Senior Advisory Committee was informed that the Naval Capability Management Board had agreed to the phased introduction into service of the Super Seasprite. In the associated brief the Committee was informed that a fully qualified Build 2 of the ITAS was not expected to be available until June 2002, but that this would also incorporate Build 3. The Flight Simulator was not expected to be delivered until late 2001.

Implementation of phased acceptance arrangements

4.18 In July 1997, the contract for the development of the ITAS was awarded by the Prime Contractor to Litton Guidance and Control System Division. During 2000, the Prime Contractor and Litton exchanged correspondence surrounding ITAS development. There was also ongoing discussion and correspondence between DMO and the Prime Contractor surrounding the status of the development of the ITAS. In December 2000, the sale of Litton Industries Inc. to the Northrop Grumman Corporation was announced with the acquisition taking place in April 2001. In February 2001, DMO wrote to the Prime Contractor providing conditional approval for alternative sub-contractors to be contracted to complete the ITAS following a mediation settlement between the Prime Contractor and the original sub-contractor. In April 2001, DMO wrote to the Prime Contractor seeking clarification on the restructuring plan and a realistic schedule for the delivery of the contracted capability. In June 2001, Northrop Grumman combined six Litton Divisions into a new Navigations System Division, which was the sub-contractor subsequently responsible for developing the ITAS.

4.19 A brief to the then Under Secretary Defence Materiel in March 2001 regarding slippage in the schedule for the development of the ITAS system outlined three options for the Project. These were to cancel the Project utilising non-performance provisions in the contract; await delivery of the helicopter

with the ITAS in its final configuration (Build 3); or proceed with a phased provisional acceptance plan. The Under Secretary was advised that:

- the option to cancel the Project was high risk with little merit and no capability delivery;
- awaiting delivery of the helicopter with the ITAS in its final configuration was regarded as having a high risk of further schedule delays, would be unacceptable to the Navy and have potential for adverse public relations for the Department, but would eventually produce a positive outcome; and
- a phased provisional acceptance had some of the similar risks as delaying acceptance but would be more acceptable to the Navy, would be a more manageable public relations issue and would produce a positive outcome sooner.

4.20 At the time this recommendation was made to the Under Secretary Defence Materiel, negotiations with the Prime Contractor for the staged acceptance of the aircraft were regarded as being well advanced. The indicated schedule for delivery at this time was as follows:

- August 2001 - provisionally accept helicopter with ITAS Build 1; and
- April 2003 - provisionally accept ITAS Build 2/3.

4.21 In late 2002, a further brief provided to the then Under Secretary of Defence Materiel indicated that negotiation of the Contract Change Proposal for the phased acceptance of the aircraft was ongoing. At this point, over \$816 million had been spent against the Project budget, with further significant expenditure having been made under the provisions of the ISS Contract. The brief outlined major contractual issues as at late 2002 which included:

- the partial delinking of the Prime Contract from the ISS Contract, which meant that payments under the ISS Contract proceeded notwithstanding that the helicopters had not been accepted under the Prime Contract;
- the absence of liquidated damages in the Prime Contract;
- issues surrounding the ability to retain Defence rights within the acquisition contract;
- ownership of supplies, including helicopters not passing to Defence until acceptance; and

- the Navy requirement to access the helicopters for training.

4.22 The brief provided seven options for how to proceed with the Project. These options are set out in Table 4.3. Option two, which reflected a May 2002 Statement of Principles agreed with the Prime Contractor,⁸⁸ was presented as the preferred option to be executed between DMO and the Prime Contractor. The other options were rejected for a range of reasons.

Table 4.3

Contractual options considered in late 2002

Option	Description
1	Continue to operate under the existing Prime Contract and ISS Contract
2	Amend the Prime Contract and ISS Contract
3	Sue for damages and continue under existing contracts
4	Sue for damages and amend the existing contracts
5	Terminate the existing contracts
6	Dispute resolution
7	Novate the contract to the parent company

Source: Late 2002 brief to the Under Secretary Defence Materiel

4.23 In April 2009, the former Under Secretary of Defence Materiel commented to the ANAO as follows:

The arguments against cancellation at that stage included:

- Navy needed the capability and still wanted the aircraft at that time;
- the delay involved in terminating the contract and acquiring new aircraft (assuming that the funds were available) was assessed as being significantly longer than the time required to fix the software issues, the majority of which at that stage related to the ITAS;
- DMO had concerns about the financial viability of the Prime Contractor and believed that little if any of the more than \$600 million expended to that date could be recovered;
- the Royal New Zealand Navy was then in the process of accepting its (simpler) Seasprites, and

⁸⁸ The May 2002 Statement of Principles envisaged amending the Prime and ISS contracts to allow for provisional acceptance of the helicopter in an Interim Training Helicopter configuration, which was a significantly less capable configuration than the Full Capability Helicopter.

- the Government was unlikely to agree to terminate the project at that stage given the above considerations and the fact that while the problems were considerable, there did appear to be a way through them. The same Government declined to cancel the project over five years later in 2007 when the cumulative effect of the problems was far greater than in 2001.

Implementation of legal advice

4.24 The late 2002 brief to the Under Secretary of Defence Materiel was primarily focussed on legal issues, including retention of rights. An approach to deal with these issues was to seek agreement with the Prime Contractor, by way of compensation for past losses, or to have the Prime Contractor undertake work at no cost. The brief identified that, if it were not possible to achieve compensation for losses incurred up to the execution of the associated Contract Change Proposal, due to the late delivery of the aircraft, it might not be possible to retain all of Commonwealth's rights under the existing contracts. Claiming compensation through renegotiations is more akin to option four in Table 4.3 which was not recommended in the brief on the basis that it may impact on the liquidity of the Prime Contractor; would diminish any remaining goodwill; and may have been unsuccessful.

4.25 The brief to the Under Secretary also included legal advice that recommended that DMO conduct a thorough examination of the entire course of dealings with the Prime Contractor to come to a more settled position about what rights DMO had in relation to the Prime Contract and the ISS Contract.⁸⁹ Once a more settled position was established regarding DMO's rights, the course of action recommended involved pursuing a negotiated solution and potentially issuing a Notice of Dispute. While a negotiated solution was pursued, resulting in an amendment to the Prime Contract to allow the provisional acceptance of an interim capability, other measures intended to improve overall contractual certainty were not implemented simultaneously as recommended.

4.26 In September 2008, DMO advised the ANAO that, at the time, the DMO's assessment was that issuing a Notice of Dispute would not assist to deliver the capability at that stage of the Project. The DMO further advised that, in the brief to the Under Secretary Defence Materiel from DMO

⁸⁹ This legal advice was provided by a Queens Counsel.

Contracting Policy and Operations, it was recommended to implement the May 2002 Statement of Principles and in parallel undertake an examination of the course of dealings between DMO and the Prime Contractor with a view to issuing a Notice of Dispute if problems arose in implementing the amendments to the Prime Contract introducing the Interim Training Helicopter arrangements.

Contract amended to enable acceptance of interim capability

4.27 The contractual renegotiations to allow for the phased acceptance of the aircraft were based around the May 2002 Statement of Principles. The Prime Contractor developed a Contract Change Proposal (CCP 56) to reflect these negotiations. In February 2003, the relevant Defence delegate signed a Proposal Liability and Approval⁹⁰ for an amount of \$3.96 million (December 2002 prices) to cover the additional costs associated with CCP 56.⁹¹ On 25 February 2003, the Project Office wrote to the Prime Contractor accepting CCP 56 which introduced the provisional acceptance of the Interim Training Helicopter into the Prime Contract.

4.28 The Interim Training Helicopter was intended to be operated for a period of 18 months from July 2003. At that time, acceptance of the Full Capability Helicopter was not expected until 2004. The specific purpose of the Interim Training Helicopter was to facilitate:

- the conduct of Operational Test and Evaluation, including First of Class Flight Trials;
- instructor training and type conversion for aircrew; and
- validation of aircrew and maintainer curricula and associated publications.

4.29 CCP 56 inserted a number of criteria into the Prime Contract that needed to be met prior to provisional acceptance occurring. These criteria included, amongst others, the requirement for the Prime Contractor to:

- (a) successfully complete the ITAS software Build 2A/2B/3 Critical Design Reviews;

⁹⁰ A Proposal and Liability Approval is a proforma used within Defence to seek approval from the Delegate to spend Public Monies and commit the Commonwealth to a liability.

⁹¹ This approval incorporated the retrospective approval of another Contract Change Proposal which represented a small component of the total increase.

- (b) complete the Interim Training Helicopter Formal Qualification Review (Physical Configuration Audit/Functional Configuration Audit);
- (c) reach agreement on a robust and achievable schedule with DMO including commencing the implementation of that schedule; and
- (d) complete ITAS Build 1 software with rectification of all outstanding priority 1 and 2 Software Trouble Reports.

Completion of Critical Design Reviews

4.30 The Critical Design Review for the ITAS Build 2 Software Development and Integration Project was conducted in March 2003, but was not regarded by DMO as being successfully completed at that time. In March 2009, DMO advised the ANAO that the Milestone for this Critical Design Review was partially paid in May 2003 with the remainder paid in June 2003 when the Prime Contractor provided further information. In November 2003, Defence wrote to the Prime Contractor outlining concerns surrounding the lack of visibility of lower level design detail for Build 2B/3. This letter stated that these concerns had been raised on numerous occasions including during the Critical Design Review. A report prepared in December 2003 by a consultant engaged by the Project Office indicated that these design issues were yet to be resolved between the Prime Contractor and DMO.

4.31 Defence advised the ANAO in September 2008 that the May 2002 Statement of Principles did not infer that there would be no follow-up action after the Critical Design Review. The ANAO notes that the amendment to the Prime Contract giving effect to the Statement of Principles (CCP 56) required the Prime Contractor to successfully complete the ITAS software Build 2A/2B/3 Critical Design Reviews prior to provisional acceptance by Defence of aircraft in the Interim Training Helicopter configuration. The DMO also advised the ANAO that holding up the Provisional Acceptance of the Interim Training Helicopter whilst the Critical Design Review follow up action was ongoing would have been detrimental to moving forward with the Project.

Formal Qualification Review delayed

4.32 In May 2003, following an exchange of correspondence, the Prime Contractor indicated that Defence had not met obligations for several action

items relating to the Formal Qualification Review⁹² schedule. In April 2003, the Prime Contractor wrote to Defence indicating that Defence had been delinquent in reviewing and approving Contract Data Requirements List (CDRL) documents required for the Formal Qualification Review. In that letter, the Prime Contractor indicated that it could not continue to provide, on an unfunded basis, the requisite staff to respond to delinquent CDRL comments. The completion of the Formal Qualification Review was set out within the Prime Contract (as amended) as a precursor to provisional acceptance.

4.33 In October 2004, a second Statement of Principles was signed between the Prime Contractor and DMO. This Statement provided that, in consideration of the benefit set out in Statement of Principles, the Prime Contractor would withdraw its claims in relation to the Formal Qualification Review and other matters. Under this Statement of Principles, the Prime Contractor was required to provide a realistic schedule for delivery of supplies.

4.34 Through the October 2004 Statement of Principles, Defence agreed to risk mitigation measures being implemented to the value of US\$3.13 million (1996 prices).⁹³ These risk mitigation measures included:

- ITAS Build 1, 2 and 3 Formal Qualification Testing;
- Design review of Mission Preparation and Mission Debrief Facility;
- Additional Operational Test and Evaluation and Certification Support; and
- In-flight demonstration of the contractual compliance of the aircraft.

4.35 Defence's records indicate that the Proposal and Liability approval signed at the time for the associated Contract Change Proposal (CCP 94) to fund these risk mitigation measures was lost within DMO. A retrospective approval was subsequently signed in late 2005 which indicated that these risk mitigation measures were then valued at \$A5.79 million (December 2005 prices). Under CCP 94, the final 10 aircraft were to be accepted in final configuration by November 2005. Defence also agreed through the

⁹² A Formal Qualification Review involves the test, inspection, or analytical process by which a group of configuration items comprising a system is verified to have met specific contractual performance requirements.

⁹³ Defence informed the ANAO in March 2009 that this amount was to be applied to additional resources in an attempt to bring forward the schedule.

October 2004 Statement of Principles to bring forward \$5 million (1996 prices) in expenditure linked to the provisional acceptance of five aircraft.

Provisional acceptance

4.36 Table 4.4 shows that nine aircraft were provisionally accepted during the Project. Two aircraft were never accepted, with one in the USA and one located at HMAS Albatross in Nowra. Of the nine aircraft that were accepted one was available for testing in September 2007. The rest were stored in preservation. One aircraft was held at PP1, which is for a preservation period of one week to 14 weeks, and the remaining seven aircraft were held at PP3, which is for a preservation period exceeding 28 weeks.

Table 4.4

Provisional acceptance of aircraft in Interim Training Helicopter Configuration

Aircraft number	RAN side number	Provisionally accepted	Hours flown after provisional acceptance	Preservation Status (September 2007)
1	840	23 Oct 2003	322.8	Available for testing
2	841	Never accepted	Not applicable	-
3	842	18 Dec 2003	287.6	PP3
4	843	18 Jun 2004	222.3	PP3
5	844	23 Feb 2004	270.3	PP3
6	845	17 Dec 2004	131.7	PP3
7	846	14 Nov 2003	213.3	PP3
8	847	1 Nov 2004	141.2	PP3
9	848	17 Dec 2004	34.9	PP3
10	849	Never accepted	Not applicable	-
11	850	30 Jun 2005	0	PP1

Source: DMO acceptance documentation, DMO responses to ANAO requests and interviews with Navy personnel.

4.37 As noted in paragraph 4.35, CCP 94 provided \$5 million in cash flow relief to the Prime Contractor. This was to be paid in \$1 million instalments with the provisional acceptance of Aircraft six, eight, nine, 10 and 11. Three aircraft were accepted under this arrangement within three months of CCP 94 being executed on 14 December 2004. Aircraft 11, which was also subject this arrangement, was provisionally accepted in mid 2005 but never operated by Navy. Aircraft 10 was never accepted. In December 2006, DMO advised the

Prime Contractor that no further helicopters would be accepted until the Full Capability Helicopter configuration was achieved.

4.38 Parts were loaned from the Defence inventory to the Prime Contractor to facilitate the acceptance of a number of aircraft. Aircraft 10 was never accepted but documentation indicates that a range of parts for this helicopter were in short supply, with parts being borrowed from other aircraft.

Issues surrounding provisionally accepted aircraft

4.39 The aircraft were provisionally accepted on the basis of submission of two forms by the Prime Contractor. These were an SG8 Provisional Acceptance Certificate and an SG2 Application for Deviation. The ANAO reviewed documentation associated with the acceptance of the nine aircraft, and note this documentation identified a range of issues with the aircraft. These issues are outlined in Table 4.5.

Table 4.5

Outstanding issues at aircraft acceptance

Aircraft number	Deviations ^{Note 1}	Unserviceabilities	Open Software Trouble Reports
1	41	37	36
3	32	30	36
4	21	Nil	36
5	28	22	36
6	23	17	36 (82) ^{Note 2}
7	41	40	36
8	17	13	36 (82) ^{Note 2}
9	23	26	36 (82) ^{Note 2}
11	19	24	36

Note 1: As part of the provisional acceptance process, the Prime Contractor was required to provide a list of items that were due for service, not installed or due for replacement at the time the aircraft was offered for provisional acceptance. These are referred to as deviations.

Note 2: The Prime Contractor documentation submitted in support of Provisional acceptance indicated that there were 36 open Software Trouble Reports applicable to the Interim Training Helicopter. However, in correspondence to the Prime Contractor, which included DMO endorsed SG8s provisionally accepting Aircrafts six, eight and nine, DMO noted a significant number of additional Software Trouble Reports had yet to be reviewed for applicability to the Interim Training Helicopter bringing the total number of open Software Trouble Reports to 82. DMO did not refer to these additional open Software Trouble Reports in accepting Aircraft 11.

Source: DMO acceptance documentation.

Deviations and Unserviceabilities

4.40 Of the SG8 Provisional Acceptance Certificates reviewed by the ANAO, most carried forward deviations from the SG2 forms. The acceptance documentation for the final aircraft accepted, Aircraft 11, detailed 19 deviations. Of these deviations, six were the subject of ongoing negotiations between DMO and the Prime Contractor, with five having been identified as deviations at the time that Aircraft three had been provisionally accepted in December 2003. Ten of the deviations for Aircraft 11 showed a completion date for rectification as 'prior to the Full Capability Helicopter' but no specific date was identified. Of the remaining deviations for Aircraft 11, one was for information only, one was addressed by alternate methods, and one was addressed by DMO loaning the Prime Contractor a part to allow provisional acceptance to occur.

4.41 Quality assurance was an issue for the acceptance of a number of aircraft. These issues included:

- Aircraft six was the eighth aircraft to be accepted and the paint scheme was regarded as being below the standard of previous aircraft. It was also noted that the aircraft was covered in dust and the leading edges of the Composite Main Rotor Blade exhibited surface corrosion, and the aircraft had large quantities of grease coming out of servicing points; and
- both Aircrafts eight and nine had issues with the autorotation settings.

4.42 In September 2005, the Commander of 805 Squadron wrote to the Project Office rejecting allotment of Aircraft 11. The associated Minute stated that the Unserviceabilities identified through a physical inspection were considered unacceptable, with Unserviceabilities on safety critical items of particular concern. The Minute went on to say that addressing quality assurance concerns and other fleet wide defects meant that the squadron did not have the capacity to correct the Unserviceabilities identified.⁹⁴ As noted in

⁹⁴ In August 2004, the Officer in Charge of AMAFTU wrote to the Project Engineering Manager and the Project Manager in relation to concerns that Engineering Change Orders had been signed without the work having actually being done by the Original Equipment Manufacturer or their sub-contractor. The associated e-mail cited four examples where this was believed to be the case. It was requested that the Project Office investigate each of these issues. When requested by the ANAO to provide evidence that this investigation occurred, Defence provided a copy of a letter to the Prime Contractor but were unable to confirm the letter had been sent.

Table 4.4 this aircraft was never operated by the Navy after being provisionally accepted by DMO.

Software Trouble Reports

4.43 Under the Prime Contract errors are classified in accordance with the categories set out in MIL-STD-498,⁹⁵ which are detailed in Table 4.6. The error limit for Priority 1 and 2 Software Trouble Reports set out in the Prime Contract was zero and there was a budget for lower priority Trouble Reports.

Table 4.6

Error classification MIL-STD-498

Priority	Applies if a problem could:
1	<ul style="list-style-type: none"> Prevent the accomplishment of an operational or mission essential capability; or Jeopardize safety, security, or other requirements designated as critical.
2	<ul style="list-style-type: none"> Adversely affect the accomplishment of an operational or mission essential capability and no workaround solution is known; or Adversely affect technical, cost, or schedule risks to the project or to life cycle support of the system, and no workaround solution is known.
3	<ul style="list-style-type: none"> Adversely affect the accomplishment of an operational or mission essential capability but a workaround solution is known; or Adversely affect technical, cost, or schedule risks to the project or to life cycle support of the system, but a workaround solution is known.
4	<ul style="list-style-type: none"> Result in user/operator inconvenience or annoyance but does not affect a required operational or mission essential capability; or Result in inconvenience or annoyance for development or support personnel, but does not prevent the accomplishment of those responsibilities.
5	<ul style="list-style-type: none"> Any other effect.

Source: MIL-STD-498

4.44 The open Software Trouble Reports included on the SG8s for provisionally accepted aircraft were recorded as Priority 3 and 4, for which there were allowances in the Prime Contract. In correspondence to the Prime Contractor, which included DMO endorsed SG8s provisionally accepting Aircrafts six, eight and nine, DMO noted a significant number of additional Software Trouble Reports (another 46) had yet to be reviewed for applicability

⁹⁵ MIL-STD-498 is a US Military Standard which was intended to establish uniform requirements for software development and documentation.

to the Interim Training Helicopter.⁹⁶ The covering letter stated that this needed to occur in order to progress the provisional acceptance activity.

4.45 Defence advised the ANAO that of the 82 Software Trouble Reports, the Majority were Priority 3, 4 and 5. One Software Trouble Report was agreed to be a Priority 2, raised 30 July 2003, and was attributed to and later corrected in ITAS Build 2A Software. One Priority 1 Software Trouble Report related to the navigation system and was subsequently closed by the contractor as an unreproducible error. One Priority 2 Software Trouble Report related to anomalies in data entry device latency. Acceptance documentation for Aircraft 11 which was the last aircraft to be accepted did not identify that these 82 Software Trouble Reports required resolution.

Warranty expired on provisionally accepted aircraft

4.46 The Project Office's brief to the Naval Capability Management Board in April 2000 identified that there were warranty implications related to the provisional acceptance of the Interim Training Helicopter that required a suitable resolution. Under the original Prime Contract, the Prime Contractor warranted the supplies, subject to conditions, for a period of 12 months from acceptance. While the original Prime Contract allowed for the provisional acceptance of aircraft, the concept of provisional acceptance of the helicopter in the Interim Training configuration was not contemplated.

4.47 The subsequent amendments inserting these arrangements into the Prime Contract through CCP 56 provided that the warranty would be 12 months from the date of provisional acceptance, with special arrangements for components of the Integrated Weapon System not delivered as part of the Interim Training Helicopter.⁹⁷ The implications of this was that the warranty period on the provisionally accepted Super Seasprites⁹⁸ expired during a period when the aircraft undertook limited flying activity (see Figure 5.2) and were subject to significant restrictions in the types of tasks they could

⁹⁶ Adding these additional 46 Software Trouble Reports to the 36 Software Trouble Reports already acknowledged by the Prime Contractor would bring the total number of open Software Trouble Reports applicable to Aircrafts six, eight and nine at the time they were provisionally accepted to 82.

⁹⁷ The Integrated Weapons System (weapons and sensors) that were not functional on the Interim Training Helicopter, were not provisionally accepted so their warranty period had not commenced.

⁹⁸ The Super Seasprite was only ever provisionally accepted in the Interim Training Helicopter configuration which did not include components which were to be delivered in the Full Capability Helicopter configuration, including key components of the Integrated Weapons System.

undertake, including a prohibition on embarked operations.⁹⁹ Aircraft 11, which demonstrated a number of quality assurance issues at acceptance, was never flown by Navy during the warranty period applying to that aircraft.

Recommendation No.3

4.48 The ANAO recommends that DMO improve acceptance arrangements for major capital equipment projects by:

- (a) reviewing its checking and verification procedures to ensure that they are sufficiently robust to identify, and where appropriate resolve, deficiencies prior to acceptance; and
- (b) employing appropriate contractual safeguards that seek to provide Defence with effective protection where issues affecting the capability are known at acceptance or are identified subsequent to acceptance.

Defence Response

4.49 Defence agreed to the recommendation and stated as follows:

Existing Defence contracting templates and practices comply with these recommendations. Contracting templates require milestone entry and exit criteria to be met before Acceptance can occur.

Formal Acceptance Certificates require the recording of any outstanding issues or items that must be met or remedied. The Acceptance of Supplies is subject to the issues or items being met or remedied.

Defence also uses deeds of settlement or similar documents to record the agreed outcomes in relation to matters identified at Acceptance and how they will be dealt with post Acceptance.

Interim Training Helicopter capability

4.50 The Statement of Operating Intent is a key document which defines the intended roles, operating environment and service envelope for an ADF aircraft type. The September 2001 Statement of Operating Intent set out the roles and tasks for the Super Seasprite Full Capability Helicopter. These included:

⁹⁹ These restrictions were applied initially through the Special Flight Permit and subsequently through the Type Certificate for the aircraft.

- *Surface warfare* including surveillance, reconnaissance, over the horizon targeting and maritime strike;
- *Undersea Warfare* including limited search and attack;
- *Boarding Party Operations* including visit, board, search and seizure;
- *Naval Gunfire Support* including observation of fire and battle damage assessment;
- *Utility Operations* including maritime search, over land search, rescue, combat search and recovery, vertical replenishment, winch transfer, medical evacuation, Defence aid to civil community and public affairs; and
- *Conversion Training* including first pilot day/night training and Tactical Coordinator co-pilot training, instrument training and deck landing training.

4.51 The March 2002 revised Statement of Operating Intent for the Super Seasprite set out the tasks and flight profiles of the Interim Training Helicopter. The Statement of Operating Intent did not prescribe specific roles to be performed by the Interim Training Helicopter. The authorised tasks were those that contributed to the purpose of the Interim Training Helicopter, which was to enable and facilitate:

- the conduct of Defence and contractor operational test and evaluation including First of Class Flight Trials;
- instructor training and initial type conversion for Defence and contractor aircrew; and
- validation of aircrew and maintainer training curriculum and associated publications.

4.52 A late 2004 report (the Visual Meteorological Conditions (VMC) Report) prepared by AMAFTU, based on testing conducted during the Special Flight Permit period, indicated that the helicopter was deficient against the tasks required of the Interim Training Helicopter.

4.53 While the Interim Training Helicopter Statement of Operating Intent was only intended to apply for 18 months, the ANAO found that Defence plans in 2007 for recertification, following the removal of the Type Certificate for the Interim Training Helicopter in 2006, did not envisage design acceptance for the Full Capability Helicopter to be completed until late 2011. Had the

Project not been cancelled in 2008, and even if Defence's 2007 estimate that it would take until late 2011 to gain design acceptance for the Full Capability Helicopter proved accurate, more than 11 years would have elapsed between the Naval Capability Management Board's agreement in 2000 to the phased acceptance of the Super Seasprite and delivery of the Full Capability Helicopter.

Progress towards full Capability

4.54 The May 2002 Statement of Principles required that DMO and the Prime Contractor reach agreement on a robust and achievable schedule with the Project Authority including commencing the implementation of that schedule. That Statement of Principles also set out the arrangements for early acceptance, which required a limited review by the Commonwealth or a full external review of the one of the key ITAS sub-contractors.¹⁰⁰

4.55 In June 2002 Defence requested, through the Prime Contractor, that a Capability Maturity Model audit be conducted of this sub-contractor to provide the Commonwealth with added confidence in the final product. This was considered essential to progressing towards interim early acceptance. In July 2002, the Prime Contractor advised Defence that there was no contractual basis for the Prime Contractor to expedite this review with the sub-contractor. When requested by the ANAO to provide a copy of the report on the Capability Maturity Model audit on the sub-contractor that it had requested in June 2002, DMO acknowledged that it had no contractual authority over the sub-contractor and had needed to manage this risk through arrangements with the Prime Contractor. In March 2009, Defence informed the ANAO that visibility of risk was maintained through a number of mechanisms including:

- Resident Project Teams located at software developer facilities;
- Preliminary and Critical Design Reviews;
- software development metrics;

¹⁰⁰ An audit of the Project conducted by Directorate-General Technical Airworthiness (DGTA) staff in April 2002 noted that the transition of software development to new developers was high risk in terms of system safety and software assurance. In September 2002 a Capability Maturity Model audit report on one of the ITAS sub-contractors noted significant risk to the successful development, implementation and acceptance of safety related projects. A further DGTA audit, requested by the Project Office, conducted in July 2007 of that sub-contractor noted that design data for ITAS Computer Software Configuration Items were not adequate to support design acceptance activities. The DGTA audit identified that these issues potentially placed the certification of the Full Capability Helicopter at risk if not adequately addressed.

- audits of the Prime Contractor and software developers; and
- involvement in Project Management Reviews, Test Readiness Reviews and Formal Qualification Testing.

4.56 The December 2004 Airworthiness Board that had recommended the granting of a Type Certificate for the Interim Training Helicopter requested a review of deficiencies in the aircraft.¹⁰¹ The July 2005 final report of this Deficiency Review noted that the ADF was yet to see what further challenges implementing the Full Capability Helicopter software would provide and expressed concern that the Interim Training Helicopter experience would be repeated.

4.57 In October 2005, the Chief of Navy was informed that the Prime Contractor was experiencing ongoing difficulty in ITAS software qualification testing for the Full Capability Helicopter (ITAS Builds 2A, 2B and 3). In June 2006, DMO agreed to split Formal Qualification Testing into two parts. At the time the second part of this testing was to commence in August 2006, not all Software Test Descriptions had been provided to DMO. The DMO advised the ANAO in September 2008 that a CDRL delivered to DMO in October 2004 defined the entry requirements for the Test Readiness Review,¹⁰² for Formal Qualification Testing but that this CDRL had not been approved and therefore was not contractually enforceable.

4.58 The DMO noted in a meeting with the Prime Contractor in June 2006 that in agreeing to go ahead with the Formal Qualification Testing that DMO had made a lot of concessions and was carrying some risk. In August 2008, DMO advised the ANAO as follows:

To clearly prove DMO's point that the software was not ready for FQT, [Formal Qualification Testing] and to avoid a legal wrangle that would not assist in delivering capability, DMO reluctantly agreed to participate in FQT.

¹⁰¹ The December 2004 Airworthiness Board raised an Airworthiness Corrective Action Request requiring the establishment of a review team to identify which deficiencies in the aircraft could be addressed through design changes, and apply priorities for rectification. This led to the establishment of a Deficiency Review Team whose final report was issued in July 2005. See paragraphs 8.27 to 8.32.

¹⁰² Prior to commencing Formal Qualification Testing a Test Readiness Review is conducted. A Test Readiness Review generally encompasses each configuration item to determine whether the test procedures are complete, and to assure that the contractor is prepared for formal configuration item testing. Test procedures are evaluated for compliance with test plans and descriptions, and for adequacy in accomplishing test requirements. A successful Test Readiness Review is predicated on the contracting agency's determination that the test procedures and informal test results form a satisfactory basis for proceeding into formal system configuration item testing.

Software Trouble Reports

4.59 In November 2006, the Project Management Stakeholder Group was informed that 32 Priority 1 and 93 Priority 2 Trouble Reports had been raised in the ongoing ITAS Build 2B/3 Formal Qualification Testing. Defence advised the ANAO that by March 2007, when this Formal Qualification Testing ceased, 45 Priority 1 and 161 Priority 2 Trouble Reports had been raised. In January 2008, a presentation prepared for the former Parliamentary Secretary for Defence Procurement showed that 927 Trouble Reports had been raised since the commencement of Formal Qualification Testing, with 400 remaining open at the time ranging from Priority 1 to Priority 5.

System Response Time and Spare Capacity Trouble Reports

4.60 Two Priority 2 trouble reports related to the ITAS Mission Data Processor's compliance with contractual requirements for system response times¹⁰³ and spare capacity.¹⁰⁴ The DMO was aware of the response time issues in June 2006, when agreement was reached to commence Formal Qualification Testing. In September 2008, Defence advised the ANAO that:

The SRT [System Response Time] and SC [Spare Capacity] trouble reports were initially allocated Priority 2. Through the STR [Software Trouble Report] analysis and review process, to which the Commonwealth was (contractually)

¹⁰³ In April 2009, the Prime Contractor advised the ANAO that:

Actual software response times depend on the speed of the microprocessor, time required to access the data, and the computational demand to achieve the desired output. The growth in the software complexity and added functionality that was demanded of the ITAS through the working of the human engineering process inevitably put a strain on achieving the specification response times. At the time of the first test of the fully integrated ITAS software in 2005–06, outages against several response time specification values were found. Tailoring the software design was successful in improving the response time in several areas, but did not achieve specification values. At the conclusion of this effort, the alternatives available to achieve the specification response times were considered to be another hardware upgrade, or the removal of functions that were not required by the software specification, but that provided for enhanced aircraft capability nonetheless.

¹⁰⁴ In April 2009, the Prime Contractor advised the ANAO that:

Early in the program, the Prime Contractor recognized that the CMFDS's [Colour Multi Function Displays] and the MDP [Main Data Processor] data throughput processing memory capacity would need to be increased to accommodate the capabilities of the emerging software design. Consequently, the Prime Contractor implemented a design to increase the data processing capacity (i.e. speed of the microprocessor) of the MDP by tenfold, and the speed of the CMFD by more than 2 times. Additionally, the storage capacity of the MDP was double and its dynamic memory (Random Access Memory) was increased by a factor of 16. The CMFD storage capacity was increased fourfold and its dynamic memory was likewise quadrupled.

not a party to prior to FQT [Formal Qualification Testing] the STRs were re-prioritised to Priority 4 prior to FQT. The Commonwealth did not have a basis to challenge prior to FQT and therefore did not have contractual basis not to proceed to FQT on the basis of these two STRs.

4.61 The Prime Contractor sought relief from both the system response times and spare capacity requirements. The DMO did not agree to the Prime Contractor's request. A brief provided to the Parliamentary Secretary for Defence Procurement in January 2008 indicated that the system response time was 400 per cent slower than the contracted schedule and there was no spare capacity while the Prime Contract required 30 per cent spare capacity, or greater. In February 2008, the Prime Contractor asserted that the system response time did not affect capability and that existing spare capacity assured software safety. In April 2009, the Prime Contractor made similar comments to the ANAO. These two issues were cited as factors contributing to the cancellation of the project in March 2008.

Formal Qualification Testing

4.62 In April 2007, testing was halted, incomplete, as a number of issues which precluded the completion of all test cases had been identified. In September 2008, Defence advised the ANAO that the abandonment of the testing was significant:

24 of the 466 software test descriptions failed to run to completion. This is an automatic failure of the test event in accordance with the contract. Consequently, when the company finally acknowledged that these events could not be completed, the Commonwealth stated its opinion that testing had been abandoned.

4.63 Defence further stated:

ITAS software development had been the major factor delaying schedule since 2000 and to have FQT [Formal Qualification Testing] abandoned incomplete meant that a project schedule to the Full Capability Helicopter and project completion could not be determined.

4.64 Over the remainder of 2007, DMO sought to have the Formal Qualification Testing completely rerun while the Prime Contractor sought to undertake limited testing based around regression analysis. DMO documentation indicated that the decision by DMO to allow modified Formal Qualification Testing to proceed in 2006 may have made the application of the Prime Contract problematic in terms of requiring the Prime Contractor to rerun the testing. A DGTA audit conducted in July 2007 of the sub-contractor

responsible for integrating the ITAS stated that the regression analysis approach would not result in a qualified system.

4.65 In early 2008, negotiation with the Prime Contractor surrounding testing of the ITAS for the Full Capability Helicopter was ongoing. Agreement was not reached on an approach to this testing prior to the Project being cancelled in March 2008. Subsequently, in February 2009, the Prime Contractor announced that formal qualification testing of the ITAS had been completed in late 2008.

Lesson No.5

The delivery of the desired capability to the ADF on a timely basis is a critical indicator of the success of a major capital equipment acquisition. Where an acquisition encounters ongoing difficulty, the acceptance of equipment at a lesser capability may be considered as a measure to progress the project and meet the needs of the ADF on an interim basis. As this potentially involves the acceptance of significant ongoing risk by DMO, a sound understanding of these risks needs to be obtained to ensure appropriate protections are established through contract amendments.

Recommendation No.4

4.66 The ANAO recommends that, before amending a contract to change acceptance arrangements for a major capital equipment project, DMO, in consultation with the Capability Development Group and the relevant Service, ensure that:

- (a) changes in risk allocation between the contractor and the Commonwealth resulting from associated contract amendment(s) are clearly identified and evaluated within a risk management context;
- (b) the issue of any previously accrued rights of the Commonwealth, which may be affected by changes to the acceptance arrangements, is appropriately addressed such as through settlement arrangements or by preserving these rights to the extent practicable; and
- (c) amendments of this nature require the written approval of the CEO of DMO, the Capability Development Group and the relevant Service Chief.

Defence response

4.67 Defence agreed with qualification to the recommendation as follows:

Agreed, with a proviso that this applies to instances where proposed changes are significant.

5. Aircraft Sustainment

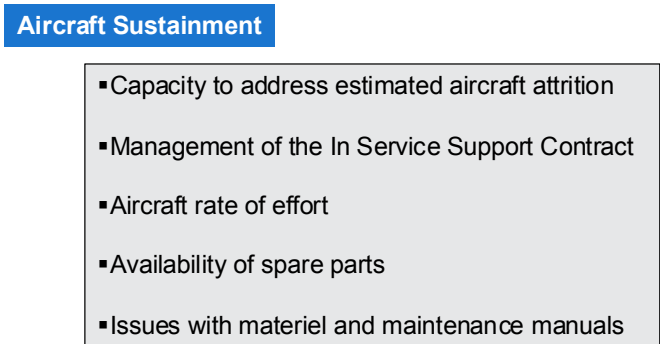
This chapter examines sustainment issues including the capability to address aircraft attrition, the ISS Contract, spares procurement and maintenance issues.

Introduction

5.1 The effective management of sustainment arrangements for Defence equipment is an important element in allowing the ADF to meet designated preparedness requirements. Sustainment includes all activities associated with keeping the equipment operational and maintained. This chapter examines sustainment issues relating to the Super Seasprite as set out in Figure 5.1.

Figure 5.1

Chapter outline



Capacity to address aircraft attrition

5.2 The October 1995 RFT for the ANZAC Ship Helicopter required the helicopter to operate and be supported for a period of 25 years from the date of delivery to the Commonwealth, during which time each helicopter should be capable of flying at least 10 000 hours. In late 1997, analysis of US Navy data by Defence was used to establish the potential attrition rates for the Super Seasprite. This analysis was based on Class A flight mishaps¹⁰⁵ that resulted in a destroyed aircraft for the SH-2F and the SH-2G variants flown by the US Navy and indicated an attrition rate for SH-2F and SH-2G Seasprites of 5.6 per

¹⁰⁵ A Class A mishap may also describe an incident where a fatality occurs, even when the aircraft was not destroyed.

100 000 flying hours.¹⁰⁶ The SH-2G most closely resembles the Australian configuration of the Seasprite. The analysis asserted that improvements in engineering and human factors in the Australian variant might be offset by new operating techniques which could increase the chance of an accident. It was therefore considered that the attrition rate of 5.6 aircraft per 100 000 flying hours was sound.

5.3 Given the RFT requirement set out in paragraph 5.2, this would mean that the 11 Super Seasprite helicopters could have been expected to fly in the order of 110 000 hours.¹⁰⁷ Therefore, based on an attrition rate of 5.6 aircraft per 100 000 hours, and subject to the effect on the estimated attrition rates because of any changes made to the Super Seasprite as compared to the variants flown by the US Navy, some level of attrition to fleet could reasonably be expected over the life of type of the aircraft.

5.4 In September 1997, the Defence Capability Committee agreed to procure an additional seven unmodified airframes¹⁰⁸ at a cost of US\$4.48 million and made a programming provision of \$100 million for the upgrade of three of these airframes with a 1999–2000 year of decision.¹⁰⁹ In December 1997, the acquisition of the seven additional unmodified airframes was approved by the then Government.¹¹⁰ In April 1998, the US FMS Case that procured the eleven Seasprite helicopters under Phase 1 of the ANZAC Ship Helicopter Project was amended to include the additional seven SH-2F airframes at a cost of US\$3.09 million.

¹⁰⁶ The SH-2F variant was in service from 1981 to 1995 with the US Navy. The SH-2G variant was in service from 1990 to 1994 and was subsequently flown by US Navy Reserve until 2001. There were no attritions of the SH-2G for the study period, but the hours flown by this variant represented only 2.7 per cent of the hours used in calculating the attrition rate.

¹⁰⁷ In May 2009, a sub-contractor involved in the management of in-service support arrangements for the Super Seasprite made the following comment to the ANAO:

At a squadron fly rate between 1,000 and 2,000 hours per year the total flying hours over 25 years would be less than half the 110,000 hours quoted. In this time the attrition of one or two aircraft out of the total of 11 would not be unrealistic.

¹⁰⁸ These airframes were in addition to the airframes acquired by the Project for upgrade to the Super Seasprite configuration and breaking down for spares under the Prime Contract.

¹⁰⁹ That is, the final decision on whether or not to proceed with upgrading these additional three aircraft to the Super Seasprite configuration was scheduled to be made in 1999–2000.

¹¹⁰ The ANAO did not sight the relevant Government approval, but rather relied on secondary evidence sourced from DMO documentation.

5.5 In September 1998, the Defence Capability Committee was informed that there was no provision for aircraft attrition in the Super Seasprite fleet. The Committee was advised that the 11 aircraft being upgraded under Phase 1 would be fully utilised. The Committee was presented with three options to address the attrition issues including:

- (a) maintaining a fleet of 11 helicopters and accepting limited capability to address attrition;
- (b) upgrading a further three airframes under Phase 3A to achieve the original capability requirement of 14 aircraft;¹¹¹ and
- (c) upgrading further aircraft under Phase 3B to maintain capability relative to an optimistic estimate of aircraft attrition.

5.6 Following consideration by the Defence Capability Committee, Phase 3A and 3B were cancelled in 1999. An October 2006 Business Case prepared as part of a review of the Project stated that 11 helicopters could not achieve the intended six flights (that is operational, manned helicopters) at sea. The Business Case stated that four embarked flights was the maximum that could realistically be achieved, based on a ratio of one aircraft embarked to two ashore. This shortfall of two flights would likely have been exacerbated by any aircraft attrition had the Project been completed.

Management of the In Service Support Contract

5.7 In-service support arrangements were considered as part of the tender evaluation process for the ANZAC Ship Helicopter Project. The 1996 report of the Integrated Logistics Support Tender Evaluation Working Group identified concern surrounding the long term supportability of the Super Seasprite, particularly given that the US Navy intended to withdraw the Seasprite from service in 2005.¹¹² The Source Evaluation Report indicated that through life support had been raised with the US Navy. In the Report, US Navy representatives were quoted as stating that they had a long term obligation under the FMS arrangement to support the SH-2Gs destined for Egypt. The Source Evaluation Report stated as follows:

¹¹¹ See paragraphs 2.21 to 2.23.

¹¹² At the time it was expected that the US Navy would withdraw the Seasprite from service in 2005 subsequently the US Navy took the decision to withdraw the Seasprite from service in 2001.

Based on the SH-2G(A) systems that are being offered to the Commonwealth there is a significant level of commonality of engines, rotor system and airframe with both the USN [US Navy] and Egyptian SH-2G helicopters. Other components are being provided by other companies (ie. avionics equipment), and normal support arrangements should apply.

Additionally, Kaman [the Prime Contractor] have provided reassurance to the Commonwealth that the company will support the helicopter as long as Commonwealth wishes to operate it. This combined with USN Support for the SH-2G to Egypt results in the TEB [Tender Evaluation Board] assessment of a high level of confidence that Kaman will be able to support the aircraft through to 2025.

5.8 An in-service support (ISS) Contract was signed with Prime Contractor on 26 June 1997, the same day the Prime Contract was signed. The original ISS Contract that was to expire on 31 December 2010, provided for the following in service support for the Super Seasprites:

- management and administration services;
- engineering services;
- technical support services;
- aircraft maintenance services;¹¹³
- logistic support services;
- training services; and
- software system support services.

5.9 To facilitate the contractual agreement, the Prime/ISS Contractor established the Kaman Aerospace International Support Centre (KAISC) at Albatross Aviation Technology Park, adjacent to HMAS Albatross in Nowra NSW. The KAISC was staffed by personnel drawn from the Prime Contractor and three sub-contractors. The KAISC also housed a small team of NASPO personnel, referred to as the Super Seasprite Integrated Logistics Support Group, which provided contract management and limited engineering services. The KAISC opened on 29 September 1999. Operation of the KAISC was originally intended to commence in early 2000, with a gradual ramp-up

¹¹³ In May 2009, a sub-contractor involved in the management of in-service support arrangements for the Super Seasprite informed the ANAO that aircraft maintenance services did not include the industrial work associated with deeper level of maintenance and repair of the air frames and ITAS.

leading to full delivery of services coinciding with the planned full delivery of the first aircraft in early 2001.¹¹⁴

1999 Internal Audit of the ISS arrangements

5.10 A Defence internal audit of the Super Seasprite Project was undertaken by personnel from the Management Audit Branch within the Inspector-General of Defence Division in late 1999. The audit reviewed both the acquisition and through life support arrangements for the Super Seasprite. The audit noted that significant restructuring had occurred within Defence following the introduction of the 1997 Defence Reform Program, which had implications for the management of in-service support for the Super Seasprite. The audit found:

Through life support planning is critical to aircraft availability/support cost over the Life of Type (LOT). Whilst outsourcing through life support arrangements is consistent with Government policy, such initiatives can present their own set of risks which need to be closely managed to achieve successful outcomes. A comprehensive In-Service Support Contract has been signed with Kaman, which will support the aircraft over the next 13 years. This contract should be reviewed early to verify the efficacy of the arrangements.

5.11 The internal audit compared the in-service support arrangements for the Royal Australian Air Force Hawk 127 (Lead-In-Fighter)¹¹⁵ and the Super Seasprite. This comparison acknowledged that while the two programs were different in terms of scope and delivered outcomes, there were similarities in the in-service support provided for the Lead-In-Fighter in a number of areas. The internal audit contained a comparison of key provisions in the Lead-In-Fighter Contract to those in the Super Seasprite ISS Contract as set out in Table 5.1.

¹¹⁴ In May 2009, a sub-contractor involved in the management of in-service support arrangements for the Super Seasprite commented to the ANAO as follows:

In reality the KAISC operation did commence in 2000 with a controlled transition from acquisition funding to ISS funding. Whilst the tasks performed were not directly related to aircraft rate of effort they were essential to maintain the integrity of the total ILS [Integrated Logistic Support] package. By the time of project termination the KAISC remained fully operational and effective.

¹¹⁵ The Royal Australian Air Force Hawk 127 is primarily used for initial or lead-in fighter training to prepare aircrew for operational conversion to the F/A-18 Hornet fighter or F-111 strike aircraft. Under the Lead-in-Fighter Prime Contract, the Prime Contractor was required to provide the aircraft under an acquisition phase and support the aircraft for five years under an in service phase.

Table 5.1**Defence internal comparison of Lead-in-Fighter and Super Seasprite In-Service Support contracts**

Contract term	Lead-in-Fighter	Super Seasprite
Contract period	5 years	13 years
Option to renew contract	Option for the Commonwealth to renew the ISS arrangements for further periods of 5 years.	-
Price basis	Calculated on an annual basis to reflect annual flying rate of effort (ROE) and survey and quote for additional work not included in the contract price.	Fee for services comprising a: management fee; monthly repayment (basically repair and overhaul); and any additional work.
Liquidated damages	Calculated at \$15 000 per working day per Lead-in-Fighter which is unavailable for inclusion in the RAAF daily pool.	-
Financial security	An unconditional financial security in the amount of \$89.38 million for the performance of both the acquisition and in-service phases of the contract.	An unconditional financial security in the amount of \$5 million for performance of the ISS Contract.

Source: Inspector-General's October 1999 internal audit report on the Super Seasprite Project.

5.12 The 1999 internal audit concluded as follows:

Overall, [the] audit considers the LIF [Lead-in Fighter] In-Service Support (ISS) contract offers several advantages when compared to the SH-2G(A) ISS contract. In the LIF contract, the Commonwealth had better protected its bargaining position by using a:

- 5 year contract period;
- Commonwealth option to extend the ISS arrangement by 5 year periods; and
- contract term for the Commonwealth to take possession of the contractor's maintenance facility in the event of a non-renewal of the ISS contract.

5.13 The 1999 internal audit found that the Lead-in-Fighter ISS Contract also incorporated a penalty for non-performance, namely enforcement of liquidated damages if the contract deliverable of a specified flying rate of effort was not achieved. In comparison, the Super Seasprite ISS Contract was a fee for service

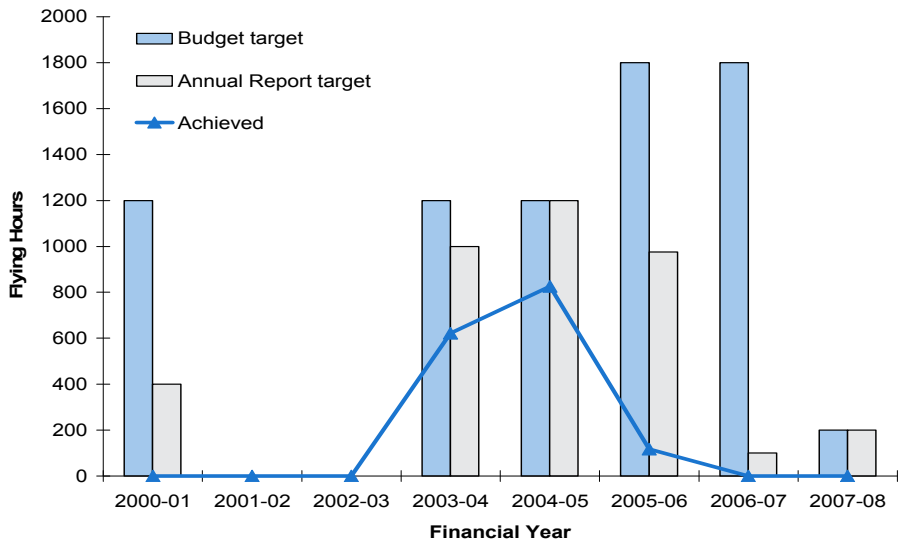
arrangement, without incentives and penalties linked to the flying rate of effort. The internal audit suggested that measurable performance incentives should have been included in the Super Seasprite ISS Contract to encourage contractor performance.

Aircraft rate of effort

5.14 Analysis of data included in Defence’s Annual Reports, Portfolio Budget Statements and Portfolio Additional Estimate Statements for the financial years 2000–01 to 2007–08 was used to derive Figure 5.2. The Figure shows that during the period the Super Seasprite was operated by Navy, the actual flying rate of effort was well below the planned levels.

Figure 5.2

Rate of effort of the Super Seasprite



Source: Defence’s Annual Reports, Portfolio Budget Statements and Portfolio Additional Estimate Statements

5.15 In February 2006, Defence informed a Senate Estimates Committee that it was then expected that in 2005–06 the Super Seasprite would complete 975 flying hours out of the budgeted 1800.¹¹⁶ The Committee was also informed by the Head of Aerospace Systems Division that:

¹¹⁶ However, flying of the Super Seasprite was suspended in March 2006, with the aircraft not subsequently operated by Navy. Accordingly, the aircraft was only actually flown for 168 hours in 2005–06.

There are actually three contributors to Seasprite availability. The first one is associated with spare parts; the second one is associated with some unexpected quality issues on some of the items that we received into service; and the third one is some competition between completing the project and supporting the in-service support of that project with the limited test pilots that we have.

Payments commenced prior to aircraft acceptance

5.16 The original ISS Contract provided for a ramp-up period from July 1998 to June 2001 during which a series of milestones were to be paid. These milestones comprised payments of A\$11.86 million, NZ\$0.16 million and US\$6.78 million. Following completion of the ramp-up, DMO was required to pay the Contractor a monthly Management Fee comprised of A\$575 904, NZ\$43 746 and US\$240 717.¹¹⁷ Under the ISS Contract, DMO was required to pay additional amounts for work that fell outside the Management Fee scope of work, including deeper level maintenance and additional in-service support.

5.17 As previously discussed, the delivery schedule in the Prime Contract was not achieved. The first aircraft was provisionally accepted in September 2003, with a further eight helicopters progressively accepted in Interim Training Helicopter configuration to June 2005. Two helicopters were never accepted. Of the aircraft provisionally accepted, one was never flown and one was operated for less than 35 hours (See Table 4.4).

5.18 DMO documentation indicates that monthly Management Fees were partially withheld from January 2000 due to Prime Contract schedule slippage. Defence informed the ANAO that during the period January 2000 to May 2002 DMO withheld ISS Contract Payments of A\$5.48 million and of US\$1.15 million.

5.19 DMO conducted contract negotiations with the Prime Contractor/ISS Contractor in May 2002 looking to, among other things, renegotiate the Payment Schedule for the ISS Contract to reflect the delay in ramp-up due to the slippage in the Prime Contract, and to amend the period of support to align with commencement of flying by Navy. On 28 May 2002, the parties signed the Statement of Principles relating to the Provisional acceptance of the Super Seasprite in the Interim Training Helicopter Configuration. This statement set

¹¹⁷ There was a slight adjustment to the monthly Management Fee for the final three milestones to A\$575 890, NZ\$43 733 and US\$243 285.

out changes to the monthly Management Fee payable under the ISS Contract as follows:

- for the months March 2002 to February 2003 –approximately A\$440 808 and US\$70 054 per month, excluding GST;¹¹⁸
- for the months March 2003 to April 2003 – approximately A\$1 million and US\$397 969 per month, excluding GST; and
- from May 2003 – approximately A\$694 559 and US\$192 793 per month, excluding GST, dependant on agreement on early acceptance proceeding.

5.20 Legal advice Defence obtained in 2002 regarding the late delivery of the aircraft offered the view that:

If as a matter of fact, the ramp up has not been completed, then it is my view that there is no obligation to pay the Management Fee.

I am instructed that the Commonwealth and Kaman have negotiated a lesser Management Fee to reflect the fact that Kaman is not providing full support to the ISS Contract, and that the Commonwealth has been paying this reduced fee since 1 July 2001. Although I have not examined the issue in any detail, the effect of this negotiated arrangement may be that the Commonwealth has waived or varied, or is estopped from asserting, its strict legal rights under the ISS Contract.¹¹⁹

5.21 A brief provided to the then Under Secretary of Defence Materiel in late 2002, which included a copy of the advice outlined above, indicated that a major issue with the Prime Contract and the ISS Contract was the partial de-linking of these contracts during a revision of the ISS Contract. As a result of this de-linking, payments under the ISS Contract were allowed to proceed independent of associated requirements of the Prime Contract having been met.

5.22 DMO documentation indicated that negotiations concluded between DMO and the Prime Contractor/ISS Contractor on 17 December 2002, and that agreement had been reached on the terms of the ISS Contract. The ISS Contract was subsequently amended in early 2003 in line with amendments to the

¹¹⁸ Defence advised the ANAO that this equated to a reduction to payment between March 2002 and March 2003 of US\$1.87 million and A\$4.51 million.

¹¹⁹ This advice was on the basis that the Ramp Up schedule could only be completed after milestones in the acquisition contract had been completed.

Prime Contract that introduced the concept of provisional acceptance of the aircraft in the Interim Training Helicopter configuration. Under the amended ISS Contract, the expiry date of the ISS Contract was extended to nine years and three months after provisional acceptance of the first helicopter.

5.23 The payment arrangements under the ISS Contract were amended to include two milestone schedules. The first applied from July 1998 to December 2004. The second was to apply from January 2005 to June 2013. Approximately 30 per cent of milestones in the ISS Contract were subject to a reduction in the amount payable if an associated milestone in the Prime Contract was not met. The last milestone subject to this adjustment was payable in October 2005.

5.24 Table 5.2 sets out payments made under the ISS Contract.

Table 5.2

Expenditure against the ISS Contract

Description	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	Total
	\$ m	\$ m	\$ m	\$ m	\$ m	\$ m	\$ m	\$ m	\$ m	\$ m	\$ m	
Ramp up payment	8.17	5.74	6.68	9.27	9.31	11.10	5.40					55.66
Management Fee							5.40	11.30	11.12	7.46		35.27
Price escalation	0.70	0.70	1.07	0.92	0.76	1.54	2.18	3.28	3.35	2.94		17.43
Payments for deeper level maintenance					0.06	0.10	0.69	2.12	2.40	4.11	0.65	10.12
Payments for other services				0.11	0.08	0.04	0.50	2.52	3.60	1.76	0.59	9.21
Payments under the 2008 Settlement Deed										5.40	1.45	6.85
Total	8.87	6.43	7.75	10.29	10.22	12.78	14.16	19.22	20.46	21.67	2.69	134.53

Note 1: A Special Flight Permit was first issued for the Super Seasprite on 30 October 2003, meaning that the helicopter could not be operated by Navy prior to that date. The Type Certificate for the Super Seasprite was withdrawn on 19 May 2006 and never reissued, meaning that the helicopter could no longer be operated by Navy after that date.

Note 2: Figures may not add due to rounding.

Source: DMO Spreadsheet updated to reflect subsequent DMO advice

Payments continue after flying suspended in 2006

5.25 On 25 February 2003, the Project Office approved a Contract Change Proposal for the ISS Contract (CCP 001), which amended the contract to reflect the provisional acceptance arrangements that had been introduced into the Prime Contract. The associated letter from DMO to the Prime Contractor/ISS Contractor indicated that the changes would be reflected in an amendment to the ISS Contract, referred to as the AL3 version, through a process initiated by DMO. The AL3 version of the ISS Contract was submitted to the liability approver within DMO on 10 March 2003 for a total liability of \$158.75 million.

5.26 In mid 2006, after the suspension of flying of the aircraft in March 2006, the CEO of DMO received advice that payments under the ISS Contract were potentially unlawful. Consequently, a review of the relevant contractual provisions was undertaken. This review identified that the AL3 version of the ISS Contract did not reflect CCP 001. Specifically, the AL3 version included a Price Schedule that contained provisions which had been negotiated out of CCP 001. On this basis, it was considered that the DMO was obliged to commence and continue monthly Management Fee payments under the ISS Contract. However, the review also indicated that the support contract did contain a clause providing for 'appropriate' adjustments of Management Fees to take account of significant variations in level of effort.

5.27 In October 2007, the ANAO asked DMO whether action had been taken to agree with the Prime Contractor adjustments to the Management Fees in line with the above review. The ANAO was informed that negotiations on this issue had been rolled into the then ongoing negotiations for a Deed of Variation associated with completing the Prime Contract. The ANAO notes that agreement on the proposed Deed of Variation was not reached prior to the Project being cancelled in 2008. This meant that the Management Fees payable under the ISS Contract were not reduced to reflect the fact that the helicopters had not been operated by Navy since May 2006.

Lesson No.6

Where in-service support arrangements are entered into at the same time as an acquisition contract, clear linkages need to be established and maintained between delivery against the acquisition arrangements and the commencement of payments under the in-service support arrangements. In-service support payment arrangements, once activated, should have clearly established linkages to the achievement of desired rates of effort.

Availability of spare parts

5.28 The original tender evaluation for the Project included consideration of supply support issues. The Integrated Logistics Support Tender Evaluation Working Group report of September 1996 stated that the Prime Contractor's listing for spares provided in the tender was based on a sound and logical assessment. The Working Group assessed the Prime Contractor's recommendation of the spares required as adequate to support operations, both ashore and afloat, for three years. The Prime Contractor's recommendation on the depth of spares to be procured was based on optimum turn around times based on in-country support. It was acknowledged that if this were not the case, additional spares would be required to allow for longer turn around times provided by overseas deeper maintenance facilities.

5.29 The Source Evaluation Report stated that:

The total budget of \$A899m (including contingency of 10%) is in excess of the available Project Budget of \$A740m by \$A159m. Within the 10% contingency 5% is required for spares, due to uncertainty in the levels 'insurance' spares¹²⁰ required for the flight. The other 5% is to cover all other Project requirements.¹²¹

5.30 A June 2002 brief provided to the then Minister for Defence outlined issues associated with spare parts. The brief advised that the Project had a set budget of US\$84 million under the Prime Contract for the procurement of spare parts to cover the first three years of operation. The brief stated that a significant percentage of the planned spare parts procurement had been acquired; however some spares had been returned to the supplier to be modified to reflect the aircraft design as it matured.

¹²⁰ The Source Evaluation Report stated that a flight operates as a single aircraft unit, usually without access to a ready supply of spares, such as gearboxes, engines, radar, etc. 'Insurance' spares are required to cater for unserviceabilities that result in the aircraft becoming non operational. The flight does not have a Deeper Maintenance repair capability on the ship and the level of 'insurance' spares required would need to be determined as part of a logistics support analysis after contract signature.

¹²¹ The Defence Capital Equipment Procurement Manual applicable at the time that the tender for this Project was conducted outlined processes for estimating contingency budgets for Projects. The manual recommended that contingency budgets be determined with reference to the level of project risk. Project risk was ascertained on the basis of complexity and degree of development associated with the project. The manual recommended a contingency budget of: over 30 per cent of the Project Cost Breakdown Structure for projects assessed as representing very high risk; 15 to 30 per cent of the Project Cost Breakdown Structure for projects assessed as representing high risk; and 10 to 15 per cent of the Project Cost Breakdown Structure for projects assessed as representing medium risk.

5.31 As noted in Chapter 4, the Prime Contractor needed to borrow parts from DMO in order to facilitate provisional acceptance of the aircraft by DMO. In late March 2004, the DMO Project Manager wrote to the Prime Contractor's Senior Contract Administrator regarding spares availability. At the time this letter was drafted the aircraft were being operated under a Special Flight Permit, and four aircraft had been provisionally accepted. This letter stated that:

As you are aware, all spares recommended by Kaman were fully assessed to support a 3-year mature rate of effort. These assessments utilised MTTR [Mean Time to Repair] and MTBF [Mean Time Between Failure] data supplied by Kaman and spares were procured accordingly. However, due to various constraints, some spares were not purchased until the full range and depth of the spares package had been advised to the Commonwealth. For information, NASPO is currently undertaking a spares review to identify those items recommended but never purchased, and also any difference between recommended and purchased quantities. This review is yet to be finalised. It should be noted that in addition to the spares procured under the acquisition contract, to date a further A\$12.5M has been committed for spares through In Service Support of which A\$9.7M has been expended.

5.32 In November 2005, an Airworthiness Board was convened to consider renewal of the Type Certificate for the Super Seasprite. The NASPO submission to this Airworthiness Board indicated that there had been a focus by DMO on ensuring there was a sufficient breadth and depth of spares to support future activities, including flights and detachments. The submission further indicated that the KAISC had analysed the spare part requirements for through life support of the Super Seasprites and set appropriate levels. The submission advised that spare parts obtained through the acquisition process were being supplemented, where necessary, by spares procured under the Defence Management and Financial Plan (DMFP) process.¹²²

5.33 During the course of the Project, \$165.36 million was expended against the Prime Contract for spare parts and support equipment. Of this amount, 14 per cent was advance payments, 4 per cent milestone payments, 66 per cent earned value method payments and 16 per cent price escalations. Table 5.3 shows expenditure on spare parts procured using sustainment funding.

¹²² The Defence White Paper 2000 introduced the DMFP. The DMFP is updated annually and incorporates in-year management data plus projection for the following nine years.

Table 5.3**Expenditure on spare parts outside the Prime Contract (\$ million)**^{Note 1}

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	Total
Expenditure	1.35	2.24	4.63	3.34	5.67	16.02	18.50	6.54	0.66	58.94

Note 1: Figures may not add due to rounding.

Source: DMO data provided to ANAO.

Spare part shortages

5.34 The NASPO submission to the 2005 Airworthiness Board indicated that the lead time for some spares was considerable but not unusual for small quantities of certain types of spare parts. The submission indicated that repair turnaround times for some items had resulted in shortages. The 805 Squadron submission to the same Airworthiness Board noted variable spare parts availability, with several items having an estimated delivery date of up to one year. The submission indicated that the reasons for spares availability delays were varied and included:

- identification of items that were not codified¹²³ when a maintenance procedure was conducted for the first time;
- identifying items which are codified but for which 805 Squadron is not loaded on the Standard Defence Supply System (SDSS) as a user; and
- identifying items that are codified but when the items were ordered and received via the normal stores a different part numbered item that could not be used was delivered.

5.35 The Squadron acknowledged that NASPO and KAISC staff had reacted as quickly as possible when these issues had been identified, but that rectification and subsequent supply could take several months.

¹²³ The 2005–06 Defence Annual Report stated that since 2003, a concerted program of work has been undertaken to reform Defence's financial management. The Annual Report outlined that Defence had implemented 16 Remediation Plans to improve the management and oversight of financial audit findings, and that ANAO financial statements audit findings have been assigned to a remediation plan. Each plan was assigned to an accountable officer responsible for progressing the remediation activities in the plan, including timely resolution of audit findings and reporting on progress to the Financial Statements Project Board. One of these plans was Standard Defence Supply System (SDSS) Items Not in Catalogue (NIC). The objective of this plan was to reduce the number of NIC items being held by Defence by implementing procurement policies, processes and procedures that ensure that items being purchased are codified and loaded onto SDSS.

Cannibalisation of parts

5.36 The 805 Squadron submission to the 2005 Airworthiness Board also stated that between December 2004 and September 2005 there had been 40 instances of aeronautical product cannibalisation¹²⁴ of parts from other aircraft within the Super Seasprite fleet. This was regarded as being a significant increase over the submission to the 2004 Airworthiness Board of 24 instances.

5.37 The submission indicated that while cannibalisation was sometimes used to return an aircraft to the flying program, it was not always possible due to parts being one-use-only breakdown spares, or the risk of obtaining parts this way was assessed as being too great. It further suggested that while cannibalisation can be used as a short-term measure, if it is used as the norm rather than an exception, it has the potential to impact on the long-term availability of several aircraft. A June 2007 in service support performance report showed that cannibalisation was continuing to occur, notwithstanding that flying had been suspended since May 2006.

5.38 The June 2007 in service support performance report also reported trends for demand satisfaction rates and outstanding demands for Repairable Items and Non Repairable Items for the Super Seasprite, which indicated:

- improvement in the demand satisfaction rate for Repairable Items;
- improvement in the demand satisfaction rate for Non Repairable Items;
- a reduction in the outstanding demands for Repairable Items; and
- an increase in the outstanding demands for Non Repairable Items.

5.39 At the time of this June 2007 report, flying of Navy's Super Seasprites had been suspended since May 2006 and eight of the nine helicopters provisionally accepted were held in preservation. The ANAO notes that for all four of the above performance indicators, the trend line was set against significant month to month fluctuations which diminish in frequency after flying was suspended.

5.40 As discussed in paragraphs 1.8 and 5.4, seven additional airframes were purchased in 1998. These were stored at the Aerospace Maintenance and Regeneration Centre (AMARC) at Davis Monthan Air Force Base in Arizona, USA. A 2002 Project Office Minute noted that some SH-2 components were no

¹²⁴ This involves the removal of parts from one aircraft to make another aircraft operational.

longer manufactured and the only source was from second hand airframes. Some components such as gearboxes were also identified as being cheaper to refurbish than buy from US Navy stocks. The Project Office indicated that there was an opportunity to refurbish components at a reduced cost while production of the Super Seasprite was ongoing. On this basis it was proposed by the Project Office that four of the airframes be retrieved from AMARC and stripped of major components. These components were to be refurbished to provide spare parts for the fleet. A Rough Order of Magnitude quote for this work of US\$5.82 million was provided by the Prime Contactor in November 2002, which was not taken up.

5.41 A Business Case drafted as part of considerations of the status of the Project in May 2006 indicated that the seven airframes continued to be stored at AMARC. The Business Case proposed to strip the seven airframes for identified parts as required by operational demands, refurbish and/or store components confirmed to be within satisfactory repair tolerance and dispose of remnants. The estimated cost was A\$12.5 million. This Business Case was not implemented and the seven aircraft were still stored at AMARC when the Project was cancelled.

Capacity to undertake testing

5.42 The 805 Squadron submission to the 2005 Airworthiness Board also set out operational maintenance aspects of Seasprite Airworthiness Management. Of the nine aircraft provisionally accepted at this time, one remained with the Project Office for the rectification of defects while eight aircraft were the responsibility of the Squadron, with one of these in preservation and one being available for AMAFTU testing.

5.43 The 805 Squadron Submission showed that flying hours achieved by the aircraft had been consistently below allocated hours since September 2005. For September 2005, the last month included in that Submission, actual flying hours represented less than 15 per cent of allocated hours. The low flying rates were attributed to maintenance related issues. The Submission noted that spares availability was a factor contributing to the reduced flying hours, with several items having an estimated delivery date of up to one year from ordering.

5.44 A significant amount of testing was planned to be conducted by AMAFTU, however the combination of poor serviceability and personnel availability impinged on the level of testing completed. Aircraft testing was

one of the means by which Defence intended to overcome the disparity between contractual airworthiness requirements and ADF airworthiness requirements. The Submission indicated that tests yet to be completed, which related to a number of open Issue Papers, included :

- low speed hard-over testing;
- slope ground landing evaluation;
- autorotation Revolutions Per Minute (RPM) procedure validation;
- divergent radar altimeter height hold evaluation;
- AFCS hard-over testing;
- LN-100G Navigation System drift evaluation; and
- Cyclic Palm Rest removal evaluation.

Issues with materiel and maintenance manuals

5.45 Over the period from late March 2004 to late October 2004, 48 Air Safety Occurrence Reports (ASORs) were submitted for 658 hours of flying. Of the ASORs submitted, 38 related to materiel, six related to maintenance and four were attributed to human factors. In December 2004, an Airworthiness Board was convened to consider a recommendation for the award of a Type Certificate and Service Release¹²⁵ for the Super Seasprite. 805 Squadron made a submission to this Airworthiness Board on ASORs that indicated that materiel failures were expected to be higher during the initial introduction into service, but were expected to reduce and stabilise as the system matured. The Squadron's submission to the 2004 Airworthiness Board on ASORs outlined significant incidents including:

- AFCS hard-overs;
- locknuts missing on tail rotor tabs, which was attributed to the manufacturer but missed by inspection;
- landing gear contact with RSD during free deck recovery; and
- rotor brake fumes.

¹²⁵ A Service Release is a declaration that the technical and operational airworthiness management requirements have been implemented to ensure that the aircraft type can be operated safely in approved roles whilst maintaining the airworthiness of the type design.

5.46 The DMO package submitted to the Airworthiness Board in support of the grant of a Service Release for the Super Seasprite identified 62 ASORs submitted up until 29 October 2004, with 52 relating to materiel.¹²⁶ In addition to the issues identified in the 805 Squadron submission, the DMO submission identified structural integrity issues with the aircraft tail rotor pylons relating to cracking and working rivets.¹²⁷ The repair of one aircraft led to the discovery of existing repairs, carried out during US Navy service, which were not in accordance with the repair manual.

Reduced confidence in the aircraft

5.47 The 805 Squadron Submission to the November 2005 Airworthiness Board identified that several defects occurred in relatively quick succession in mid 2005, which were partially attributed to a breakdown in the Original Equipment Manufacturer's quality assurance processes. The Submission advised that these defects, along with a number of issues where less than satisfactory Original Equipment Manufacturer advice had been received, had adversely impacted on aircrew confidence in the aircraft.¹²⁸ In one case, an aircrew member had no confidence in the aircraft and was posted from the Squadron.

5.48 In November 2005, the Airworthiness Board was briefed by two experienced pilots on the reduced confidence they and their colleagues had in the aircraft. The Airworthiness Board's report indicated that this was regarded by the Board as being unique in the ADF aviation community and a cause for significant concern. Factors contributing to reduced confidence levels included a spate of technical issues and ongoing concern surrounding Original Equipment Manufacturer data.

5.49 The reduced confidence in the aircraft was not restricted to aircrew, with maintenance personnel expressing varying levels of confidence in the maintenance manuals. The CANAG submission to the 2005 Airworthiness

¹²⁶ It should be noted that the Prime Contractor was not obliged to submit ASORs for events that occurred while the Prime Contractor was operating the aircraft, although these may have been captured in circumstances where Commonwealth air crew had visibility of the issues.

¹²⁷ The NASPO submission to the late 2005 Airworthiness Board indicated that following lengthy discussions, the Original Equipment Manufacturer had agreed to the subcontractor inspecting and replacing all suspect rivets across the fleet with action ongoing at that time.

¹²⁸ The NASPO Submission to the 2005 Airworthiness Board noted quality assurance issues with the state of delivered stores and in some cases the materiel state of the refurbished aircraft. That Submission indicated that the CEO of DMO had raised these issues with the CEO of the Prime Contractor.

Board noted that whilst the contracted verification process for the manuals was complete, new publication discrepancies continued to be identified on a daily basis, which was to be expected given that the publication review process was a desktop review where procedures were not physically verified on the aircraft.¹²⁹

5.50 Publication discrepancies were required to be addressed through an in-service Publication Improvement Report and Reply (PIRR) submitted to the ISS Contractor. At the time of the CANAG Submission to the 2005 Airworthiness Board, 227 PIRRs (including 10 urgent PIRRs) had been raised during the period from 1 December 2004 to 30 September 2005. In March 2009 Defence indicated that the PIRRS were mainly attributable to the addition of Critical Maintenance Operations Details of the PIRRs raised by 805 Squadron are set out in Table 5.4. The table shows that 9 per cent of the PIRRs raised during the period had been incorporated into the manual and 45 per cent had received replies from the ISS Contractor.

Table 5.4

Publication Improvement Report and Reply raised by 805 Squadron

	Prior to 1 December 2004	1 December 2004 to 30 September 2005	Total
Total raised in period	286	227	513
Replies to PIRRs raised in period	262	103	365
Amendments incorporated to PIRRs raised in period	211	20	231
Percentage of replies to PIRRs	92	45	71
Percentage of PIRRs incorporated into manuals	74	9	45

Source: CANAG Submission to 2005 Airworthiness Board

5.51 The November 2005 Airworthiness Board noted that inadequacies in technical publications were evident due to the abbreviated verification and validation program applied to the acceptance of these manuals, and that the

¹²⁹ An August 2006 Seasprite Roadmap aimed at regaining certification of the aircraft following the withdrawal of the Type Certificate in May 2006 stated as follows:

... the SH-2G(A), during ITH operations, was afflicted by many unserviceabilities, in many cases apparently associated with the poor build quality of the aircraft and poor quality control of supplied stores. This has been further exacerbated by a significant number of errors in the maintenance manuals. The combined affects of these has resulted in key concerns including reduced confidence in the aircraft and a low rate of effort (ROE) has impacted on the transition of the SH-2G(A) capability into operational service.

discrepancies had potential for an adverse impact on airworthiness.¹³⁰ The Board noted that the process of introducing technical publications without an adequate verification and validation program would naturally present maintenance difficulties, and that these difficulties were being encountered by an already strained maintenance workforce. Notwithstanding this, the Board considered that adequate maintenance arrangements were in place to identify and investigate potential discrepancies and raise PIRRs as appropriate, subject to requests for publication changes being processed expeditiously.

Critical Maintenance Operations

5.52 DMO advised the ANAO that the Prime Contractor in its role as ISS Contractor was responsible for the development, review and approval of all maintenance publications in accordance with the ADF's Technical Airworthiness Regulations. The requirements for Independent Maintenance Inspections are set out in Technical Airworthiness Regulation 5.1.6. Under this regulation, as a minimum and unless otherwise specified by the relevant Authorised Engineering Organisation, Independent Maintenance Inspections shall be performed whenever any of the following safety-critical items or systems are replaced, adjusted or reconnected:

- flying controls and associated equipment;
- engine controls and associated equipment;
- undercarriage controls, brake and steering controls, and associated equipment;
- installed airborne oxygen equipment;
- aircrew escape and survival equipment; and
- explosive ordnance and associated equipment.

¹³⁰ In April 2009, the Prime Contractor informed the ANAO as follows:

During the negotiation that culminated in the contract change for Provisional Acceptance of the aircraft, it was recognized that the Verification of the aircraft period would be abbreviated. In consideration for this, the Prime Contractor agreed to retain staff to support Defence's Verification and to provide an amendment service for 2 years following the completion of the Verification process. Further, the Prime Contractor agreed to upissue any manual in which more than 10% of the pages contained changes. This was tacit acknowledgement that the abbreviated validation period could result in greater than expected number of corrective actions.

5.53 Independent Maintenance Inspections were not mandated in the Super Seasprite Maintenance Publications for the large majority of Critical Maintenance Operations.¹³¹ The 805 Squadron Submission to the 2005 Airworthiness Board stated that, at the time, all other RAN aircraft types had these inspections mandated for Critical Maintenance Operations in their relevant maintenance manuals.¹³² Defence advised the ANAO in September 2008 that there was no requirement for Critical Maintenance Operations to be in maintenance publications. DMO advised the ANAO that interim arrangements were implemented subsequent to the issue being identified in June 2003. This occurred through an Aircraft Engineering Officer Technical Memorandum which DMO advised was subsequently updated on four occasions. DMO indicated that this arrangement was considered to be compliant with the Technical Airworthiness Regulations.

5.54 The October 2005 NASPO Submission to the Airworthiness Board indicated that 72 PIRRs had been submitted in relation to Critical Maintenance Operations. Table 5.4 shows a significant backlog in PIRRs. The DMO advised that a program was initiated by the NASPO Chief engineer in the second half of 2005 to review the criticality of all maintenance procedures and raise amendments to the maintenance publication via the PIRR process to include Independent Maintenance Inspection requirements. The DMO advised the ANAO that the publication amendments were completed in mid 2007. At this time, the aircraft had not been operated by Navy for 12 months.

Related Air Safety Occurrence Reports

5.55 A DGTA audit conducted in April 2005 covered the Maintenance Management System. The DGTA audit noted that there had been 15 maintenance related ASORs raised since December 2004 to the time the 2005

¹³¹ In April 2009, the Prime Contractor informed the ANAO that Defence's direction with respect to independent maintenance checks varied over the period of the Prime Contract:

Initially the Prime Contractor was directed to exclude them from individual maintenance procedures in favor of a general requirement for independent maintenance checks. After flight operations began, it was evident that the decision needed to be revisited and Defence decided that maintenance checks would be added back into the maintenance publications

¹³² On 19 June 2008, in response to Recommendation 8.01 of the Board of Inquiry into the Sea King Nias Accident, DGTA issued a Technical Airworthiness Directive clarifying requirements set out in the relevant ADF Manuals for Critical Maintenance Operations where there is no published guidance. The Board of Inquiry, through Recommendation 8.11, also recommended that CANAG, with DGTA, ensure that Navy has an adequate system for highlighting Critical Maintenance Operations in aircraft maintenance documentation and had effective oversight by senior maintainers.

DGTA audit was conducted. Of the incidents during 2005, common causes related to failure to correctly follow procedures and inattention to detail. One was identified in the audit report as a significant maintenance incident, as it related to failure to fit a cotter pin to a flight control assembly.

5.56 Table 5.5 sets out the ASORs for the period 9 December 2004 to 30 September 2005. As was the case in the period leading up to award of Type Certificate for the Super Seasprite in December 2004, the vast proportion, 71 per cent of ASORs, related to materiel. The second largest proportion represented 21 per cent of the ASORs, and was attributed to the human – maintenance category.

Table 5.5

ASORs for period December 2004 to September 2005

Contributing factor	Number
Human – aircrew	4
Human – maintenance	13
Materiel	45
Environment	1

Source: CANAG Submission to 2005 Airworthiness Board

5.57 Five of the 13 maintenance ASORs related to inappropriate conduct of Critical Maintenance Operations and were described as:

- use of inappropriate procedure to install AFCS actuator assembly due to the use of a superseded procedure;
- electrical short during firing circuit testing on flotation system due to following an unapproved variation to procedure;
- corrosion of rescue hoist bumper assembly hardware that was not identified through inspection;
- collective control rod input to AFCS that was not correctly cotter pinned; and
- damage to Composite Main Rotor Blade during assembly.¹³³

5.58 Publication deficiencies were identified as contributing to four maintenance incidents, with three of these maintenance incidents related to

¹³³ CANAG Submission to 2005 Airworthiness Board.

inappropriate or incomplete conduct of Critical Maintenance Operations. The 805 Squadron Submission advised the Airworthiness Board that maintenance personnel had been thoroughly and repeatedly briefed to cease maintenance if in any doubt about a maintenance procedure.

Submission to the Airworthiness Board by Directorate of Flying Safety

5.59 A submission prepared by the Directorate of Flying Safety for the 2005 Airworthiness Board concluded as follows;

The safety reporting culture in the Super Seasprite community was in a healthy state. There remains to be a far greater proportion of 'materiel' related ASORs when compared to other helicopter fleets across the FEG [Force Element Group].

5.60 The conclusion of the Directorate of Flying Safety submission was based on analysis derived from a database which had known limitations on assigning causal categories to ASORs to facilitate analysis. The Directorate of Flying Safety submission to the Airworthiness Board referred to only one serious incident. This incident involved a maintenance sailor receiving a potentially fatal electric shock during a maintenance operation.

5.61 A supplementary submission was prepared by the Directorate of Flying Safety, following an October 2005 AMAFTU report, due to concern that the earlier submission understated the issues identified by the Officer-in-Charge of AMAFTU. These concerns included two incidents of a cotter pin being missing on the collective control rod on the AFCS actuator assembly, and identification of a main rotor bar spade crack. The Directorate of Flying Safety advised the Board through the supplementary submission that the small number of incidents reported by AMAFTU did not provide evidence of a larger problem that was purportedly observed by the Officer-In-Charge AMAFTU. The incidents surrounding the AFCS actuator assembly related to the unsatisfactory completion of Critical Maintenance Operations.

Maintenance Reinvigoration Program

5.62 The DGTA Submission to the 2005 Airworthiness Board noted that CANAG had initiated a capability wide review of maintenance attitudes and practices during August and September 2005, which included 805 Squadron. While the primary driver for this review was the Sea King Nias Island accident, a maintenance ASOR (see paragraph 5.57) relating to the cotter pinning of collective control rod input to the AFCS also contributed to the

decision to undertake this review. The review, known as the Maintenance Reinvigoration Program, provided anecdotal evidence of inappropriate practices and attitudes across naval aviation, and a program of rectification was initiated.¹³⁴ The style of the review had focussed on open and frank reporting, rather than the identification of individuals, thus the DGTa was unable to establish the extent to which these issues were areas of concern within 805 Squadron.

5.63 The 2005 audit of the NASPO Maintenance Management System by DGTa concluded that information gained from the Maintenance Reinvigoration Program, combined with the incidents reported, provided an indication that improvement in maintenance quality was warranted within 805 Squadron. Following the Sea King Board of Inquiry, the ADF Airworthiness Authority ordered a strategic review of the ADF Airworthiness Management System. According to the November 2007 report on that review, the Maintenance Reinvigoration Program was completed in June 2007 with residual longer-term aspects transitioning to the running system.

¹³⁴ The Maintenance Reinvigoration Program identified that personnel were on occasion not following the requirements of the ADF aviation maintenance regulations by signing for other people's work; ignoring the requirement for independent maintenance quality inspections; either not reading or not following maintenance procedures; and not documenting 'minor' maintenance. The focus groups which participated in the review identified a number of drivers contributing to the above including the level of activity; a lack of appropriate supervision throughout the supervisory chain; and an inadequate understanding of responsibilities under the maintenance regulatory system.

6. Aircraft Certification

The achievement of type certification is an essential element in delivering an airborne capability to the ADF. This chapter analyses the processes undertaken in support of achieving type certification of the Super Seasprite.

Introduction

Aircraft certification is a complex process involving detailed technical and operational considerations. The acquisition of the Super Seasprite occurred during a period of transition from Navy specific aircraft certification arrangements to the ADF Airworthiness Management System. The Project Office and the Prime Contractor were responsible for undertaking defined processes to demonstrate the airworthiness of the aircraft. The Super Seasprite was awarded a Special Flight Permit in November 2003 and a Type Certificate in December 2004 allowing Navy to operate the aircraft subject to limitations set out in Chapter 8. In May 2006, the Type Certificate for the Super Seasprite was withdrawn and never reissued (see Chapter 9). Factors contributing to the decision to withdraw the Type Certificate are set out in Chapters 1, 8 and 9. This chapter focuses on initial certification of the aircraft as set out in Figure 6.1.

Figure 6.1

Chapter Outline

Aircraft Certification

- The Airworthiness timeline for the Super Seasprite
- The introduction of the ADF airworthiness arrangements
- Contractual certification requirements
- Special Flight Permit awarded and renewed
- Type Certificate awarded

The Airworthiness timeline for the Super Seasprite

6.1 Prior to acceptance by DMO, the Super Seasprite was subject to civil aviation legislation. In December 2000, CASA issued an exemption from the *Civil Aviation Safety Regulations 1998* and the *Civil Aviation Regulation 1988* for

the Super Seasprite for Acceptance and Production Test Flying (the CASA exemption). The CASA exemption imposed a series of conditions to be met for flight testing. The CASA exemption was reissued in late 2004 imposing the same conditions. Individual aircraft, once provisionally accepted in the Interim Training Helicopter configuration, were transferred to the State Register and therefore no longer subject to CASA regulation.

6.2 Under the ADF Airworthiness Arrangements a series of documents, referred to as Airworthiness Instruments, authorise the conduct of ADF Operations (See Figure 6.2). A Special Flight Permit is required to authorise activities such as developmental, production and type acceptance test and evaluation, proof of concept/demonstration flights, or ferry flights. The Super Seasprite was operated by the Navy under a Special Flight Permit, in an interim configuration, from October 2003 to December 2004.

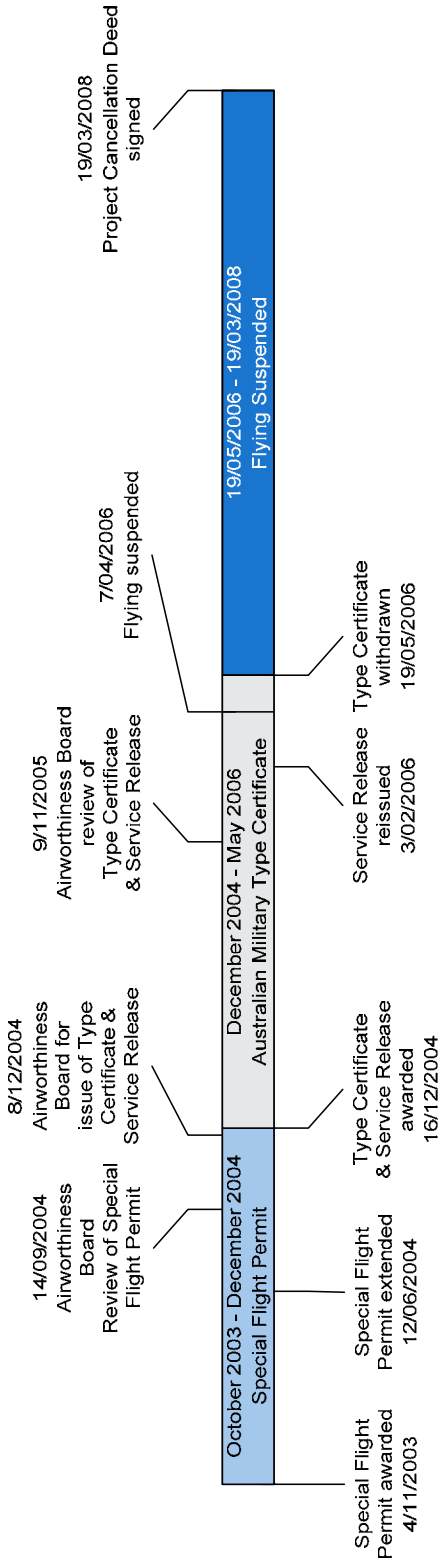
6.3 An Australian Military Type Certificate (Type Certificate) formally attests that an aircraft is airworthy if it conforms to a specific type design; is operated in accordance with approved operating instructions; is maintained in accordance with approved instructions for continuing airworthiness; and is operated within approved and defined roles. The Super Seasprite, in its Interim Training Helicopter configuration, was issued with a Type Certificate in December 2004. This Type Certificate imposed a significant number of restrictions on the operation of the aircraft.

6.4 A Service Release is a declaration that the technical and operational airworthiness management requirements have been implemented to ensure that the aircraft type can be operated safely in approved roles whilst maintaining the airworthiness of the type design. The Service Release for the Super Seasprite contained a number of limitations in addition to those included in the Type Certificate.

6.5 The Type Certificate for the Interim Training Helicopter configuration of the Super Seasprite was withdrawn in May 2006, which also invalidated the Service release. The Super Seasprite was never subsequently issued with a Special Flight Permit or a Type Certificate meaning that the aircraft was not subsequently operated by Navy.

Figure 6.2

Key certification events for the Super Seasprite



Airworthiness Instruments

Note: Over the period from November 2003 to March 2006 flying was suspended on three occasions, utility training was suspended or deferred on two occasions and a limitation was imposed on one occasion due to discrepancies in the navigation system.

Source: ANAO analysis of the Defence and DMO documentation.

The introduction of the ADF airworthiness arrangements

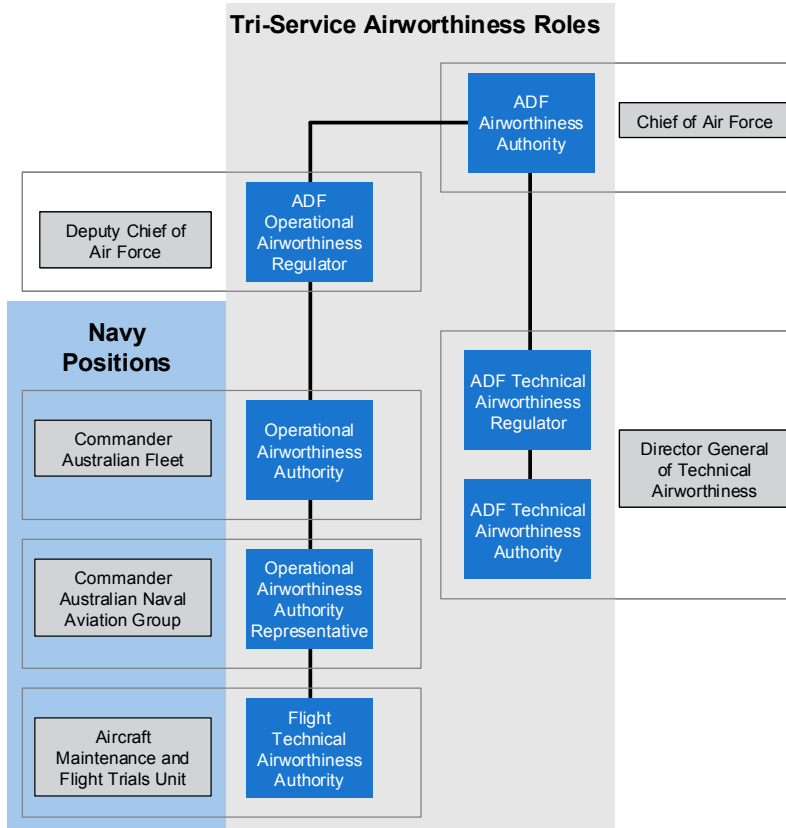
6.6 The 1998 Review of ADF Aviation Safety Management (RAASM) recommended that an ADF airworthiness structure be developed based on:

- a single ADF Airworthiness Authority;
- the development of a framework for ADF regulations to regulate operational and technical airworthiness;
- the conduct of ADF aviation activities in accordance with the new framework; and
- an independent safety and investigation body.

6.7 As a result of the RAASM, the Chief of the Defence Force appointed the Chief of Air Force as the ADF Airworthiness Authority through the Chiefs of Staff Committee in 1998.

Key roles in the airworthiness system

6.8 The ADF Airworthiness Authority is supported by a range of personnel with responsibility for performing key functions in the ADF Airworthiness Management System. Figure 6.3 depicts key airworthiness roles for Navy.

Figure 6.3**Key roles in the ADF Airworthiness Managements System for Navy**

Source: Adapted from Defence Documentation

Technical Airworthiness

6.9 The Chief of Staff Committee determination 2/98, agreed to establish a joint Technical Airworthiness Agency with the Director General of Technical Airworthiness (DGTA) as the head. DGTA's title when regulating technical airworthiness is the Technical Airworthiness Regulator. Defence Instruction (General) OPS 02-2 requires the ADF Technical Airworthiness Regulator to maintain a procedural framework for the technical aspects of continuing airworthiness management, design, maintenance and quality assurance regulation, together with a robust systemic approach to risk management. The Technical Airworthiness Regulator is responsible for the provision of advice in the form of 'Technical Airworthiness Regulator Recommendations' to the ADF Airworthiness Authority concerning the technical airworthiness of ADF State Aircraft. DGTA is also the delegated Technical Airworthiness Authority for

determining technical suitability of all State aircraft and aircraft related support equipment.

Operational Airworthiness

6.10 The Operational Airworthiness Regulator is responsible for the development of a regulatory framework for operational airworthiness management. In 1999, the Chief of the Defence Force appointed the Deputy Chief of Air Force as the Operational Airworthiness Regulator.

6.11 Within the regulatory framework established by the ADF Operational Airworthiness Regulator, an Operational Airworthiness Authority is responsible for all aircraft types under their management. Operational Airworthiness Authorities are responsible for the provision of advice in the form of Operational Airworthiness Authority recommendations to the ADF Airworthiness Authority concerning the operational airworthiness of ADF State aircraft. The Commander Australian Fleet is the designated Operational Airworthiness Authority for the Navy.

6.12 Operational Airworthiness Authority's may delegate operational airworthiness management duties and/or responsibilities for specific aviation systems to Operational Airworthiness Authority Representatives. The Operational Airworthiness Authority Representative for the Super Seasprite was CANAG, who is located at HMAS Albatross.

Airworthiness Coordination

6.13 The Director Airworthiness Coordination and Policy Agency (DACPA) is responsible to the ADF Airworthiness Authority, through the Operational Airworthiness Regulator and the Technical Airworthiness Regulator, for coordination of ADF airworthiness policy development and monitoring of ADF compliance.¹³⁵ DACPA performs a secretariat role for ADF Airworthiness Boards, the Operational Airworthiness Review Policy Committee and the ADF Aviation Safety Management Committee.

Airworthiness Review

6.14 The role of the Airworthiness Board is to examine the airworthiness of each ADF aircraft type, operating as a State Aircraft, in accordance with

¹³⁵ The ADF operates aircraft that are either registered on the Australian Register (Australian Aircraft) or State Register (State Aircraft). The State Register is the register of aircraft operated by the Commonwealth for military use. The Director of the Airworthiness Coordination and Policy Agency is the custodian of the State Register under the authority of the ADF Airworthiness Authority.

Defence Instruction (General) OPS 02-2. An Airworthiness Board is co-chaired by two reserve officers of at least one star rank, directly appointed by the ADF Airworthiness Authority. As both operational and technical aspects are reviewed, Board members are selected that have appropriate operations and engineering backgrounds. The Airworthiness Board is assisted by invited advisers.¹³⁶

6.15 The Board members do not generally have detailed specialist knowledge of the aircraft system they are reviewing. The effectiveness of the review process and the resulting conclusion depend upon the quality of the submissions provided by airworthiness authorities and managers responsible for the aircraft type. The review by a Board is based on two elements, a detailed written submission and an oral presentation.

6.16 Prior to an Airworthiness Board convening, both the Technical Airworthiness Authority and the Operational Airworthiness Authority provide recommendations for the award of a Type Certificate to the ADF Airworthiness Authority. These recommendations are based on their regulatory requirements being met. The Airworthiness Board consideration of whether to recommend to the ADF Airworthiness Authority the issue of a Service Release includes the review of technical, operational and logistics activities conducted by, and for, the relevant DMO Project Office.

6.17 Prior to initial type certification of an aircraft type, an Airworthiness Board considers both operational and technical requirements, and then reports their findings to the ADF Airworthiness Authority. The Airworthiness Board also conducts periodic reviews of each aircraft type. A successful periodic review results in the continuation of the Service Release.

6.18 The Airworthiness Authority may establish an Airworthiness Board to review the airworthiness of any aircraft type should circumstances arise that cast doubt on the validity of a particular certification. Such circumstances may arise from evidence pertaining to aircraft accidents or on the advice of the Operational Airworthiness Authority, Operational Airworthiness Regulator or Technical Airworthiness Regulator.

¹³⁶ For this Project these included the DGTA, the Operational Airworthiness Authority Representative, AMAFTU, Director of Flying Safety, Personnel from 805 Squadron, Personnel from the Naval Aviation Group, Personnel from the Project Office and the Commander 16 Brigade (Aviation).

Contractual certification requirements

6.19 Up until 1998, Navy's airworthiness policy was derived from Royal Navy processes as reflected in AP (RAN) 10 - Policy for Certification and Acceptance of New Aircraft and Major Aircraft Modifications. The version of AP (RAN) 10 provided to the ANAO was issued by the Chief of Naval Staff in November 1979. A 2001 DGTA presentation advised that AP (RAN) 10 had not been amended in 21 years. A 2001 DGTA comparison of the difference between AP (RAN) 10 and the Technical Airworthiness Management Manual (TAMM) indicated that the supporting processes detailed within AP (RAN) 10 were not in place and there was no regulatory body to ensure compliance .

6.20 In 1998, the Navy adopted the Tri-Service Airworthiness System that emerged from the RAASM. The contract for the acquisition of the Super Seasprite, having been signed in June 1997, set out AP (RAN) 10 as the certification process applying to the aircraft. Defence subsequently decided, primarily for commercial reasons, that the Prime Contract would not be amended to reflect the revised ADF airworthiness arrangements. The justification presented for this was that, in 1999, the Prime Contractor was already demonstrating that it was under cost pressures in delivery against the Prime Contract. Essentially, the Project was already encountering difficulties. Defence records indicate that Defence considered that the Prime Contractor would take advantage of any opportunity to renegotiate the contract price.

6.21 This created a disparity between the Airworthiness Requirements the Prime Contractor was contracted to meet, and what was required to allow Navy to operate the aircraft following acceptance. To address this disparity, Defence planned to conduct a modest test and verification program between contractual acceptance and type certification.

6.22 In April 1998, DGTA advised the Project Office that a transition strategy would be required to bridge any differences between the acceptance philosophies of Navy and the new Tri-Service System; address activity already completed by Navy; and balance workloads against resources being transferred to DGTA. In October 1999, a Management Audit Branch audit report noted that changes made to the Super Seasprite from its previous configuration had reduced Defence's ability to rely upon previous certification by the US Navy. The audit found that the aircraft certification process might be protracted because of the need to revalidate the certification baseline. The audit report recommended that this issue should be addressed in the Project Transition Plan as a matter of urgency.

6.23 In July 2001, the Project Design Acceptance Strategy for the Super Seasprite was endorsed by DGTA. By this time, the Preliminary Design Review and Critical Design Review had already occurred in 1998 and 1999 respectively under the pre-existing certification process (AP (RAN) 10/DEFSTAN970). In September 2008, Defence advised the ANAO that:

The Project Design Acceptance Strategy derived from a new certification regime, existed outside the contract and addressed the changes from the (USN) certification basis. In doing so it recognised the additional effort that would be required to certify the system to a different (non-contracted) standard and therefore catered for any differences between the system extant at PDR/CDR [Preliminary Design Review/Critical Design Review] and that under which the aircraft would be subsequently managed.

6.24 The Type Certification Plan that was approved by DGTA in September 2001 contained the following statement:

Due to the time span of the Project, and the flux in the regulatory environment (from DAVENG-N to DGTA-ADF), there has been substantial change in the orders and instructions applicable to certification. AP (RAN) 10 was the certification policy document applicable at the time of Contract award, however the aircraft must now be certified by an ADF Airworthiness Board under the requirements of AAP 7001.048 ADF Airworthiness Manual. The contractor was tasked with conducting design verification and design certification, but not with conducting an airworthiness process for the SH-2G(A) [the Super Seasprite]. Thus, responsibility falls to the Commonwealth to achieve this, and the Project Office to manage. Consequently some tailoring of current orders and instructions is required, within the constraints of the original Contract, to produce an acceptable position to both the Project Office and the ADF Airworthiness Authority.

6.25 In December 2004, when the formal airworthiness review of the Super Seasprite for the issue of a type certificate took place, a number of issues associated with the robustness and validity of software, flight deck interface, anthropometrics restrictions, control margins and certain flight control failure modes had been identified. These issues contributed to a significant increase in the flight testing and reporting required in support of the formal airworthiness review of the Interim Training Helicopter configuration.

6.26 In April 2005, the ADF Airworthiness Authority wrote to the CEO of DMO regarding the linking of contract milestone payments to Airworthiness Instruments for other acquisition projects. This Minute outlined difficulties surrounding close linkages between the contract milestones and certification arrangements. The Minute stated as follows:

For recent major acquisitions, including the LIF [Lead-in Fighter], CL604 [VIP Transport], B737 [Airborne Early Warning and Control Aircraft] and ARH [Armed Reconnaissance Helicopter] significant milestone payments have been linked solely to the achievement of Airworthiness Instruments. The Airworthiness Board Members have advised me that, in some cases, DMO has placed significant pressure on airworthiness delegates and the board itself to make positive recommendations for a broad scope of operations to support acceptance of the delivered capability and achieved industry objectives. This potentially undermines the airworthiness process which is aimed at achieving operational capability with an acceptable level of risk.

I fully understand that incentive payments for contractors to achieve airworthiness requirements is necessary. However, to ensure that the ADF are delivered capabilities that meet requirements without compromising safety, I request that you ensure that significant milestone payments are not solely linked to issue of Airworthiness Instruments.

6.27 While no Super Seasprite contract milestone payments were directly linked to either the achievement of Airworthiness Instruments or achieving airworthiness requirements, it is apparent given the ADF Airworthiness Authority's comments to the CEO of DMO (set out in paragraph 6.26) that even for projects where these linkages do exist certification activities can encounter difficulties . As aircraft certification is a key requirement in delivering airborne capabilities to the ADF, achieving an appropriate balance between contractual and certification requirements is essential to conducting a successful procurement.

Recommendation No.5

6.28 The ANAO recommends that DMO, in conjunction with the airworthiness authorities and preferred tenderers, develop appropriate plans for certification of airborne capabilities being acquired for the ADF and ensure that processes required to achieve certification are clearly established in the relevant acquisition and sustainment contracts.

Defence response

6.29 Defence agreed to the recommendation and stated as follows:

Existing Defence contracting templates provide for detailed verification and validation plans.

Special Flight Permit awarded and renewed

6.30 A Special Flight Permit is required to enable Defence to operate an ADF aircraft that does not have a valid Service Release, or an ADF aircraft that has been modified beyond its certification basis. When a Special Flight Permit was issued for the Super Seasprite on 30 October 2003 the conduct of an independent review by the ADF Airworthiness Board was not required as a precursor to this occurring. In contrast, the award of a Type Certificate or Supplemental Type Certificate and Service Release does require such a review.

6.31 In order to have an aircraft issued with a Special Flight Permit, relevant areas within Defence need to be convinced that outstanding airworthiness matters will not adversely affect the airworthiness of the aircraft, within the limits established for the scope of activities sought under the Special Flight Permit. The processes for issuing a Special Flight Permit are set out in the ADF Airworthiness Manual, the Technical Airworthiness Management Manual and the Technical Airworthiness Regulations.

6.32 The ADF Airworthiness Authority signed the Special Flight Permit for the Super Seasprite on 30 October 2003. The Special Flight Permit set out the operating conditions for the aircraft which were split into four phases including train-the-testers, certification and test evaluation, train-the-trainers and operational test and evaluation. Each phase set out an intended operation and entry criteria. Within five days of the Special Flight Permit being issued, the Director of the Naval Aviation Project Office wrote to the Operational Airworthiness Authority Representative indicating that a number of Special Flight Permit entry criteria for First of Class Flight Trials under Phase 2 would not be applied. Two of these related to the Integrated Data Acquisition System, for which Design Acceptance and Design Approval requirements were yet to be satisfied. The other entry criteria which would not be applied related to certification and contractor operational test and evaluation task plans, for which related operations were not authorised.

6.33 The Special Flight Permit for the Super Seasprite also required an airworthiness verification to be applied to each aircraft as they were provisionally accepted. The Design Acceptance Representative was responsible for this verification, which involved endorsing an attachment to the Special Flight Permit stating that the aircraft had been inspected and was considered safe for flight in the roles and purposes stated on the Special Flight Permit. Of the nine aircraft provisionally accepted, eight received this endorsement

within a week of provisional acceptance. The remaining aircraft received endorsement just over a month after provisional acceptance.

Renewal of the Special Flight Permit

6.34 The Super Seasprite was planned to be considered by an Airworthiness Board for the award of a Type Certificate and Service Release in May 2004. In April 2004, the Project Director wrote to the Operational Airworthiness Authority and the Technical Airworthiness Authority seeking a six month extension to the Special Flight Permit, as the Project was not ready for the Airworthiness Board at that time.

6.35 On 12 June 2004, the ADF Airworthiness Authority renewed the Special Flight Permit, based on recommendations received, with an expiry date of 31 December 2004. Some three months later, acting on a directive from the ADF Airworthiness Authority, the Airworthiness Board met to ensure that adequate regulatory processes had been applied to control risk during the operation of the Seasprite as an Interim Training Helicopter under the Special Flight Permit.

6.36 A brief by DACPA to the September 2004 Airworthiness Board set out arrangements for Operational Airworthiness Regulatory oversight, and outlined the processes relating to the issue of the Special Flight Permit for the Super Seasprite. This brief identified a series of issues associated with processes surrounding the issue of the Special Flight Permit including that:

- the Special Flight Permit was not fully compliant with regulations, in that, plans detailing the 'scope of operations' had not been produced. ACPA, in consultation with DGTA regulatory staff, developed a Special Flight Permit with 'entry criteria' that required the supporting documentation to be drafted and approved by the Operational Airworthiness Authority Representative and Project Engineering Manager prior to entering each phase of flying activity; and
- formal operational airworthiness audits (by the ADF Operational Airworthiness Regulator) were yet to be established, as a result there was:
 - very limited independent review of the operational airworthiness management of the Special Flight Permit operations; and

- there was no independent review of compliance against the regulatory requirements of the ADF Airworthiness Manual and associated Defence Instruction for supporting documentation provided to the Operational Airworthiness Authority Representative.

6.37 The report on the September 2004 Airworthiness Board stated that the then CANAG had provided background to the Airworthiness Board on the Super Seasprite acquisition explaining that:

...contractual delays and political pressures had led to the complexities of a the incremental acceptance of the Interim Training Helicopter (ITH) and the Full Capability Helicopter, involving concurrent testing and training activities.

6.38 The report also indicated that the then DACPA had explained to the Airworthiness Board that:

... with significant pressure to commence flying and with insufficient detail surrounding the scope of operations provided as part of the SFP [Special Flight Permit] package, a hybrid approach to the SFP procedure was taken.

6.39 In relation to certification, the brief by DACPA to the Board identified the following issues:

- the legacy approach to certification based on AP (RAN) 10;
- the lack of detailed analysis and independent assessment by ACPA of regulatory compliance with the Special Flight Permit, particularly with regard to the scope of operations;
- problems with the management of airworthiness Issue Papers, which are the prime means by which outstanding issues and deficiencies are resolved, with communication with DGTa being a particular problem;¹³⁷
- concerns surrounding unreliable settings on altimeter and cyclic control and limits due to the anthropometric restrictions in the cockpit;
- an AFCS failure during a training sequence that highlighted concerns about the Original Equipment Manufacturer's certification baseline and accompanying data; and

¹³⁷ In September 2008, Defence advised the ANAO that improved guidance on the management of Issue Papers was produced and is contained in the current version of the ADF Airworthiness Manual.

- concern surrounding data provided by the Original Equipment Manufacturer for autorotations (see Figure 6.4).

Figure 6.4

Case study - inaccurate autorotation data

Autorotations are used to perform power off landings from altitude. An autorotation is used when the engine fails, or when a tail rotor failure requires the pilot to effectively shut down the engine. To enter the autorotation, the pilot lowers the collective¹³⁸ all the way down, simultaneously adding right pedal. Lowering the collective maintains rotor RPM during the entry to autorotation, and keeps the angle of attack at a normal value during the glide. As the air starts flowing up through the rotor system, the RPM will start to increase, and depending on how the helicopter is rigged, the RPM may get too high.

In July 2004, Officer-in-Charge AMAFTU contacted the Commanding Officer 805 Squadron identifying concern around the autorotation performance of the Super Seasprite and, in a subsequent e-mail, recommended that flying of the Super Seasprite be suspended. While the Commanding Officer 805 Squadron did not support the suspension of flying, on the basis that dual engine failure or loss of tail rotor thrust was improbable, he did acknowledge concerns within the Squadron surrounding the validity of autorotation charts.

In September 2004, the Project Office wrote to the Prime Contractor providing baseline data collected by AMAFTU to assist in the resolution of the autorotation issue. An Issue Paper regarding the autorotation issue was forwarded to DGTA by the Project Office in October 2004. That Issue Paper indicated that three sorties flown in the aircraft, with weight ranges of between 12 100 pounds and 13 500 pounds, produced inconsistent results to those set out in the Aircraft Flight Manual. The Issue Paper indicated that a Temporary Flying Order provided an interim procedure to be applied until such time as the issue was resolved. The Project Office considered that the Temporary Flying Order was appropriate in the short term and the Prime Contractor should determine the veracity of the autorotation data in the Aircraft Flight Manual and, where appropriate, issue amendments and revise maintenance test flight procedures.

In October 2005, the Project Office wrote to DGTA indicating that the Prime Contractor had provided amended procedures that needed to be verified by AMAFTU. In December 2007, DMO indicated in a letter to the Prime Contractor that the changed procedures were to be tested by AMAFTU but that this would not occur until the aircraft had returned to flight. This testing did not occur prior to the Project being cancelled.

Source: Defence Documentation

Conclusion reached by the September 2004 Airworthiness Board

6.40 In September 2004, the Airworthiness Board submitted a report to the ADF Airworthiness Authority on the outcome of its review of the Special Flight Permit. As noted in paragraph 6.35, the specific purpose of the Airworthiness Boards' review was to ensure that adequate regulatory processes had been applied to control risk during the operation of the Seasprite as an Interim Training Helicopter under the Special Flight Permit. The Board

¹³⁸ The collective lever, which pilots manipulate with their left hand, alters the pitch of all the main rotor blades by the same amount at the same time. Pulling the collective lever up increases the pitch and the helicopter ascends, lowering the collective lever reduces the pitch and the helicopter descends.

concluded that there had been an adequate degree of regulation applied to the airworthiness management of the Super Seasprite. The Board acknowledged pressures associated with the Project, but did not consider that airworthiness had been compromised, although there were a number of issues that needed to be resolved. The Board considered that reasonable progress had been made towards the achievement of type certification and indicated that operations under the Special Flight Permit should not be prolonged. In September 2008, Defence advised the ANAO that:

Over the period covering the initial award of the SFP [Special Flight Permit], the subsequent review of the SFP and the award of an AMTC/SR [Australian Military Type Certificate/Service Release], the AAP 7001.048 – ADF Airworthiness Manual was operative. That version of the publication made it clear that an SFP offered a lower level of rigour and oversight for both initial award and ongoing operation compared with an AMTC/SR. Over time, Defence's view has matured and the current version of the ADF Airworthiness Manual reflects this matured thinking. Indeed, the rigour applied today for award of an SFP, particularly for a new capability or major design change to an existing capability, is at least as rigorous as award of an AMTC/SR. In particular, such an SFP will require the convening of an AwB [Airworthiness Board] and it will require AwB review at least annually. The management of the SFP for the Multi Role Helicopter project is a current example of the rigour applied under the existing regulations. An understanding of the limitations of the SFP process at the time it was awarded for Seasprite in October 2003 is vital, in that it puts into context the AwB desire to recommend the award of an AMTC/SR.

Type Certificate awarded

6.41 A November 2004 brief prepared by the Director of Aircraft Engineering for the DGTA noted that the Super Seasprite did not comply with the entirety of the Certification Basis Description for the aircraft, but that Issue Papers had been raised against all known airworthiness non-compliances. At the time, a further 11 Issue Papers were in the process of being raised. The brief indicated that DGTA staff were confident that adequate and appropriate resources had been applied to the compliance finding process. The brief to the DGTA also noted that the requirements and specifications in the Prime Contract were endorsed by the Chief Naval Engineer rather than DGTA and that the Technical Airworthiness Regulator did not have oversight of early project engineering activities

6.42 Both this brief to DGTA and the Technical Airworthiness Regulator recommendation to the Airworthiness Board for the issue of a Type Certificate in December 2004 noted that the Super Seasprite had numerous technical issues, including:

- a legacy design which did not comply with modern airworthiness standards such as crashworthiness and the potential for single point failures in the hydraulic and electrical systems;
- the aircraft had been substantially modified to unique airworthiness design requirements, with the Integrated Weapon System and Composite Main Rotor Blades provided as significant examples;
- it was a remanufactured aircraft and there was no DGTA oversight of decisions made during the restoration process; and
- significant aircraft weight growth had occurred with the aircraft regarded as being close to its limits in terms of structural design in the area of flight envelope and performance (See paragraph 8.35).

6.43 The Technical Airworthiness Regulator recommendation for the award of the Type Certificate noted that the Certification Basis Description involved a hybrid approach of accepting Kaman Engineering Standards as legacy specifications, and assessing significant modifications against internationally recognised standards such as US Federal Aviation Regulation 29 (FAR 29).¹³⁹ FAR 29.1 prescribes the airworthiness standards for the issue of Type Certificates for transport category rotorcraft. Compliance findings to demonstrate equivalence against selected elements of standards such as FAR 29 were conducted within DMO, as the requirement for compliance was not imposed through the Prime Contract.

Airworthiness Board notes certification risks

6.44 The Airworthiness Board met on 8 December 2004 to consider recommending the award of a Type Certificate and Service Release for the Super Seasprite. The Airworthiness Board was informed by CANAG that Navy had a clear understanding of the complexities involved in introducing the Super Seasprite into service, and CANAG expressed confidence that Navy

¹³⁹ The Prime Contract required the Prime Contractor to provide an assessment of compliance against DEFSTAN-970 (UK) certification basis not FAR 29, which was also in effect at contract signature. DEFSTAN-970 underpinned APR (RAN) 10.

had a suitable framework for the management of the Super Seasprite. The report issued by the Airworthiness Board recommending the award of a Type Certificate noted a range of issues associated with aircraft certification, including:

- (a) certification of the various aspects of the aircraft had occurred against a variety of standards;
- (b) given the legacy nature of much of the design, the Board accepted that it was appropriate for the certification standards to be applied in a grandfather manner; and
- (c) because of the extended duration of the acquisition process and the inherent legacy systems designs it was considered that the Super Seasprite would, to some extent, always possess lower airworthiness standards when compared with contemporary airworthiness practice.

6.45 The report of the Board stated that current rigorous operational airworthiness management practices such as improved regulation, training operations and procedures, could mitigate the design deficiencies to some extent, but that the level of aviation risk for the Super Seasprite would be higher than aviation platforms that meet contemporary design standards. Consequently, risk could not be completely mitigated to the extent desired by the Operational Airworthiness Authority Representative and, moreover, redesign might not be practicable in some cases.

ACPA concerns surrounding certification

6.46 In mid December 2004, following the Airworthiness Board's meeting, ACPA wrote to the ADF Airworthiness Authority highlighting issues surrounding the certification of the Super Seasprite. The Minute indicated that the determination of airworthiness for the Super Seasprite had been considerably more difficult than for other aircraft. While each airworthiness delegate on the Airworthiness Board provided recommendations for the issue of a Type Certificate, all recommendations contained caveats.

6.47 ACPA attributed difficulties in producing documentary evidence required to support certification to a lack of Navy personnel experienced in supporting the introduction of a new aviation capability. In late January 2005, DMO and CANAG responded to the ACPA Minute by writing to the Deputy Chief of Air Force. The response stated that experience levels in DMO and Navy were adequate to certify and introduce the Super Seasprite into service. As noted in Chapter 1 (paragraphs 1.16 to 1.22), the Project Office experienced

ongoing difficulties in attracting and retaining appropriately qualified and experienced personnel which was acknowledged as impacting on certification activities.

6.48 The DMO/Navy Minute to the Deputy Chief of Air Force indicated that the real hurdles facing the final release of the aircraft into operational service release were due to certifying an aircraft design that in some cases went as far back as the 1960s in an airworthiness environment introduced post contract signature which is still maturing. As outlined in paragraph 6.20, Defence made a conscious decision in 1999 not to amend the Prime Contract to reflect changes in the certification arrangements, thereby accepting the risk and any additional workload.

Lesson No.7

The type certification process is an essential element in providing an airborne capability to the ADF. Contractual arrangements that do not adequately allocate the responsibility for achievement of type certification to the contractor can significantly increase both the risk profile of the procurement of an airborne capability, and the level of effort required to achieve type certification.

7. Systems and Software Safety

Systems and software development activities were critical elements of the Super Seasprite Project. Systems and software development testing activities are required to be undertaken in accordance with standards and to a degree of rigour relative to criticality to flight of the functions performed by the systems and software. This chapter examines the development of the AFCS within this context.

Introduction

7.1 The development and integration of systems and software is conducted according to standards to allow the aircraft to meet certification requirements. At all three Airworthiness Boards for the Super Seasprite, concerns were discussed surrounding the design of the AFCS and the approach to development. A failure condition resulting from the design of the AFCS known as an AFCS induced hard-over was a key factor in the decision by the ADF Airworthiness Authority to withdraw the Type Certificate for the Super Seasprite in May 2006 (see Chapter 9). These concerns had not been resolved when the Project was cancelled in 2008. This Chapter covers systems and software safety issues, focussing on the AFCS, as outlined in Figure 7.1.

Figure 7.1

Chapter outline

Systems and Software Safety

- System and software safety program
- Approach to certification
- AFCS induced hard-overs
- Senior level review
- Measures to improve the airworthiness of the AFCS

System and software safety program

7.2 The issue of ITAS and the AFCS system safety was an area of ongoing correspondence between the Project Office and the DGTA. In July 1998, DGTA personnel wrote to the Project Office identifying that the ITAS performed a number of safety critical functions, such as the control and display of positional, altitude and attitude data. The Minute advised that a level of scrutiny, similar to that applied to the Prime Contractor, should be applied to system safety program and development processes of the sub-contractors developing the ITAS. The Minute commented that the Hazard Log did not seem to identify many possible hazards that might exist in a complex military aircraft such as the Super Seasprite.

7.3 In August 1998, the Project Office requested that DGTA review Software Test Plans that had been provided as contract deliverables for the ITAS and the AFCS. DGTA staff noted that these Software Test Plans did not provide any indication that the Prime Contractor intended to perform any high level assurance activities normally required for aircraft. DGTA documentation indicated that testing of safety critical requirements was intended to:

- confirm that specified requirements have been satisfied; and
- demonstrate, with a high degree of confidence, that errors which could lead to unacceptable failure conditions, as determined by the system safety assessment process, have been removed.

7.4 In September 1998, DGTA staff provided comments on the ITAS Software Development Plan and expressed the expectation that all safety critical elements should have been identified during the recently conducted software Preliminary Design Review. In early 1999, a report prepared by the Navy's Deputy Director Maritime Aviation noted that the most significant shortfall in the software Critical Design Review, which was conducted after the Preliminary Design Review, was the lack of safety analysis in the Computer Software Configuration Item designs presented. That Critical Design Review focused on ITAS Build 1,¹⁴⁰ although it was noted that the nature of the systems architecture of the ITAS did not allow for Build 1 to be considered in isolation from later ITAS Builds. The Critical Design Reviews for the remaining Builds did not occur for several years.

¹⁴⁰ The ITAS was planned to be developed in stages referred to as 'Builds'. See Table 4.1 for a description of what was included in the various Builds of the ITAS.

Certification standards

7.5 A Minute from the System Configuration and Integrity Section within DGTA to the Director of the Project in September 1998 outlined that the AFCS and the ITAS sub-systems may implement a number of safety critical functions. The Minute outlined that failure by either of these systems to perform these functions would have a catastrophic effect.

7.6 This Minute indicated that the Prime Contractor appeared to have implemented a MIL-STD-882C¹⁴¹ safety program as required by the Prime Contract, and that while MIL-STD-882C includes the provision for addition of specific requirements for the development and testing of safety related systems, it did not provide content as to requirements for safety related systems. The Minute noted that the commercial aviation standard RTCA DO-178B set out requirements for designing and testing safety related systems software, and that this standard was the Technical Airworthiness Authority's preferred method for developing safety related software. This standard was extant at the time the Prime Contract was signed but the Prime Contract did not require its application. Figure 7.2 discusses a US Federal Aviation Administration (FAA) Advisory Circular issued in late 1993 on the application of RTCA DO-178B to aircraft certification.

Figure 7.2

FAA Advisory Circular on RTCA DO-178B

FAA Advisory Circular 20-115 dated 1 November 1993 called attention to RTCA DO-178B – Software Considerations in Airborne Systems, which was issued in December 1992. The Advisory Circular identified related Federal Aviation Regulations including FAR 29, which prescribes the certification process for rotorcraft.

RTCA DO-178B was developed to establish software considerations for developers, installers and users when the aircraft equipment design is implemented using microcomputer techniques. The Advisory Circular stated that it was expected that current and future avionics design will make extensive use of this technology. The RTCA document outlined verification, validation, documentation and software configuration management and quality assurance to be used in microcomputer systems.

The Advisory Circular indicated that an applicant for Type Certificate or a supplemental Type Certificate for any electronic equipment or system employing digital computer technology may use the considerations outlined in RTCA DO-178B as a means, but not the only means, to secure FAA approval of digital computer software.

Source: FAA Advisory Circular AC No, 20-115B 1/11/93

¹⁴¹ MIL-STD-882C is a US Military Standard.

7.7 In March 2000, an internal DGTA Minute outlined a series of concerns in relation to safety compliance of the Super Seasprite. This Minute stated that the specifications of the Super Seasprite required software development to be in accordance with US Military Standards, MIL-STD-498 and MIL-STD-882C. Neither of these standards was assessed as definitively addressing software for high integrity systems.¹⁴² The DGTA Minute outlined three main areas concern being:

- lack of confidence in the Project Office oversight and carriage of software certification issues;
- lack of correlation with internationally recognised standards; and
- lack of confidence in development processes.

7.8 The Minute concluded that without adequate resolution of these concerns, achieving a recommendation for the award of a Type Certificate may not be assured. The Minute further stated that serious concerns existed surrounding the Project Office's capacity to undertake software design acceptance for the ITAS and AFCS. This matter was regarded as a particular concern because System Configuration and Integrity assumed that the software included high integrity software components, where failure might result in loss of the aircraft. Subsequent to this Minute, DGTA wrote to the Director NAPO in April 2000 recommending that:

- NAPO acquire the services of a competent software engineering organisation to assess the adequacy of software safety related development documents, with adequacy assessed against RTCA DO 178B – Software Considerations in Airborne Systems as a benchmark or a standard nominated by the Prime Contractor and endorsed by DGTA.
- following this review, the Project Office should incorporate a compliance finding plan into the certification plan for DGTA endorsement, with the development and endorsement of this plan being critical to receiving a Technical Airworthiness Regulator recommendation for Type Certificate; and

¹⁴² High integrity systems in this context relates to software intensive systems where failure can result in loss of aircraft.

- the Project Office should retain the services of the competent engineering organisation to provide guidance on making software compliance findings, or where the Project Office did not have competency to make the compliance finding, to make these assessments.

7.9 A September 2000 e-mail within DGTA compared the software certification processes for the Super Seasprite to processes for the C130J Hercules and the Lead-In-Fighter. Both the C130J Hercules and the Lead-In-Fighter Projects were regarded as having good safety standards and competent personnel or service providers performing key roles. The Super Seasprite was regarded as having few of the advantages of these Projects¹⁴³. In mid 2000 an external service provider was engaged to assist the Project Office in evaluating safety related software aspects of the Project. While the external service provider retained to assist in assessing software development was regarded as being competent by DGTA personnel, there were ongoing concerns surrounding the capacity of the Project Office to oversight software development activities.

Senior level briefings

7.10 In March 2001, the then Under Secretary Defence Materiel was provided with a brief on the issue of software safety by the Director of the Project Office. The brief outlined a number of issues with the AFCS Flight Control Computer that needed to be resolved. A remedial plan was to identify actions required to achieve an AFCS product that was capable of being accepted as airworthy. The brief indicated that the requirements set out in the Prime Contract did not align with DGTA's preferred certification basis. The contract DMO had entered into with an external service provider was intended

¹⁴³ In May 2009, an engineer employed in the Project Office between 1998 and 2002 advised the ANAO as follows:

The staffing resources available to the project were also limited as was the project's ability to engage ESPs [external service providers]. DGTA compared NAPO's ability to undertake certification activities with several other RAAF projects but much greater resources were available to those RAAF projects for a similar (or less) technical complexity system than the Super Seasprite. A later change on project directorship started to ease these limitations, but staffing level limits and limited ability to engage ESPs left this project much less resourced than similar RAAF projects. From mid 2001 onwards this was further aggravated by the move of NAPO from Canberra to Nowra with several key staff not moving and recruitment of suitable senior engineers difficult in the Nowra area.

to provide both an assessment and advice on achieving a product that would achieve a similar level of software safety assurance to RTCA DO-178B. The March 2001 brief advised that:

There is a risk, that the contractual requirements and the prime contractor's co-operation may not be enough to provide a product capable of meeting DGTA's requirements. This should be known in the next few months. If we are unable to achieve a compliant product under the existing contract, we will be forced to either request an ECP [Engineering Change Proposal] from Kaman for the additional work to provide an acceptable product (potentially \$1 million to \$2 million).¹⁴⁴ The only alternative option was to impose operational constraints on the SH-2G(A), which would be unacceptable to RAN.

7.11 A summary of the contractual deliverables relating to the AFCS safety drawn from DMO documentation is included at Figure 7.3. The Figure illustrates that the underlying philosophy applied in developing the AFCS was known at the time of contract signature.

¹⁴⁴ It is not clear how the \$1 million to \$2 million figure was calculated. Documentation surrounding the 2007 decision to continue with the Project suggested that, at that time, the amount required to address this issue was estimated at around \$50 million.

Figure 7.3**AFCS systems and software development arrangements in the Prime Contract**

The design of the AFCS for the Super Seasprite was based on the legacy simplex (single channel) flight control system of the earlier version of the helicopter. Although the Super Seasprite AFCS incorporated a digital computer, in lieu of an analogue system, it retained the underlying design “philosophy” that the pilot would recover the aircraft.¹⁴⁵ Under the Prime Contract Statement of Work, the Prime Contractor was required to prepare, maintain, update and conduct work in accordance with the System Safety Program Plan. The Systems Engineering Management Plan, which is an attachment to the Prime Contract, states that the System Safety Program Plan will be based on US Military Standard MIL-STD-882C.

MIL-STD-882C sets out generic requirements for the software development and system safety processes. The standard sets out the way a Software Risk Index is allocated to software requiring both consideration of potential hazard severity and the degree of control that the software exercises over the hardware. The System Safety Program Plan also required the Prime Contractor to produce a Safety Assessment Report. DMO documentation indicated that the Safety Assessment Report included the following statements:

- The AFCS was designed to allow the operator to intervene and take control at the Pilot’s discretion. All potentially catastrophic and critical failures can be averted by operator interventions. All hazards within the AFCS can be averted by operator intervention. All hazards identified within the AFCS can be mitigated to a safe condition by operator intervention; and
- The pilot/observer was considered the independent safety system and has time to intervene.

There are five Software Hazard Risk Indices set out in MIL-STD-882C with five being low risk and one being high risk. Based on this philosophy the contractor assigned a Software Hazard Risk Index of Two to the AFCS. Allocation of Software Hazard Risk is based on a matrix of control category and hazard category, with software exercising higher degrees of control and assessed as having more extreme consequences attracting lower Software Hazard Risk Indexes. This index is used to guide the approach to development and the degree of software testing, with software that has a high Hazard Risk Index requiring a high level of rigour in both these areas.

Source: DMO documentation.

7.12 The ANAO notes that another brief to the then Under Secretary Defence Materiel, dated six days earlier than the brief discussed in paragraph 7.10, recommended the phased acceptance of the aircraft but did not raise the AFCS safety concerns. The brief did refer to Build 3 ITAS, where the ITAS and the AFCS were to be integrated, but was silent on whether resolution of safety issues for the AFCS would impact on the delivery of the Super Seasprite capability.

¹⁴⁵ This philosophy is referred to as ‘pilot-in-the-loop’. Defence advised the ANAO that pilot-in-the-loop is not in itself an un-airworthy proposition.

Disparity between contracted standards and certification standards

7.13 In August 2001, the Director of Aircraft Engineering within DGTA wrote to the Director of the Project Office. This Minute was drafted following receipt of the report on the Prime Contractor's software and system safety programs prepared by an external service provider engaged by DMO. The report contained a number of findings and recommendations in relation to the AFCS. The Director of Aircraft Engineering prioritised these recommendations and stated that their implementation was the minimum action required to support a Technical Airworthiness Regulator recommendation for issuance of a Special Flight Permit and Type Certificate. The Director of the Project Office subsequently wrote to the Prime Contractor on 16 August 2001, indicating that the Provisional Acceptance of the aircraft was conditional on these recommendations being addressed.

7.14 The Prime Contractor responded to this letter in October 2001, asserting that the System Safety Program had been conducted in accordance with contractual requirements. The Prime Contractor noted that DMO's external service provider had stated that there was no attempt to determine the extent to which the Prime Contractor had fulfilled any contractual obligation. The Prime Contractor indicated that most of the tasks and/or requirements were not specified in the Prime Contract and, as a consequence, many of the recommendations were regarded to be beyond the scope of the contract. The Prime Contractor also noted that delays totalling 15 months in DMO responding to the System Safety Hazard Analysis Report and Hazard Logs had adversely affected progress. The Prime Contractor's response to the 12 recommendations in the external service provider's report relating to the AFCS was that these recommendations had been addressed, or would be addressed through planned activities.

Approach to certification

7.15 In March 2003, the Director of the Project Office wrote to the Prime Contractor indicating that DMO had formed the view that the necessary restrictions associated with the AFCS meant that the aircraft would not meet the operational requirements under the Prime Contract. The letter advised that in order for the AFCS to meet the conditions for use under operational conditions, a higher level of safety integrity was warranted under the Prime Contract and the provisions of the System Safety Program Plan. The DMO indicated that it was not satisfied by the argument presented by the Prime Contractor in relation to Builds 1 and 2 of the AFCS. One month prior to this

letter, DMO had approved the Contract Change Proposal that introduced the concept of Provisional Acceptance of the Interim Training Helicopter into the Prime Contract.

7.16 Using information from the Prime Contractor's safety analysis,¹⁴⁶ DMO's March 2003 letter concluded that a single channel AFCS of extensive flight control capability is clearly capable of introducing hazards of severity level one (catastrophic), and therefore a Software Hazard Risk Index of One was regarded as appropriate for certain functions of the AFCS and ITAS. Given that these issues were significant to the certification of the aircraft and the delivery of the Full Capability Helicopter, it is unclear why DMO agreed to the insertion of the Provisional Acceptance arrangements for the Interim Training Helicopter into the Prime Contract in February 2003 without agreement having been achieved on the approach to resolving this issue. In March 2009, Defence informed the ANAO that:

The Prime Contractor Kaman was adamant in their resolve not to change the SRI [Software Risk Index] to 1 and the DMO had no contractual mechanism to force Kaman to change the approach.

7.17 The Director's March 2003 letter to the Prime Contractor also dealt with the ITAS. The letter stated that DMO was gravely concerned that the approach adopted for the development of the AFCS had been extended to ITAS Builds 2A, 2B and 3. The letter noted that a particular area of concern was the Tactical Navigation System, which provided guidance to the AFCS for aircraft flight path direction, and the Tactical Data Management System which was to provide safety critical data displays. The letter indicated that AFCS flight-hold and approach modes (AFCS Builds 1 and 2) and ITAS coupled navigation modes with AFCS (ITAS Build 3) exercised direct control over potentially hazardous systems and although time may be available for intervention by the pilot, the degree of control is not reduced. This letter was written some five years after the DGTA first expressed concern with respect to ITAS and AFCS development.

Special Flight Permit

7.18 In October 2003, the then Design Acceptance Representative wrote to the Technical Airworthiness Regulator seeking a recommendation for the

¹⁴⁶ CDRL 3.8.4.3 Functional Hazard Assessment of the AFCS sub-system component.

award of a Special Flight Permit. An Annex to that Minute was titled 'Accomplishments Against the Design Acceptance Strategy' and stated that the System Safety Program had considered hardware and software safety and identified hazards for the scope of flying operations to occur under the Special Flight Permit.

7.19 The Annex relied upon the findings of the external service provider DMO had engaged to undertake airworthiness compliance findings in relation to software development and systems engineering. The findings contained in the external service provider's July 2003 compliance finding report were based on contractual and derived criteria considered necessary for the independent assessment team to recommend certification.

7.20 The external service provider stated that a key component used to determine compliance was the Prime Contractor's Hazard Log but that this had not been delivered in its final form to DMO,¹⁴⁷ raising doubt as to the completeness of the evidence used in support of this compliance finding. Notwithstanding this, the external service provider's July 2003 compliance finding report indicated software system and software design activities undertaken were adequate for restricted flight under an Special Flight Permit, pending resolution of the following:

- a final Hazard Log and delineation of any changes to unofficial copies of the log provided to the external service provider;¹⁴⁸
- the implementation of a plan for specific flight restrictions identified in the report prepared by the external service provider; and
- the implementation of a plan for any other specific flight restrictions delineated in the Prime Contractor's safety CDRLs and associated documentation.¹⁴⁹

¹⁴⁷ The Technical Airworthiness Regulations require the Design Acceptance Representative to ensure that all data assessed in the making of a compliance finding is the applicable version of such data.

¹⁴⁸ The Prime Contractor asserted in late 2001 that DMO had contributed to a 15 month delay in the production of this document. See paragraph 7.14.

¹⁴⁹ The external service provider prepared a draft compliance findings report in support of type certification in April 2004. This report recommended type certification be awarded to the Interim Training Helicopter pending delivery of the final Hazard Log for the Interim Training Helicopter; delivery of updated Integrated Logistics Support documentation associated with the Hazard Log; the implementation of a plan regarding the resolution of the flight test deficiencies; and the implementation of a plan for the incorporation of specific flight restrictions identified in the report.

7.21 In the Annex to the Design Acceptance Representative Minute referred to in paragraph 7.18, it was stated that the safety documentation provided a clear assessment of risk associated with ITAS and AFCS operation. The ANAO notes that the July 2003 Compliance Finding Report prepared by the external service provider contained no such statement.

7.22 The Compliance Finding Report contained a case study for the AFCS. The case study focused on the validity of the risk assessment for AFCS software, in particular, the Flight Control Computer interface with systems internal and external to the AFCS that could introduce failures and instability. The conclusion of that case study stated the following in respect to the Software Hazard Risk Index:

The Software Hazard Risk Index assignment of 2 is being accepted because of contractor customer acceptance of this risk assignment in the past. Because the software development activities have progressed at great lengths based on the original risk assessment, and unless a tangible deficiency can be brought to the spotlight, it must be acceptable.

7.23 It is clear, based on the above statement that the external service provider had formed the view that software development had progressed too far to increase the Software Hazard Risk Index. The ANAO notes that this report was dated some four months after the March 2003 letter from the Project Office to the Prime Contractor asserting that the Software Hazard Risk Index assignment of Two was not acceptable and that Software Hazard Risk Index of One was required (see paragraph 7.16). On 16 October 2003, DGTA recommended that a Special Flight Permit be awarded to the Super Seasprite subject to certain limitations. In respect to AFCS Safety, the DGTA Minute which recommended the award of the Special Flight Permit stated as follows:

The AFCS has been designed as a 'hands on' autopilot, where pilot intervention is the primary mitigation for AFCS failure. As yet the ability of the Pilot to maintain safety in the event of an AFCS failure has not been fully assessed, tested and demonstrated in high pilot workload regimes such as low level operations and IMC [Instrument Meteorological Conditions]. To mitigate these risks, the following limitation on AFCS flight, as proposed in the Special Flight Permit, is endorsed until testing has been endorsed to the Operational Airworthiness Authority's satisfaction:

- Coupled flight (auto approach, auto hover, and auto depart) below 500 feet is prohibited.
- Coupled flight (auto approach, auto hover, and auto depart) in IMC and night VMC conditions is prohibited.

Type certification

7.24 An external service provider prepared a draft Compliance Finding Report dated April 2004 in support of type certification of the Super Seasprite. This report contained the same case study on the AFCS as included in the July 2003 Compliance Finding Report. The body of this report indicated that the main flaw was the single channel design of the AFCS, which resulted in a lack of in-range data error detection.¹⁵⁰ The report indicated that this deficiency was mitigated, to an unknown degree, by the situational awareness of the pilot.

7.25 A DMO Compliance Finding Report on the Integrated Weapon System was dated three days after the ADF Airworthiness Authority renewed the Special Flight Permit in June 2004. This report was based on the certification baseline described in the Interim Training Helicopter Certification Basis Description. The baseline was developed from the following source references:

- (a) the US Federal Aviation Regulation Part 29 (FAR 29) for the Certification of Transport Category Rotorcraft;
- (b) detailed specifications for the Super Seasprite helicopter - Kaman Engineering Standard (KES) 4000 Revision C, dated 4 October 2002, applicable to the Interim Training Helicopter configuration; and
- (c) Super Seasprite Prime Item Development Specification for the Integrated Weapon System - KES 4002 Revision C, dated 8 October 2002, applicable to the Interim Training Helicopter configuration.

7.26 That report made a number of compliance finding recommendations against the various sub-systems of the Integrated Weapon System. The non-compliant areas are summarised in Table 7.1.

¹⁵⁰ In September 2008, Defence advised the ANAO that this was a failure of system engineering not the system itself.

Table 7.1**Summary of the findings of 2004 Compliance Finding Report for the Integrated Weapon System**

Sub-system	Area of non-compliance
Displays	FAR 29 and KES 4002
Mission display and controls	FAR 29
Primary ITAS hardware	FAR 29
Associated ITAS hardware	FAR 29
Flight Reference Instruments	FAR 29
AFCS	FAR 29
Caution advisory and warning system	FAR 29
Cockpit Voice Recorder and Flight Data Recorder	FAR 29
Communications	FAR 29
Navigation	FAR 29
Human machine interface	FAR 29 and KES 4002
ITAS Software	FAR 29

Source: June 2004 airworthiness Compliance Finding Report on the Integrated Weapon System

7.27 Seven of the compliance findings were subject to the successful outcome of Instrument Meteorological Conditions flight certification. The report noted that an Issue Paper was to be raised to document the need for the Instrument Meteorological Conditions flight certification testing to be performed by AMAFTU. A brief prepared for the Chief of Navy in early January 2005 indicated that this testing was to occur in late 2005. That brief stated that AMAFTU had assessed that issues with the accuracy and mode of operation of the Flight Control Computer in the AFCS were likely to present problems in certifying the aircraft for flight in Instrument Meteorological Conditions.

7.28 The June 2004 airworthiness Compliance Finding Report on the Integrated Weapon System stated that, under FAR 29, failure condition analysis must consider the crew warning cues, corrective action required and the capability of detecting faults. The primary hazard mitigation assumptions offered for pilot intervention in the event of an AFCS component failure occurring without warning were judged inadequate for critical flight conditions where pilot workload is high. The report stated that an AFCS Issue Paper was to be written to document the need for the AFCS certification testing to be performed by AMAFTU to provide the minimum evidence

required to assure compliance with Certification Basis Description requirements.

AFCS induced hard-overs

7.29 An AFCS induced hard-over is a potential failure condition, that may occur in all flight control systems, resulting in a control input occurring that was not initiated or directed by the pilot. The risk of a hard-over is mitigated by designing a system so the chance of one occurring is low and by putting in place a process to control the outcome should one occur, which can range from pilot intervention through to multi-channel control systems.

7.30 The Super Seasprite has a legacy simplex flight control augmentation system consisting of complementary single electric trim and single hydraulic boost. The Australian variant incorporated a new Digital Flight Control Computer which was intended to provide improved AFCS functionality. For the Super Seasprite an AFCS induced hard-over was a fault condition where the AFCS actuator moves to the extremity of its range and remains in that position, resulting in the aircraft diverging from its flight path in the direction of the hard-over.¹⁵¹ The onset of the hard-over can be abrupt and may require timely and deliberate intervention on the part of the pilot to regain control of the aircraft and then further control input to overcome and stabilize the attitude change induced by the hard-over.

7.31 For the Super Seasprite two causes of hard-overs were regarded to be most significant. The first of these related to hard-overs occurring due to issues surrounding the interface between the AFCS and external inputs such as the Air Data Computer. This issue was concerning because it indicated that the system was unable to adequately cope with corrupt input data. The second was the design of the AFCS software because the software was not designed to be flight critical. If it had been designed to be flight critical, the design process

¹⁵¹ DMO analysis of potential causes of longitudinal hard-overs outlined the following observations:

- there were reliability concerns with the Air Data Computer actually supplying bad data to the Flight Control Computer and ITAS despite passing all Built-in-Tests;
- erroneous airspeed data from the Air Data Computer was a causal factor in the longitudinal hard-overs experienced;
- there appeared to be a disparity on what airspeed and barometric data the ITAS displays to aircrews and what the Flight Control Computer was using for flight control; and
- there were several instances of barometric altitude displayed on the ITAS being erratic or (more insidiously) stable but different from actual.

would aim to minimise the potential for a fault to command a hard-over condition. Instead, the design philosophy applied in development of the AFCS was reliant upon the pilot intervening to gain control of the aircraft in the event of a failure. This design philosophy was referred to as ‘pilot in the loop’.

Hard-overs during Special Flight Permit period

7.32 The Super Seasprite was awarded a Special Flight Permit in October 2003. Some two months later, a brief to the Operational Airworthiness Authority from the Project Manager indicated that a test pilot had experienced an Air Data Computer failure with the Flight Director engaged, resulting in a rapid nose-down pitch change. The brief advised that of serious concern was the failure of the AFCS to disengage following the Air Data Computer failure. It was considered, at the time, by the Chief of Staff within CANAG that the existing restrictions (on flight operations as set out in the Special Flight Permit) were sufficient while the Project Office and the Prime Contractor investigated the fault.

7.33 The harbour phase and seagoing First of Class Flight Trials for the Super Seasprite were undertaken over the period from April 2004 to May 2004. The Type Certificate for the aircraft issued in December 2004 subsequently prohibited landings on ships. There was no such prohibition in the Special Flight Permit that had been reissued in June 2004 after the first known air data computer induced hard-over had occurred in January 2004. The limitation in the Type Certificate, signed in late 2004, stated that the minimum obstacle clearance for unknown landing sites and confined area operations was 25 feet. Subsequently, AMAFTU testing in early 2006 suggested that this distance needed to be doubled to 50 feet. In September 2008, Defence advised the ANAO that:

The predicted ADC [Air Data Computer] failure rates and extant understanding of FCC [Flight Control Computer] operation during the period leading up to the FOCFT [First of Class Flight Trials] indicate the decision to proceed to FOCFT was reasonable and appropriate.

7.34 In August 2004, a Super Seasprite experienced an induced AFCS malfunction caused by the aircraft Captain pulling a Flight Control Computer circuit breaker, and prior to the pulling of this circuit breaker there was no malfunction. The tripping of this Circuit Breaker was mandated in the event of specific AFCS malfunctions. As it was a training flight, the left hand seat was occupied by a Qualified Flying Instructor. After the circuit breaker was pulled, the aircraft commenced an uncommanded roll to the left, and despite full

cyclic input to the right the aircraft was unrecoverable. Following the resetting of the circuit breaker, the aircraft was recovered. Flying operations were suspended after this event for three days pending the identification of risk treatments by AMAFTU.

Impact of other deficiencies on hard-overs

7.35 A late 2004 report (the VMC Report) prepared by AMAFTU, based on testing conducted during the Special Flight Permit period, indicated that large, and at times unpredictable, cyclic displacements occurred during take-off under some circumstances as a result of the operation of the AFCS. The report noted that the combined impact of anthropometric limitations and unpredictable cyclic position on take-off due to cyclic latching¹⁵² would significantly reduce control margins and may prevent either the pilot or instructor (occupying the left hand seat) from regaining aircraft control following an AFCS malfunction. Meaning that a range of other design issues could act as impediments to the safe recovery of the aircraft from a hard-over. In September 2008, Defence advised the ANAO that:

It is the Prime Contractor's assumption that was fundamentally incorrect. The contractor presented to the Commonwealth that the pilot could recover from all failure modes however refused to provide evidence. Defence did not recognise the criticality of this issue until the actual occurrence, which was after provisional acceptance.

7.36 The VMC Report also stated that the aircraft's electrical system failed to provide adequate indications following generator failures, and in some instances crew responses to electrical system failures would result in power isolation to primary flight information and the AFCS. The report noted aircrew were not provided with indicators of some failures associated with AFCS

¹⁵² The VMC report described the cyclic displacement issue, which was referred to by the term 'cyclic latching'. Cyclic latching was a characteristic of the Super Seasprite whereby the cyclic may become unpredictably displaced in either the lateral or longitudinal axis, or both, during a take off resulting in reduced control margins and possible loss of aircraft control in the event of a subsequent AFCS malfunction. In March 2009, Defence informed the ANAO that the cyclic latching issue was well understood and limitations were in place to limit the occurrence. The issue was confined to circumstances where the aircraft lifted off from sloping surface and washed out over time after take-off. Defence stated it did not present a risk for routine shore operations from an airfield. Defence further advised that the Contractor had assured Defence that this issue had been resolved in the next release of Build 1 AFCS Software. In April 2009, the Prime Contractor advised the ANAO that a software change was made to the AFCS in mid 2004 to eliminate this cyclic displacement and further flight testing confirmed this was no longer an issue.

functionality, the result of which could lead to controlled flight into the ground or water, with the risk of this occurring being greater at night.

Airworthiness Board consideration of AFCS issues at Type Certification

7.37 The Technical Airworthiness Regulator's recommendation for the Type Certificate in December 2004 stated the following with respect to the AFCS:

The analogue SH-2G cockpit primary instruments and AFCS have been replaced by new hardware, software and functionality that is unique to the SH-2G(A). Several of the technical deficiencies identified in the IWS [Integrated Weapons System] design appear to result in two main hazards:

- unpredicted departure from controlled flight; and
- erroneous primary flight information.

During IWS design, these hazard types were mitigated on the assumption that the pilot was always 'in the loop' to immediately recognise system failures and maintain controlled flight. It is worth noting, that during Special Flight Permit period operations, there have been several instances where aircraft have entered uncontrolled flight. For the SH-2G(A), these hazards should be considered 'likely'.

7.38 The December 2004 Airworthiness Board noted that the software had been certified to MIL-STD-498, supplemented by RTCA DO-178B. The weapons system integration was certified to an amalgam of US Military Standards; Federal Aviation Regulations and Advisory Circulars; and Prime Contractor Engineering Standards.

Deficiency Review Report

7.39 The 2004 Airworthiness Board acknowledged that the Air Data Computer issue was being partially addressed through a design change, with operational mitigation provided by a reduced operating envelope. A brief prepared by DGTa personnel prior to the Technical Airworthiness Regulator making a recommendation for the issue of a Type Certificate indicated that in the design of the AFCS it was assumed that the pilot was the mitigant to a number of hazard conditions. The integrity of the glass cockpit¹⁵³ was underpinned by the ability of the pilot to recognise and maintain controlled

¹⁵³ The glass cockpit refers to the electronic display which provides information to the aircrew through four Colour Multi Function Display units and two Smart Display Unit which form part of the ITAS.

flight in the event of a system failure. Through an Airworthiness Corrective Action Request, the Airworthiness Board requested that a review team investigate, among other things, a longer term solution to the system design issue associated with Air Data Computer failures.¹⁵⁴

7.40 The Restricted version of the report made a series of recommendations that were intended to address issues with aircraft. Three of these recommendations relating to the AFCS are set out in Table 7.2. The table also includes relevant issues derived from the report. The ANAO notes that these issues are consistent with concerns identified in the March 2003 letter from the Director of the Project Office to the Prime Contractor outlined in paragraphs 7.15 to 7.17, and that this letter predated the award of the Special Flight Permit.

¹⁵⁴ The Airworthiness Corrective Action Request raised by the December 2004 Airworthiness Board required the establishment of a review team to identify which deficiencies in the aircraft could be addressed through design changes, and apply priorities for rectification. This led to the establishment of a Deficiency Review Team whose final report was issued in July 2005. See paragraphs 8.27 to 8.32.

Table 7.2

2005 Deficiency Review Final Report recommendations relating to AFCS

Recommendation	Associated issue from the Deficiency Review Final Report
The System Safety Hazard Analysis (SSHA) should be reviewed to determine whether the assumption of the 'man in the loop' as mitigant for software failures is valid.	<ul style="list-style-type: none">• The SSHA was based on the assumption that the 'man in the loop' can be used as a mitigant for software induced failures. AMAFTU had demonstrated that this assumption is not always valid.• Preliminary testing by AMAFTU highlighted that there are regions of the flight envelope where, following a software induced malfunction, the pilot will not be able to recover. This has put in doubt the existing software design assumption that the 'man in the loop' can be used as a mitigant for all software failures.
Delivery of the AFCS Build 3 software independent of the Full Capability Helicopter, and integration to the Interim Training Helicopter configuration should be aggressively pursued.	<ul style="list-style-type: none">• Cyclic latching exacerbates control margin issues and is a significant impediment to slope landing and embarked operation. The Deficiency Review Team understood that a fix had been incorporated into AFCS Build 3, software which was to be delivered with the Full Capability Helicopter.
Determine the requirements and if required, implement changes to enable software to be acceptable as critical to safety of flight.	<ul style="list-style-type: none">• The criticality of the AFCS software was detailed in a number of paragraphs in the Deficiency Review Report, in particular the impact that results from not being able to use the 'man in the loop' as mitigation for all possible software malfunctions. To account for this it is necessary for the software and the associated design process to be evaluated as acceptable for critical to flight safety operations. This will require analysis of the current state of the software design with the aim of determining its viability as flight safety critical software. The review may determine no further action is required or may result in the requirement to rewrite the software.

Source: Deficiency Review Report, July 2005.

7.41 In relation to the recommendation relating to expediting AFCS Build 3 outlined in Table 7.2, the Project Office wrote to the Prime Contractor in early March 2006 regarding the provision of the System Safety Documentation Baseline for the Interim Training Helicopter in-service support. This was some 12 days prior to the AFCS hard-over that led to the withdrawal of the Type Certificate. An annex to that letter outlined required updates to the Hazard Database, with three of these hazards pertaining to AFCS Build 3. The Project Office provided the same comment against all three of these hazards as follows:

As the software related to this activity has been tagged with a SRI [Software Hazard Risk Index] of 2, and the AFCS Build 3 Formal Qualification Testing has been conducted, the hazard can be closed following incorporation of reference to the safety requirement and the AFCS Formal Qualification Testing test report.

7.42 Figure 7.2 also outlined a Deficiency Review Team recommendation that the SSHA should be reviewed to determine whether the assumption of the 'pilot in the loop' as mitigant for software failures is valid. The annex to the March 2006 Project Office letter to the Prime Contractor regarding that hazard database, dated eight months after the recommendation of the Deficiency Review Team, stated the following with respect to the agreement to close hazards in relation to AFCS Build 3:

It should be noted that the Commonwealth do not concur that the pilot will be able to adequately recover in the event of a control hard-over caused by an erroneous command in all phases of the flight envelope. The Commonwealth are pursuing these via further flight testing and will advise Kaman [Prime Contractor] of the results.

7.43 DMO documentation indicated that an Independent Hazard Assessment by an external service provider was provided to NASPO in December 2005. The main findings included in this assessment were as follows:

- independent hazard identification by the external service provider was mostly consistent with hazards identified by the Prime Contractor;
- AFCS contained a number of sources for potential in-range flight data errors and single point failure;

- significant reliance placed on crew situational awareness and timely response to mitigate unexpected control surface movements; and
- the external service provider held that Prime Contractor risk categorisation may have been non-conservative for the anticipated operational flight envelope.

March 2006 hard-over

7.44 The aircraft normally sits in a five degree nose up attitude in hover. The Aviation Safety Occurrence Report relating to the 14 March 2006 hard-over indicated that during a lift off to hover at 10 feet, during a maintenance test flight, an uncommanded aft step input in cyclic was felt.¹⁵⁵ This caused a corresponding nose up attitude. An e-mail from the CANAG to the Chief of Navy stated the input was arrested and the AFCS was disengaged in accordance with the erratic and abnormal control inputs within the Flight Reference Cards.

7.45 The ASOR also stated that during the incident the Air Speed Indicator and Altimeter were seen to give multiple erroneous indications, with the Air Speed Indicator varying between zero and 150 Knots Calibrated Airspeed. At the time, both the Air Speed Indicator and Altimeter also indicated 'red Xs'. Subsequent to landing, a 200 foot discrepancy in altimeters was identified between the ITAS and standby altimeter, with the ITAS being in error. Defence advised the ANAO that this was symptomatic of an Air Data Computer failure.

¹⁵⁵ This Maintenance Test Flight followed an incident on the previous day where during a hover the ITAS, Air Speed Indicator and Altimeter provided erroneous indications and the aircraft responded by giving erroneous input with the aircraft randomly varying altitude by plus or minus 50 feet.

Senior level review

7.46 A February 2006 Minute from the Chief of Air Force to the Chief of Navy and the CEO of DMO reiterated the concern surrounding DGTA confidence in the design and issues set out in the Restricted¹⁵⁶ version of the July 2005 Deficiency Review Final Report. The Minute referenced specific text from the Deficiency Review Final Report in relation to AFCS hard-overs as follows:

AFCS induced hard-overs cause a significant and immediate control input, such that altitude and consequently position will vary prior to the pilot regaining control. A hard-over in the forward axis while over the flight deck [of a ship] could see the aircraft impact the hangar before the crew can reasonably be expected to react.

7.47 The above quotation did not include the final sentence of that paragraph of the Deficiency Review Final Report which indicated that AFCS failure behaviour and likelihood must be quantified to inform risk assessments for embarked operations. Instead, the Chief of Air Force made a statement, not restricted to embarked operations, which indicated that he remained concerned that this fundamental flaw in the aircraft control system remained uncharacterised. The Minute concluded that:

The stated opinion of the Naval user community in Reference C [the Deficiency Review Final Report Restricted Version], and similar statements made to the 2005 Airworthiness Board by DMO representatives, make it clear that there was general agreement that the aircraft may never meet the capability requirements for which it was originally purchased.

7.48 On 24 March 2006, CANAG provided a brief to the Chief of Navy in response to allegations that the incident on 14 March 2006 resulted in significant movement aft and the tail wheel striking the ground. CANAG stated that this was incorrect and that while the incident was unexpected by the pilot, the Tactical Coordinator had reported the occurrence as relatively benign.

7.49 The brief to the Chief of Navy indicated that the requirement for a 25 foot clearance from obstacles had been increased to 50 feet based on interim advice received from AMAFTU. The brief did not outline that AMAFTU had

¹⁵⁶ There were two versions of the Deficiency Review a Restricted version and a Confidential version. The difference between the versions of the Deficiency Review Report is set out in paragraph 10.5.

indicated that a more rigorous type of testing might produce results indicating that the clearance of 50 feet may be insufficient in the event of an AFCS hard-over. Notwithstanding, that pre-existing AMAFTU documents suggested that the restriction may have been insufficient. CANAG's 24 March 2006 brief to the Chief of Navy concluded that:

The hard-over issue remains an undesirable, but manageable event, due to the risk measures that are in place and is considered to be acceptable at this time, given the information available. It is readily acknowledged that the existing restrictions associated with hardover represent an obstacle to full employment of the Seasprite at sea. Accordingly, the significant test activity by AMAFTU is aimed at providing quantitative data for further resolution of the issue.

7.50 Subsequently, the Chief of Navy responded by thanking the CANAG and stating as follows:

...the comprehensive advice below was most useful at a meeting I've just had with CDF [Chief of the Defence Force] and DCAF [Deputy Chief of Air Force]. Until the Rx [receipt] of this advice and based on a series of reports through the RAAF chain, CDF had been of the opinion that we may be facing a situation which could warrant grounding of the fleet. He is no longer of that view but does require that a full examination and review be conducted in order to confirm that we have a safe way forward.

7.51 The Chief of the Defence Force had directed the Chief of Navy that a meeting be convened later in March 2006 involving key airworthiness parties. This meeting was to review hard-over history for the Super Seasprite. The Chief of Navy advised CANAG that the meeting should also review the Project's risk management profile and come out with a clear indication on the way forward. The Chief of Navy required a documented outcome.

7.52 On 27 March 2006, a meeting was convened to discuss AFCS issues. The principals at this meeting were DGTA, CANAG and the Director of the Project Office. On 28 March 2007, CANAG provided a briefing pack to the Maritime Commander and the Chief of Navy on the outcome of that meeting. The pack contained a covering Minute, a dot point brief and background information.

Frequency of Hardover events could not be determined

7.53 The background information included in the briefing pack provided to the Maritime Commander and the Chief of Navy noted that there had been four hard-over occurrences that were not induced through flight testing in approximately 1600 flying hours. Of these one was self induced by the crew

pulling the Flight Control Computer system circuit breaker, two were as a result of erroneous Air Data Computer inputs to the Flight Control Computer and one was associated with a malfunction in the collective system. DGTa expressed concern that the frequency of hard-over events was of the order of magnitude of one in 500 flying hours. The aircraft design specification requirement was for a failure rate of one in one million hours for failures that may create a catastrophic outcome. DGTa regarded this as unacceptable in the longer term from a technical airworthiness perspective.¹⁵⁷

7.54 DGTa also expressed reservation about the ability of his staff to generate a credible order of magnitude assessment of the likelihood of hard-over occurrence. He stated that the design specification of elements of the flight control system, and in particular the software in the flight control computer, were such that he had no baseline from which to assess the rigour of each of the systems. This was considered a key statement, as in the absence of the ability to quantify the likelihood, the default likelihood was one in 500 hours.

7.55 This meant that, pending a design solution, the ADF would be operating an aircraft with a failure rate 2000 times greater than the accepted standard for the aircraft's design baseline, and in the order of 20 000 times greater than the US Federal Aviation Regulation standards current at that time. On 29 March 2006, the Maritime Commander informed the then Minister for Defence that the Super Seasprite flying operations had been suspended based on the advice of CANAG.

Measures to improve the airworthiness of the AFCS

7.56 Between April 2006 and July 2006, a series of correspondence was exchanged with the Prime Contractor in relation to the AFCS. Central to these

¹⁵⁷ In April 2009, the Prime Contractor advised the ANAO as follows:

Regarding the excessive hardover events experienced in early Defence flight operations, the Prime contractor agreed at the time to undertake immediate cause and corrective action. Two of these events were determined to be caused by the Air Data Computer, which was new to the SH-2G(A) and which was found to have design flaws..... These flaws were corrected thereby eliminating the source of the hardover events. One of the two remaining events was caused by a maintenance error in the collective system and an appropriate maintenance manual change was made to prevent recurrence. The final event was, in fact, not a spurious event at all but was caused by a deliberate in-flight procedural violation. Nevertheless, a design change was made to prevent a hardover occurring if this condition were to recur in the future. These changes, taken together addressed all known causes for hardover conditions.

was disagreement between DMO and the Prime Contractor on the Software Hazard Risk Index of the AFCS.

7.57 A DGTA Minute in May 2006 indicated that achieving compliance with contemporary standards would require extensive software redesign and possibly some hardware changes for hazards that could not effectively be treated by software changes in isolation. The Minute indicated that the necessary hardware changes may not be viable, meaning that shortfalls against the contemporary standards would require rigorous analysis. The AFCS remediation program was split into two phases. These phases were:

- Phase 1 which was intended to remove obvious design flaws to support restricted return to flying under a Special Flight Permit; and
- Phase 2 which involved the redevelopment of the AFCS to meet identified design standards and safety objectives.

7.58 In July 2006, the Head Aerospace System Division in DMO wrote to the Prime Contractor, agreeing as a matter of expediency that the cost of Phase 1 work would initially be shared subject to a determination as to whether or not the work was in or out of scope of the Prime Contract. Phase 1 work was to use the funding approved through Contract Change Proposal 94 for Operational Test and Evaluation and Certification, with DMO's share not to exceed US\$200 000.¹⁵⁸

7.59 Phase 2 work was to be funded out of the \$110 million (January 2007 prices) Real Cost Increase subsequently agreed to in early 2007, following the then Government's decision to proceed with the Project. A February 2008 presentation by the Prime Contractor to the then Parliamentary Secretary for Defence Procurement and the then Minister for Defence indicated that the full scope of AFCS enhancement had been agreed in 2006. In this presentation, the Prime Contractor claimed that completion of Phase 2 had been delayed by scope changes introduced by DMO and a growing cost and schedule. In early 2008, a Deed of Variation to introduce Phase 2 of the AFCS remediation program (AFCS Phase 2) into the contract was still under negotiation. At that time, the Project Office estimated cost of AFCS Phase 2 was likely to be \$50 million and it was expected to take three years to complete, with schedule

¹⁵⁸ Contract Change Proposal 94 was agreed in late 2004 in order to resolve several matters including requests by the Prime Contractor for cash flow relief and schedule risk mitigation incentives as well as claims that provisional acceptance of the Interim Training Helicopter had been delayed due to DMO not processing Contract Deliverable Requirements List documents on a timely basis.

being regarded as high risk. Agreement on a variation to the Prime Contract to insert the requirements for AFCS Phase 2 was not achieved prior to the Project being cancelled.

7.60 The February 2008 presentation by the Prime Contractor suggested that it may be possible to eliminate Phase 2 entirely based on the very positive results of Phase 1. This presentation asserted that the AFCS met all DMO's goals and flight testing had confirmed flight safety. Internal DMO briefs in 2008 noted that Phase 1 had introduced greater error checking of input data. These briefs indicated that the suitability of the AFCS for use in Instrument Meteorological Conditions had yet to be proven, and that the airspeed hold function suffered lags, with the implementation of the coupled Instrument Landing System and Flight Director function being poor. The briefs also indicated that the AFCS generated over torques during test flights, that is the AFCS commanded the engines to produce power that exceeded the transmission limits. The briefs indicated problems were not expected to be rectified under Phase 2 of AFCS remediation program.

7.61 The March 2008 Negotiating Directive for the termination of the Project, approved by the CEO of DMO in March 2008, contained a section entitled Factual Overview. This section indicated that AFCS Phase 1 remediation work had been completed and had been tested by the Prime Contractor and Defence. The report in respect of the flight testing was to be delivered during March 2008, however the preliminary view following testing was that the remediation work had not resolved all the safety issues expected to be resolved through Phase 1, and would therefore impact on the scope of AFCS Phase 2.¹⁵⁹

7.62 Some 10 months earlier, in May 2007, the Project Office wrote to CANAG outlining the plan to conduct flight testing of Aircraft 10, which had been fitted with updated flight control software. A copy of a Ministerial brief attached to this Minute indicated that testing of the AFCS Software Phase 1 remediation had been successfully completed in early 2007. This Test Flying occurred in late May 2007 under a Civil Aviation Safety Authority exemption with the aircraft operated by air crew employed by a sub-contractor to the

¹⁵⁹ The DMO informed the May 2007 the Senate Estimates Committee as follows:

The issue is the automatic flight control system and it requires additional work. There was an additional part done from April onwards as Phase 1. It was split into two phases. The first phase has been completed. Returning the aircraft to flying status will require a special flight permit, a board to review the status of the aircraft and return it to flying status looking at those modifications that were made to the automatic flight control system.

Prime Contractor. Defence provided ANAO with copies of subsequent advice to the then Minister in the form of a Question Time Brief and Question on Notice response, both from August 2007, each of which indicated ongoing issues surrounding AFCS Phase 1 although neither specifically sought to correct the May 2007 advice. In March 2009 Defence informed the ANAO that following further analysis of flight test data, and subsequent testing by Defence in November 2007, DMO formed the view that Phase 1 AFCS remediation had not resolved all safety of flight issues.

7.63 Consistent with ANAO findings, DMO documentation from early 2007 indicated a range of shortcomings in the way contractual arrangements surrounding the AFCS had been managed by DMO including:

- ongoing difficulty in resolving the position with respect to the Software Hazard Risk Index within Defence, thereby allowing the AFCS to be completed under Software Hazard Risk Index 2;
- a risk that the contractor could argue that the requirement to re-engineer the AFCS to RTCA DO-178B arose out of changes to the airworthiness regime in 1998 or actions by DGTA that were independent of contract requirements; and
- AFCS Phase 1 work was being undertaken with DMO approval on the basis of a Software Hazard Risk Index of 2.

8. Management of Deficiencies

Flight testing during 2003 and 2004 identified a range of deficiencies with the provisionally accepted aircraft. This chapter examines the management of the more significant deficiencies, a number of which resulted in limitations and restrictions on how Navy was able to operate the aircraft.

Introduction

8.1 One of the approaches that Defence intended to use to overcome the difference between the 1997 contractual certification requirements and the revised ADF airworthiness arrangements, introduced in 1998, was through flight testing (see paragraphs 6.19 to 6.27). This testing identified a number of issues with the aircraft in addition to those surrounding the ITAS and AFCS (see Chapters 4 and 1 respectively). Like the AFCS induced hard-over issue, these deficiencies were mitigated through the application of limitations and restrictions on the way Navy was permitted to operate the aircraft. These were set out initially in the Special Flight Permit and subsequently in the Type Certificate and Service Release. A number of these deficiencies also impacted on a pilot’s capacity to recover the aircraft following an AFCS hard-over. These deficiencies, combined with the AFCS design issues, contributed to the decision to withdraw the Type Certificate in 2006 (see Chapter 9) and the decision to cancel the Project (see Chapter 10). The management of these deficiencies and associated limitations is outlined in this Chapter as set out in Figure 8.1.

Figure 8.1

Chapter outline

Management of Deficiencies

- Outcomes of flight testing
- Progress toward resolving deficiencies
- Limitations and restrictions
- Aircraft crashworthiness
- Understanding of deficiencies

Outcomes of flight testing

8.2 The original aim of the First of Class Flight Trials was to allow the Prime Contractor to partially demonstrate the embarked capabilities and for Defence to assess the performance of the Super Seasprite in an embarked environment. The original scope of the First of Class Flight Trials was reduced by the limitations placed on the aircraft in Interim Training Helicopter configuration.

8.3 Phase 1 of the seagoing First of Class Flight Trials occurred from 19 April 2004 to 14 May 2004 aboard HMAS Parramatta. This Phase produced a range of Ship Helicopter Operating Limits, although the trial was limited by RSD interference issues, a serviceability issue with the landing gear on the aircraft (unrelated to the RSD issue), and prevailing weather conditions. The First of Class Flight Trials Phase 1 report was dated March 2005, nearly 12 months after the trials were concluded.

8.4 The First of Class Flight Trials Phase 1 report detailed a range of deficiencies identified during the First of Class Flight trials. These are outlined in Table 8.1.

Table 8.1

Deficiencies identified in March 2005 First of Class Fight Trials Report

Category	Number
Unacceptable deficiencies with correction essential	5
Unsatisfactory deficiencies with correction highly desirable	12
Unsatisfactory deficiencies with correction desirable	12

Source: March 2005 - First of Class Fight Trials Report

8.5 Most significant amongst these deficiencies was the undercarriage of the aircraft striking the RSD; issues associated with the AFCS; and space constraints within the cockpit (anthropometric restrictions).

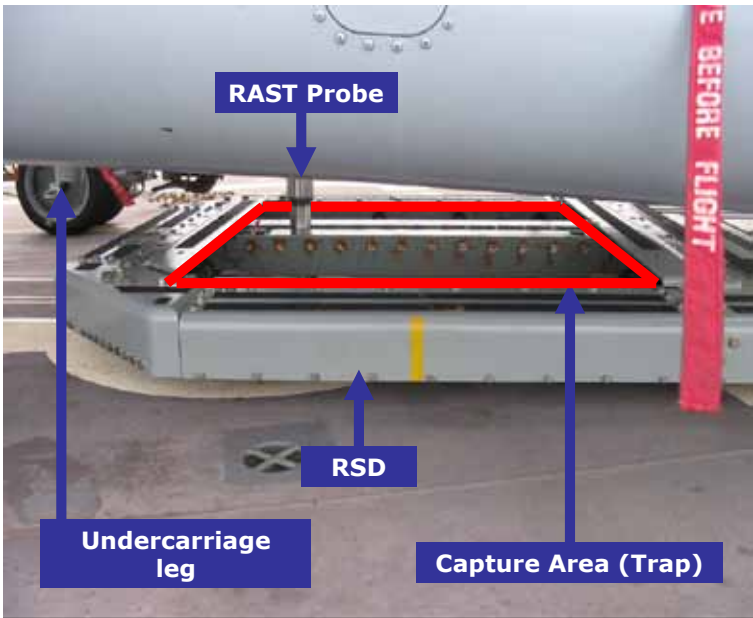
RSD Interface

8.6 The RAST System is a deck handling system that can be used to haul down an aircraft to the flight deck, secure an aircraft to the flight deck and move an aircraft to and from the hangar. The RAST system enables helicopter operations to occur up to and through Sea State 5 with minimal loss of capability. During the tender process for the ANZAC Ship Helicopter, the Prime Contractor offered the RAST system as a secondary option and this

option was taken up. The ANZAC Ship was already fitted for the RAST. The Australian version of the Seasprite was the only version to be modified for RAST operations. The RSD is fitted to the deck of an ANZAC ship and forms part of the RAST System. The RSD clamps a probe fitted underneath the aircraft cabin, securing the helicopter to the deck and enabling the aircraft to be moved along the flight deck and into the hanger (see Figure 8.2). The RSD may be used during a haul down landing, where the helicopter is pulled onto the deck by a cable, or during a free deck landing, where the pilot positions the aircraft over the RSD during landing.

Figure 8.2

RAST probe in RSD



Source: Defence documentation

8.7 Table 8.2 provides a chronology of the RAST issues from tender evaluation through to project cancellation.

Table 8.2

Chronology of key events relating to the RAST

Year	Issue
1996	The Operation Tender Evaluation Working Group noted that the RAST or similar system was necessary to meet the requirements of unrestricted operations in Sea State 5. The Engineering Tender Evaluation Working Group concluded that the Super Seasprite was compatible with the ANZAC RAST System.
1999	The Chief of Navy was informed that the Super Seasprite required a different haul down pressure to the Seahawks, necessitating modifications to the ANZAC Class and the FFG for interoperability.
1999	A Critical Design Review report outlined a range of design issues with the RAST including that the main probe assembly was fitted in an off-centre position beneath the aircraft cabin floor.
2002	A Resident Project Team Report on RAST Functional Testing conducted by the Prime Contractor in late 2000 concluded that the mechanical interface between the aircraft and the RAST had been successfully evaluated, and the clearances during landing and straightening evolutions were considered satisfactory.
2003	The added 'effective weight' of a RAST haul down (2000 pounds) had not yet been demonstrated to be within the structural envelope for the landing gear.
2004	During the First of Class Flight Trials, the starboard undercarriage leg of the aircraft was found to impact the RSD during a free deck landing when the RAST probe was located in the port aft corner of the capture area. This contact caused some damage to the undercarriage leg. As RSD is also used to move the helicopter to and from the hangar, the inability to land the aircraft into the RSD created the requirement to merge the aircraft with the RSD while on the deck. However, as there was insufficient clearance between the Radome and the RSD, the use of ramps was required to allow this merge to occur. This procedure impacted on the capacity of the vessel to conduct operations while the merge was taking place. ¹⁶⁰

¹⁶⁰ In April 2009, the Prime Contractor advised the ANAO that the development relied on Defence supplied engineering defining the ship side of the RAST system, and operational data defining the range of landing conditions that the system would need to accommodate. The operational requirement was limited to accommodating up to a 15 degree angular alignment relative to the ship's longitudinal axis. The Prime Contractor stated during development and testing conducted by the Prime Contractor discrepancies were discovered but that:

In spite of this, difficulties were encountered during initial sea trials when the aircraft side of the RAST was first mated with the ANZAC Ship side of the RAST. At this point it was determined that interference could exist between the ship's RSD and the structural part of the landing gear for a limited range of landing conditions. More importantly, however, it was also determined that the range of possible landing conditions considered in the design (as supplied by Defence) was much too restricted and that consideration of the real, full range of conditions would show that landing gear/RSD interference could occur frequently and could be expected to cause unacceptable damage to the landing gear structure.

Year	Issue
2004	The Prime Contractor acknowledged responsibility to prevent interference when the aircraft is within the capture area but not for a mis-traps. ¹⁶¹
2004	DGTA wrote to the Project Manager outlining their position on an Issue Paper on the RSD aircraft landing gear interface issue recommending that RSD landings be prohibited until a suitable solution was developed.
2004	A Statement of Principles, agreed between DMO and the Prime Contractor in October 2004, included a section on resolution of the RAST issue which required the Prime Contractor to rectify the RAST to comply with the Prime Contract, or DMO would pay for a 'skirt' proposal. Under the Statement of Principles the technical soundness of the proposal needed to be proven through a Preliminary Design Review.
2005	The first Preliminary Design Review for the RSD skirt proposal concluded that the proposal was not feasible due to obstructions on the ANZAC Flight Deck.
2006	A second Preliminary Design Review was held at the insistence of DMO but did not demonstrate that the revised skirt proposal was compliant against a large number of detailed requirements.
2006	The fitting of the RAST probe to the underneath of the aircraft was identified as adversely impacting on the crew survivability in the event of an accident.
2006	In December 2006, the Project Office proposed a joint prototype evaluation of the RSD skirt.
2007	The Defence Science and Technology Organisation (DSTO) conducted computer modelling to estimate the landing limits and unrestrained toppling and sliding limits for a Super Seasprite on an ANZAC Class Ship using the revised RSD skirt proposal. The report indicated that landing limits derived from this modelling showed that when landing over the modified RSD, the helicopter is limited to a very low rate of descent, low drift rates and low amplitudes of ships roll due to the low structural integrity of the main landing gear.
2007	The Project Manager indicated that to properly fix the RAST interface issue it would be necessary to move to the next model of the RAST.

Source: Defence Documentation

8.8 As noted in Table 8.2 the Statement of Principles signed in October 2004 included a section on resolution of the RAST issue. Under the Statement of Principles, the Prime Contractor was required to rectify the RAST to comply with the Prime Contract, or DMO would pay for a 'skirt' proposal, subject to conditions set out in the statement. The skirt proposal involved modifying the RSD by adding a number of angled panels around the RSD to allow the

¹⁶¹ A mis-trap occurs when an attempt is made to land the helicopter into the RSD but the RAST probe beneath the aircraft is not inserted into the capture area of the RSD. The ANAO observed video of a Seahawk pilot attempting to land into an RSD and experiencing several mis-traps before correctly positioning the aircraft over the RSD.

landing gear to slide sideways to prevent the undercarriage legs from contacting with the RSD.

8.9 In September 2008, Defence advised the ANAO that cost sharing of the skirt proposal under the Statement of Principles was seen as an acceptable and equitable way to achieve the required outcome given uncertainty surrounding the contracted requirement. Defence advised that while the contract clearly placed an obligation on the Prime Contractor with respect to successful engagement of the capture area, it was silent on the situation where the probe failed to arrive in the capture area. The Project Office saw the need to address all interface conditions and, consequently, additional cost would be incurred. By 2007 there was uncertainty surrounding the impact of the October 2004 Statement of Principles on the contractual provisions surrounding RAST. The RAST issue was never resolved and was cited in a number of briefs as a factor contributing to the decision to cancel the Project.

Anthropometrics

8.10 The report on the First of Class Flight Trials identified that space limitations within the cockpit impacted on the ability of certain air crew to exercise full control authority over the aircraft. There are three standard helicopter flying controls as described below.

- The collective lever, which pilots manipulate with their left hand, alters the pitch of all the main rotor blades by the same amount at the same time. Pulling the collective lever up increases the pitch and the helicopter ascends, lowering the collective lever reduces the pitch and the helicopter descends.
- The cyclic column, which pilots manipulate with their right hand, varies the pitch on the main rotor blades over the period of one revolution, enabling pilots to tilt the rotor disc. Pushing the cyclic column forward tilts the rotor disc forward, pitching the helicopter's nose down and moving the aircraft forward. Pushing the cyclic column to the left tilts the rotor disc to the left, rolling the helicopter to the left and so on.
- The tail rotor pedals, which pilots manipulate with their feet to alter the pitch of the tail rotor. The tail rotor controls the direction in which the helicopter points and balances the torque that is generated by spinning the main rotor.

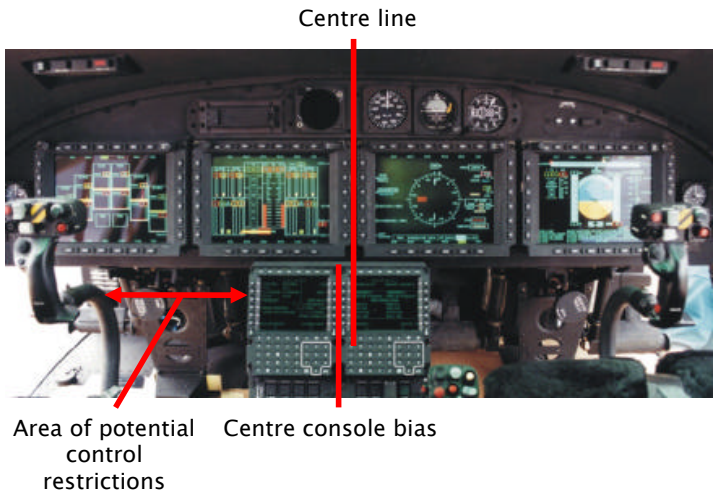
8.11 The Super Seasprite crew seats were fixed fore and aft relative to the aircraft and only offered vertical adjustment. Pilots of varying heights were

accommodated by adjusting the tail rotor pedals closer to, or further away, from the fixed seating position. Aircrew with longer upper leg lengths could experience contact between their upper shins/knees and the aircraft’s instrument panel, presenting both a crashworthiness and comfort issue.

8.12 The cockpit was relatively narrow and the space to physically move out of the way of the cyclic control was limited, especially in the left hand seat (the Super Seasprite has a left biased centre console which was slightly wider than other Seasprites). Depending on the girth of the pilot’s or tactical coordinators legs and torso, actual control margins achievable were well below designed limits, potentially restricting operations with wider centres of gravity and also compounding problems encountered in recovering from certain flight failures, such as an AFCS hard-over. This issue was particularly significant in circumstances where a Qualified Helicopter Instructor occupying the left seat of the aircraft needed to intervene to correct student mishandling, particularly during critical flight phases such as autorotations or returning to a ship’s flight deck (See Figure 8.3).

Figure 8.3

Cyclic control restriction left hand cockpit seat



Source: Adapted from Defence documentation

8.13 A chronology of key anthropometric events is set out in Table 8.3.

Table 8.3**Chronology of key anthropometric events**

Year	Issue
1996	The Engineering Tender Evaluation Working Group assessed that cockpit seating was compliant with RFT requirements with a low risk and high confidence. The report indicated that seat and tail rotor pedals adjustments would allow a wide range of body sizes to operate the aircraft.
1998	The Preliminary Design Review identified potential anthropometric constraints and raised an action item for lateral cyclic envelope investigation by the Prime Contractor that DMO subsequently found to be deficient.
2001	Further aircraft handling qualities testing in late 2001 was also found to be unacceptable by DMO. Defence advised that, despite the reissue of the test report and further flight testing, DMO and the Prime Contractor reached an impasse.
2004	First of Class Flight Trials identified anthropometric restrictions.
2004	An AMAFTU report prepared in support of type certification noted that while the Original Equipment Manufacturer's cyclic control envelope was based on mechanical limitations, anthropometric test results demonstrated that significant portions of that envelope were not useable for the majority of aircrew. This report noted effects of these anthropometric restrictions were exacerbated by the requirement to use relatively large cyclic displacements in order to control the aircraft in normal flight and during manoeuvres within the flight manual envelope.
2004	A Special Flying Instruction issued in November 2004, required that aircrew meet the size restrictions to ensure a minimum level of risk for the front seat passengers. A brief prepared for the Chief of Navy indicated that two Qualified Helicopter Instructors had been removed from the 805 Squadron as a result of not meeting these restrictions.
2006	A brief prepared Director-General Naval Aviation Systems for the Secretary of Defence, the Chief of Navy and the CEO of DMO indicated that there was no simple engineering fix to rectify the anthropometric restrictions and that anthropometric screening of air crew may be required for the life of the aircraft.
2006	Consideration was given to re-gearing the flight control system, which was seen as an option for alleviating the anthropometric restrictions. This regearing would have required further testing, as it may have altered the handling qualities of the aircraft.
2007	Correspondence between DMO and the Prime Contractor in early 2007 indicated limited progress on this issue.

Source: Defence Documentation

8.14 The ANAO sought clarification on the timeframes surrounding when the anthropometric concerns first emerged and subsequent action by DMO to resolve this issue. Defence advised the ANAO in September 2008 that actionable data was not evident and available until AMAFTU testing occurred in 2004. Anthropometric issues were cited in a number of briefs as a factor contributing to the proposal to cancel the Project. These briefs noted the potential to re-gear the cyclic and that a real cost increase was agreed to by Government in 2007 that made allowance for this modification. The Project was cancelled in 2008 before the issue was resolved.

Test Report identifies deficiencies

8.15 The purpose of the November 2004 VMC Report prepared by AMAFTU was to evaluate the aircraft in the Interim Training Helicopter configuration for its suitability to conduct VMC flight operations in accordance with the Interim Training Helicopter Statement of Operating Intent. This testing was undertaken to address the difference in the testing requirements as set out in the Prime Contract and that which DMO considered necessary for achieving certification. DMO advised the ANAO that, in terms of handling qualities of the aircraft, under the Prime Contract the Prime Contractor was only required to test at one altitude, which in the view of DMO was insufficient to achieve certification.

8.16 The VMC Report made recommendations relevant to the application for a Type Certificate with a limited VMC Service Release. The report was based on fifty-four flight tests totalling 93.8 hours conducted over a period of nine months between December 2003 and August 2004. Additionally, some flight test data was extracted from the results of the First of Class Flight Trials conducted in mid 2004.

8.17 The VMC Report outlined that the results of testing, and associated data analysis, revealed five major areas of concern that were regarded as significantly impacting the suitability of the aircraft to perform the required tasks during the Interim Training Helicopter period. These included:

- aircraft response following AFCS servo¹⁶² hard-over or boost related failures;

¹⁶² A servo is a powered mechanism producing motion or forces at a higher level of energy than the input forces.

- control margins;
- problems associated with the aircraft electrical system;¹⁶³
- absence of warning/caution indications following AFCS related failures; and
- crew survivability following a crash.

8.18 In April 2009, the Prime Contractor indicated that:

- testing by AMAFTU with respect to aircraft response following AFCS servo hard-over or boost related failures was flawed and led to an invalid conclusion;
- changes had been made to the aircraft electrical system to address concerns in this area;
- design changes had been developed to enhance the level of AFCS failure annunciation for fielding in the Full Capability Helicopter; and
- modifications to the aircraft had been made to enhance post crash egress and post crash failures.

8.19 The VMC Report categorised deficiencies identified during aircraft testing as set out in Table 8.4.

Table 8.4

Deficiencies identified in VMC Report

Category	Number
Unacceptable deficiencies with correction essential	25
Unsatisfactory deficiencies with correction highly desirable	44
Unsatisfactory deficiencies with correction desirable	63

Source: November 2004 – VMC Report

8.20 The VMC Report indicated that the tested configuration was not acceptable for Instrument Flight Rule certification, and had demonstrated limited potential for the Interim Training Helicopter missions as defined in the Statement of Operating Intent. The report suggested that upon rectification or

¹⁶³ On 20 February 2008 a report was prepared on the Electrical Power Generation and Distribution System Anomalies identified in the VMC Report which recommended amendments to the Aircraft Flight Manuals and Flight Reference Cards and the development of an Electrical System Deficiency Issue Paper for approval by CANAG and to DGTA.

mitigation of the unacceptable deficiencies, the tested configuration would be suitable for Interim Training Helicopter missions in VMC conditions, and should then be assessed for Instrument Flight Rule certification.¹⁶⁴

Progress toward resolving deficiencies

8.21 In October 2003, the then Design Acceptance Representative wrote to the Technical Airworthiness Regulator seeking a recommendation for the award of a Special Flight Permit. An Annex to that Minute was titled 'Accomplishments Against the Design Acceptance Strategy'. The Annex included a summary of 11 Issue Papers some of which related to the significant changes to the aircraft, while others related to other airworthiness issues.

8.22 In October 2004, ACPA noted that the Type Certification package prepared by the Project Office included 145 operational compliance findings in the Certification Basis Description and that only 15 were compliant and 130 were non-compliant.¹⁶⁵ At the time, the Project Office acknowledged this as a large number of non-compliances and indicated that this was largely as a result of the VMC report not having been delivered at that point. The Project Office advised ACPA that it expected that the VMC Report would provide evidence of compliance against some non-compliances, however due to aircraft problems found by AMAFTU, that there may still be a large number of non-compliances open at the time the Airworthiness Board considered the application for a Type Certificate. The Project Office indicated that these non-compliances had been managed by raising Issue Papers and introducing operating limits.

8.23 ACPA noted that the Issue Paper summary in the Type Certification package contained a large number of blank spaces, and advised that copies of all Issue Papers should be made available to the Airworthiness Board. The

¹⁶⁴ In April 2009, the Prime Contractor advised the ANAO as follows:

The Prime Contractor performed the test program agreed in the Test and Evaluation Program Plan, passing all the test requirements for IMC. Additionally some of the "preconditions" to IMC testing established by Defence - even if agreed by the Prime Contractor as "issues" - had no relation to flight in IMC and would have in no way precluded the conduct of IMC testing.

¹⁶⁵ Defence advised the ANAO that the Certification Basis Description considers both airworthiness and capability certification requirements. Whilst the report stated 130 findings were non-compliant, a number were in fact partially compliant, however the management system does not recognise partial compliance. Recognition that there may be further non-compliances identified contributed to significant operational limitations incorporated into the Type Certificate.

Project Office commented that a number of the Issue Papers had only recently been released as they had arisen from AMAFTU testing, for which a test report had not yet been issued. The Project Office indicated that the Issue Papers had been provided to the Technical Airworthiness Regulator for comment, but had only informally been advised to the Operational Airworthiness Authority Representative.

8.24 Three days after AMAFTU issued the VMC Report, the Project Engineering Manager signed the Design Acceptance Certificate in support of the award of a Type Certificate on 25 November 2004. The Design Acceptance Certificate listed 37 open Issue Papers. This was an increase of 26 Issue Papers over the Design Acceptance Certificate that was issued in support of the award of a Special Flight Permit. By the time the Airworthiness Board met in December 2004 there were 41 open Issue Papers.

8.25 The ANAO compared Issue Papers that existed at Design Acceptance for Special Flight Permit to those that existed at Design Acceptance for Type Certification, 15 months later. Of the 11 Issue Papers that existed at Design Acceptance for Special Flight Permit, nine remained open when the Design Acceptance Certificate was issued in support of Type Certification. Of the two Issue Papers closed, one related to troop seats, crew seats and airframe crashworthiness. This Issue Paper was closed with no further action recommended on the basis that it was regarded as being a legacy issue. The other Issue Paper closed related to Dynamic Component retirement lives. Both of the closed Issue Papers related to ongoing issues for the helicopter in 2007.¹⁶⁶

8.26 A comparison of the 37 Issue Papers open at the time the Design Acceptance Certificate was issued for Type certification to those included in the Notice of Dispute issued in 2007, revealed that all open Issue Papers identified in the 2004 Design Acceptance Certificate remained open when the Notice of Dispute was issued. Of these, 19 were listed as requiring resolution by the Prime Contractor and 18 were to be resolved by DMO.

¹⁶⁶ The Operational Airworthiness Authority Representative agreed to the removal of the 75 per cent limitation on Dynamic Component Retirement Lives in May 2004 in line with a Technical Airworthiness Regulator recommendation. This recommendation was based on an Australian Design Usage Spectrum which was later found not to be representative of operations conducted under the Special Flight Permit, particularly in terms of the number of take-offs and landings. In November 2004, the Issue Paper for Dynamic Component Retirement Lives was reopened due to significant numerical inconsistencies being identified in the tabulated flight loads and fatigue calculation for the Main Rotor Hub and Main Rotor Drive Shaft. Consequently, the 75 per cent limitation was reimposed. In late 2006, the Technical Airworthiness Regulator noted that loads associated with RAST operation were not accounted for in the calculation of dynamic component retirement times.

2005 deficiency review

8.27 The Technical Airworthiness Regulator recommendation for the award of a Type Certificate in 2004 was based on experience gained during operations conducted by the Navy since the issue of the Special Flight Permit and on the results included in the AMAFTU VMC Report. The Technical Airworthiness Regulator indicated that these collective sources provided a number of differing opinions concerning matters which potentially impacted on the technical airworthiness. On this basis, the Technical Airworthiness Regulator indicated that an independent review of the design limitations was required to provide a clear plan for safely expanding operations beyond the limitations, intended to be imposed through the Type Certificate and Service Release, to meet the required Statement of Operating Intent for the Interim Training Helicopter; and that until this plan was available and agreed by relevant agencies, all operations should be limited to those detailed in the VMC Report.

8.28 The December 2004 Airworthiness Board noted that deficiencies identified in the VMC Report, together with the 41 deficiencies identified in Issue Papers, were being risk managed through limitations to the flight envelope. The Board acknowledged that the aggregation of deficiencies may result in a higher level of risk than would be normal for a type certification and that risk management by restricting flight operations were less effective given the cumulative underlying effect of the deficiencies. Consequently, the Airworthiness Board raised an Airworthiness Corrective Action Request requiring the establishment of a review team to identify which deficiencies could be addressed through design changes, and apply priorities for rectification. The Board had agreed that the CANAG lead the review. The Deficiency Review Team was provided with the following terms of reference by CANAG:

- (a) review all airworthiness Issue Papers and prioritise based on airworthiness impact;
- (b) review the VMC Report deficiencies to determine their impact on airworthiness, their relationship to extant Issue Papers and their impact on capability;
- (c) consider technical solutions for each Issue Paper/deficiency;
- (d) consider the likely cost/practicality of each technical solution; and
- (e) categorise the issues, based on the considerations set out above, in accordance with a criteria set by ACPA.

8.29 The Team provided an Interim Report to CANAG in late March 2005. This report identified that the Detailed Operational Requirements for the Super Seasprite were used as the benchmark against which to consider each deficiency. The Final Report was completed in July 2005 and noted that there were several important factors that needed to be taken into account when considering deficiencies, proposed solutions and through life management of the capability including:

- there was an interrelationship between many of the deficiencies, with individual deficiencies appearing of little significance or not cost effective to rectify, but which cumulatively warranted action;
- solutions considered prior to the review had been bounded by the terms of the Prime Contract;¹⁶⁷
- there were very few easily identifiable quick fixes; and
- system/component reliability was a significant driver behind some of the issues, yet very little data was available.

8.30 The report classified 57 Issue Papers into five priorities for rectification. These criteria are set out in Table 8.5.

Table 8.5

Prioritisation of Issue Papers by the Deficiency Review Team

Priority	Description	Number of Issue Papers
1	Must be corrected for safety of flight in operating environment (airworthiness issue).	20
2	Significant issue that must be addressed to achieve the Detailed Operation Requirements (significant capability issue).	3
3	Monitor in service as the issue did not have an immediate effect on airworthiness or capability, however may have a long term effect (primarily cost of ownership)	13
4A	Rectification complete or not considered necessary for safety of flight or achievement of Detailed Operation Requirements capability.	11
4B	Considered too costly to rectify based on the concept of diminishing return (legacy issues).	10

Source: Deficiency Review Report

¹⁶⁷ Meaning that solutions proposed to rectify issues to that time had not considered means outside the existing contractual arrangements to overcome the difficulties.

8.31 Priority One and Two issues encompassed a range of areas including, but not limited to, issues associated with the AFCS, navigation system, anthropometric restrictions, RAST interface and autorotations. Priority three issues included landing gear static strength and fatigue, RAST issues, main rotor hub static strength, dynamic component lives, crashworthiness and air data computer failures. Priority 4B issues included crashworthiness issues, composite main rotor blades, aspects of the AFCS performance and autorotation flare issues.

8.32 The Restricted version of the report made a series of recommendations which were intended to address a number of Issue Papers.¹⁶⁸ These recommendations included:

- reviewing the FAR 29 certification baseline to address the requirements of a hybrid aircraft and system, and for inaccuracies;
- implementing software modifications to address issues with the Radar Altitude Warning System and AFCS;
- reviewing the System Safety Hazard Analysis to determine whether the assumption that the pilot was a valid mitigant for software induced failures;
- testing the flight data recorder to confirm accurate data is recorded and could be read;
- development of a holistic weight reduction strategy;¹⁶⁹
- investigation of strategies to address control margins and anthropometric deficiencies;
- manual handling trials for merge and demerge with RSD and considering the viability of replacing the RAST system on the ANZAC Ships and the FFGs with the RAST/ASSIST system; and
- assessment of issues associated with Instrument Meteorological Conditions certification.

¹⁶⁸ The Confidential version of this report also contained these recommendations but included a further recommendation questioning the viability of the Project (see Paragraph 10.6).

¹⁶⁹ As indicated in Chapter 6, the increases in all up weight of the aircraft were identified as far back as 1999 as potentially having implications for the operational capability of the aircraft.

Limitations and restrictions

8.33 The October 2003 Technical Airworthiness Regulator's recommendation for the issue of a Special Flight Permit for the Super Seasprite outlined a number of technical risks associated with the aircraft, and a series of limitations for inclusion in the Special Flight Permit. These issues are outlined in Table 8.6 along with an indication as to whether the issues had been resolved by the time the Project was cancelled in 2008.

Table 8.6

Unresolved technical risks identified in October 2003

Technical risk	Operating limitation required	Defence management strategy
The Super Seasprite was regarded as being susceptible to non-divergent ground resonance oscillations when one landing gear member was in contact with the ground.	Yes	Addition of a second weight on wheels switch (one on each landing gear) reduced the incidence of oscillations with software to be modified to further reduce the incidence.
The AFCS was designed as a 'hands on' autopilot, where pilot intervention is the primary mitigation for AFCS failure. At that time, the ability of the pilot to maintain safe flight in the event of AFCS failure had not been fully assessed, demonstrated and tested in a high pilot workload regime.	Yes	Operational mitigations were established in the Special Flight Permit to reduce exposure to higher risk environments. Modifications to the AFCS computer to introduce external sensor error trapping, subsequently known as AFCS Phase 1, were underway.
The Super Seasprite did not comply with modern crashworthiness requirements.	No ¹⁷⁰	A study of the effects on the Australian modifications to the Seasprite was initiated. The outcomes of this study were to be managed through a new airworthiness Issue Paper. Development of a new Issue Paper was commenced but not complete when the Project was cancelled.
The Suitability for Instrument Meteorological Conditions was yet to be demonstrated	Yes	Dependent on resolution of a range of issues.

¹⁷⁰ It was considered that there was no appropriate technical mitigation immediately available to overcome this deficiency.

Technical risk	Operating limitation required	Defence management strategy
Deficiencies in the Radar Altimeter Warning System created the potential to contribute to loss of situational awareness, possibly leading to controlled flight into terrain	Yes	There were two issues with the Radar Altimeter Warning System. The more significant one referred to here was to be addressed through a software change. The 2005 Deficiency Review indicated that the preliminary analysis of this change was favourable but that formal evaluation was required. This was to occur with the introduction of the Full Capability Helicopter.
The dynamic component fatigue lives were calculated using a similar methodology to previous variants of the Seasprite. The typical US Navy fatigue life calculation methodology was to reduce calculated fatigue lives to 75 per cent of the calculated life.	Yes	DSTO was tasked to undertake destructive testing of the main rotor tie-bar which was the component of most concern. At the time the Project was cancelled testing of the tie-bar indicated an improved level of confidence in the integrity of the tie-bar and the issue appeared to be close to resolution.
Wheel brakes had shown a tendency to overheat during moderate braking, resulting in reduced braking effectiveness. ¹⁷¹	Yes	Operation limitations extant in the US Navy for the SG-2F and SH-2G applied with cautions to be incorporated into flight manuals.

¹⁷¹ The attachment to a 2007 Notice of Dispute DMO issued to the Prime Contractor noted that the wheel brakes had the tendency to heat up to the point of smoke emanating from the brake assembly. That document indicated that the implications of reduced brake effectiveness during running landings was the aircraft overrunning the intended landing area during an emergency landing and the risk of fire.

Technical risk	Operating limitation required	Defence management strategy
The demonstrated structural envelope for the landing gear allows for a maximum sink rate of up to six feet per second at a maximum all up weight of 14 200 pounds. ¹⁷²	Yes	Operational mitigations were established in the Special Flight Permit as an intermediate measure. DSTO were conducting further analysis to assess the impact of the RAST on the undercarriage.

Source: Defence Documentation including September 2008 response to Issues Papers.

¹⁷² The landing gear was based upon legacy SH-2 design. The increased risk associated with landing gear strength was reinforced when a New Zealand Seasprite (SH-2G (NZ)) landing gear failed during First of Class Flight Trials. Although found to be outside the RAN design operational sink speed limits, the incident was regarded as demonstrating the likelihood of a failure, especially under increased sea states. In August 2006, the Project Office noted that the six feet limit applying to shipboard landings, while technically sound, created uncertainty as to whether aircrew could remain within this limit while providing the intended capability throughout the life of the aircraft. In April 2009, the Prime Contractor stated as follows:

Prior to the First of Class Flight Trials [FOCFT] in 2004, DGTa, concerned that the requirements of AR-56 [Naval Air System Command Structural Design Requirements for Helicopters] were inadequate, imposed an additional conservatism of requiring an analytical margin of 150% on ultimate strength, which, applied to the undercarriage design, resulted in a 6 ft/sec landing sink rate limit for initial testing. As a result the Prime Contractor conducted additional landing analyses using ship motions with specific outcomes defined as outlined by Defence structural analysis staff. The results of that analysis were briefed prior to the FOCFT at a Program Review in March 2004. This analysis substantiated the original work performed in accordance with AR-56 that showed an acceptable margin of strength up to the operational limit of 12ft/sec descent, and that the DGTa imposed restrictions were overly restrictive and not consistent with the previously accepted shipboard landing techniques for the SG-2G aircraft. Defence undertook to confirm the results of the analysis during FOCFT however AMAFTU’s inability to field an inflight data system prevented that task from being closed.

8.34 The Special Flight Permit set out operating limits applying to the Super Seasprite that were consistent with the limitations set out in Table 8.6. A number of the issues outlined in Table 8.6 were impacted by increases in the all up weight of the aircraft. Issues surrounding limitations on weight and controlling weight increases were significant for the life of the Project as outlined in the Case Study below.

Figure 8.4

Case Study – Increase in all up weight

The 1995 Detailed Operational Requirement for the ANZAC Ship Helicopter set out the requirement for an aircraft of between 6 500 pounds and 13 000 pounds, later increased to 13 700 pounds. In April 1999, it was acknowledged that the Prime Contractor was having difficulty in containing the weight and consideration was being given to increasing the maximum take off weight from 13 500 pounds to 14 000 pounds. The Prime Contractor predicted that the aircraft would fail to meet its contractual mission requirements without this weight increase.

In response to the proposal to increase the maximum all up weight, DGTA commented in May 1999 that this might have implications for aircraft performance and handling qualities; aircraft structural strength margins; aircraft structural fatigue life; the determination of flight loads; and the component retirement times of dynamic components. A June 2004 risk management matrix for the Interim Training Helicopter Introduction Into Service indicated that the increase in all up weight may lead to potential problems of undercarriage collapse, requiring operational limits to be imposed.

The July 2005 Deficiency Review Report recommended that a concerted effort be put into reducing the all up weight of the aircraft which had increased to 14 200 pounds. The report noted that a reduction in all up weight would reduce the adverse impacts of a number of issues.

Briefs provided the Director-General Naval Aviation Systems to senior Defence officers in early 2008 indicated that the increases in the all up weight of the aircraft would impact on the capability to operate from a ship. One of these briefs indicated that the lack of agility over the flight deck, combined with the 700 pound increase in the aircraft's maximum take off weight would limit the maximum sea state for operations to sea state 4. The 1995 Detailed Operational Requirement required that the aircraft be able to operate off an ANZAC Ship up to the high end of sea state 5.¹⁷³

8.35 In April 2009, the Prime Contractor advised the ANAO as follows:

Very early in the program it became apparent that the all up weight of the SH-2G(A) would need to grow to accommodate all of the new mission equipment and still carry sufficient fuel to satisfy the mission requirements. While it was not a desirable thing to do, no alternative existed and, consequently, the Prime Contractor proposed a change from the originally specified 13,500lbs. all up weight to an all up weight of 14,200lbs. Defence approved this change only because the Prime Contractor was able to show the

¹⁷³ Sea state 4 is characterised as moderate with significant wave heights of 1.5 to 2.5 metres and winds of 18 to 20 knots. Sea state 5 is characterised as rough with significant wave heights of 2.5 to 4 metres and winds of 21 to 25 knots.

effect of this increase would be completely offset by improved performance of the CMRB [Composite Main Rotor Blades], a benefit that was not considered in the original specification but that had recently been measured in flight testing of the new rotor. The new rotor was more aerodynamically efficient, requiring the same power in hover at 14,200lbs that the earlier rotor required at 13,500lbs and it was slightly higher in flapping inertia, a characteristic that related to control effectiveness. The increased flapping inertia assured that controllability, including agility, at 14,200lb would be at least as good as it had been at 13,500lb with the earlier rotor. The Prime Contractor went on to prove this by performing a complete and comprehensive handling qualities flight test which verified that the 14,200lb SH-2G(A), with new CMRB, met or exceeded all mandated handling quality requirements.

Formation flying under the Special Flight Permit

8.36 In March 2004, concerns were outlined to the Operational Airworthiness Authority Representative that a planned formation fly past of the NUSHIP Perth¹⁷⁴ in Melbourne by the Super Seasprites was beyond the scope of the Special Flight Permit.¹⁷⁵ A Minute prepared in response to these concerns indicated that formation flying is a core skill of Naval Aviators and, given the level of experience of the trainees, was acceptable and reasonable within the Special Flight Permit at that time.

8.37 In a May 2004 Minute the Technical Airworthiness Authority supported extending the Special Flight Permit subject to the Operational Airworthiness Authority Representative being satisfied that the operating limits remained current and was being adhered to during activities under the Special Flight Permit.¹⁷⁶ The Operational Airworthiness Authority Representative responded to this Minute stating that the operating limits

¹⁷⁴ The NUSHIP Perth was the last ANZAC ship to be launched, it was subsequently known as the HMAS Perth.

¹⁷⁵ These concerns outlined that the approved training syllabus for Super Seasprite in Interim Training Helicopter configuration did not include training for formation flying. In September 2008, Defence advised that the CANAG and the Project Manager were the approval authority for the training syllabus under the Special Flight Permit.

¹⁷⁶ The Technical Airworthiness Authorities recommendation was also subject to the Design Acceptance Representative updating his Engineering Authority for the scope of activities conducted under the Special Flight Permit.

imposed by the Special Flight Permit were acceptable.¹⁷⁷ On 12 June 2004, the ADF Airworthiness Authority renewed the Special Flight Permit, based on recommendations received, with an expiry date of 31 December 2004. The wording of the Special Flight Permit and attachments to the Special Flight Permit were unchanged from the original version of the Special Flight Permit.

8.38 In renewing the Special Flight Permit the ADF Airworthiness Authority directed that an Airworthiness Board be convened to ensure that operations being conducted under the Special Flight Permit were subject to adequate regulatory processes to control risk. An August 2004 brief prepared by ACPA for the September 2004 Airworthiness Board indicated that there were concerns that some operations, while technically authorised within the Special Flight Permit, were outside the intent of the Special Flight Permit. These included demonstration flights and formation flying (See Figure 8.5). The September 2004 Airworthiness Board's view was that while some operations such as demonstration flights and formation flying were beyond the scope of the Special Flight Permit, the risks associated with these operations had been managed appropriately. The Special Flight Permit was not amended after the September 2004 Airworthiness Board review of the Special Flight Permit. Some three months later the December 2004 Airworthiness Board, which recommended the award of the Type Certificate to the Super Seasprite raised an Airworthiness Corrective Action Request due to uncertainty surrounding the impact of some control deficiencies on activities such as close formation flying.

¹⁷⁷ The 15 December 2005 report on the Board of Inquiry into the Crash of a Navy Sea King on the Island of Nias in Indonesia on 2 April 2005 found that the Operational Airworthiness Authority Representative did not receive any training or education with regard to his responsibilities as Operational Airworthiness Authority Representative. In September 2008, Defence acknowledged to the ANAO that at the time covered by this audit the lack of formal training and education of Operational Airworthiness Authorities and Operational Airworthiness Authority Representatives is acknowledged. Defence advised that this had markedly improved since 2005.

Figure 8.5

Super Seasprites formation flying at HMAS Albatross



Source: Department of Defence

Limitations and restrictions in the Type Certificate and Service Release

8.39 The December 2004 Airworthiness Board required the imposition of an extended range of restrictions and limitations on the operation of the aircraft through the Type Certificate and the Service Release.¹⁷⁸ The Board also required that, prior to the issue of a Type Certificate and Service Release, the Operational Airworthiness Authority Representative was to provide ACPA with a report detailing the Mission Risk Profiles in which each of the unacceptable deficiencies identified in the VMC Report had been assessed, including the original risk and the assessed risk. The day after the Airworthiness Board meeting, 805 Squadron prepared a report that evaluated the unacceptable deficiencies identified in the VMC Report from the perspective of risk pre and post the application of risk mitigation strategies. The report indicated that the weighting of all risks would be reduced through the proposed mitigations.

8.40 On 16 December 2004, the ADF Airworthiness Authority signed the Type Certificate for the Super Seasprite Interim Training Helicopter. The Type Certificate prohibited:

- intentional flight in Instrument Meteorological Conditions; and
- landing on ships.

¹⁷⁸ Derived from the VMC Report

8.41 The Type Certificate also set out a number of flight envelope restrictions including:

- centre of gravity limitations;
- weight restrictions;
- relative wind restrictions;
- lift off to hover restrictions;
- rate of descent for landing limitations;
- external load and vertical replenishment restricted to day VMC conditions;
- no sloping ground operations;
- altitude limitations;
- angle of bank restrictions; and
- maximum airspeeds.

8.42 On the same day, the ADF Airworthiness Authority approved the Service Release for the Interim Training Helicopter, subject to a number of limitations that the Operational Airworthiness Authority Representative, Technical Airworthiness Authority, or a combination of both, had authority to close. Service Release limitations included:

- intentional flight in turbulence was prohibited;
- restrictions were placed around the nature of coupled operations that could be conducted;
- boost off running landings were not permitted;
- restrictions were placed on the nature of practice malfunctions that could be conducted;
- aircraft all up weight was required to exceed 12 000 pounds, with flight prohibited where the temperature calculated does not fall within the aircraft's test temperature +/- 10 degrees;
- limitations on autorotation training;
- minimum obstacle clearance of 25 feet for unknown landing sites and confined areas of operation;
- restriction on utility operations;

- flight manual exceedences required authoritative advice from the Original Equipment Manufacturer or DGTA;
- tail rotor gearbox to be removed and quarantined for occurrences of torque 51 per cent above the steady state for dual engine operations, pending clarification of discrepancies between flight manual and maintenance manual for tail rotor gearbox overhauls;
- a 75 per cent cap on all Dynamic Component Retirement Lives; and
- navigation plot independent of the navigation system to be maintained.

8.43 The requirement to maintain a navigation plot independent of the navigation system was as a result of issues with the aircraft navigation system. The management of these issues is outlined in Figure 8.6.

Figure 8.6**Case study – Management of the issues associated with the navigation system**

The Super Seasprites were fitted with two LN-100G Inertial Navigation Units. In October 2001, the Resident Project Team reported on problems identified with the LN-100G during a training flight. These problems included heading errors; intermittent altitude disagreements; and radial error between LN-100G Number 1 and LN 100G Number 2. The report concluded that the number and severity of LN-100G problems observed since the first ITAS evaluation flight had occurred in July 2001 provided little confidence in the LN-100G system or its integration with the ITAS.

In November 2003, the Commanding Officer 805 Squadron wrote to CANAG indicating that flying had been temporarily suspended due to problems with the navigation system. This Minute stated that the squadron had experienced two occurrences where large navigational errors had been induced in both LN-100G Inertial Navigation Units during day VMC conditions. These occurred with no associated warning or cautions and were regarded as insidious in nature. It was therefore considered that restrictions should be put in place.

The Project Office wrote to the Prime Contractor in February 2004 indicating that the restrictions were impacting on training activities. The letter sought assurance from the Prime Contractor that there were no errors in attitude output from the Inertial Navigation Unit as a result of the LN-100G anomaly. The letter sought assurance that a proposed workaround continued to be the recommended approach to mitigating the issue pending a permanent fix. The Prime Contractor confirmed the workaround procedure and indicated that the aircraft attitude was unaffected, except in circumstances where the aircraft turns to a heading to compensate for false drift. In late February 2004, CANAG lifted the restriction on flying operations.

A meeting held in July 2004 noted the issue of excessive LN-100G lateral and heading drift. The meeting was informed that an Inertial Navigation System drift of up to 60 nautical miles per hour had been measured during acceptance testing. The meeting noted that the absence of a crew alert, accompanied by unexpected aircraft drift in coupled hover and erroneous flight information could cause crew confusion and reduce situational awareness.

In early 2007, DMO issued a Notice of Dispute on the Prime Contractor that identified nine occurrences where the system had failed to hold the aircraft in hover as instructed by the Pilot, and subsequently drifted laterally. The implications of this were that until the issue was resolved, the aircraft could not be operated in Instrument Meteorological Conditions and an independent navigation plot was required increasing crew workload. Flight data was not recorded at the time the drift was experienced during flight trials. The DMO was unable to obtain further data as flying was suspended. This absence of data created contractual uncertainty on this issue.

Scope of flying activities under the Type Certificate

8.44 As noted above, a significant range of restrictions were applied to the Super Seasprite through the Type Certificate, Service Release and Special Flying Instructions promulgated by the Operational Airworthiness Authority Representative. The December 2004 Airworthiness Board stated in its report that these restrictions, in comparison to other ADF aircraft, were onerous and conservative, with a significant impact on Interim Training Helicopter capability, and would require substantial effort in the management of the revised flight envelope and their articulation to aircrew. The Board was

confident that the aircraft, if operated in accordance with those restrictions, had a sufficient basis of airworthiness for the Interim Training Helicopter role.

8.45 In October 2007 the Operational Member of the Airworthiness Board advised the ANAO as follows:

When the Airworthiness Board reviewed Seasprite on 9 November 2005 it was mindful of the conditions and limitations that had been imposed on Seasprite Operations. It was also aware that under the Interim Training Helicopter capability the Seasprite was to be employed under Service Release in Interim Training Helicopter Statement of Operating Intent Profiles, specifically, Operational Test and Evaluation, Instructor Training, initial type conversion and the validation of air and ground crew training curricula and publications.

8.46 The Operational Member of the Airworthiness Board also stated that:

In essence, the limitations recommended by the Airworthiness Board and accepted by the ADF Airworthiness Authority restricted the Seasprite to daytime Visual Meteorological Condition operations clear of cloud, could not be flown in close formation or land in confined areas, and could not be employed on ship borne activities unless flown by a Flight Test Aircrew under Flight Test Schedule. It was restricted to a test, development and training schedule.

8.47 The ANAO notes that a December 2005 Minute surrounding the management of in-service support arrangements for the Super Seasprite, indicated concern surrounding the nature of operations being conducted. An example was the participation of the Super Seasprite in a family day. A Minute prepared by the Commanding Officer 805 Squadron subsequent to the family day indicated that the residual risk related to this activity was assessed as medium, which was regarded as acceptable, and that the family day had been approved by acting CANAG. The DMO advised the ANAO that 55 family members were flown on 2 December 2005 but advised that no reference could be found from a higher authority to prevent the flying of families. Defence further advised that the processes under which the Commanding Officer 805 Squadron authorised the Seasprite operations included a detailed risk assessment and management and remained within the scope of the Type Certificate.

Proposal to recommence embarked operations

8.48 In October 2005, the Head Aviation System Division DMO wrote to the Chief of Navy acknowledging the Chief of Navy's imperative to get the Super Seasprite to sea, indicating that this had been established as a priority for the

Project Office. The Minute outlined that, in August 2005, the Chief of Navy had been advised that the Type Certificate and Service Release did not allow for embarked operations other than for trials. The Minute indicated that to remove this restriction the following needed to occur:

- the completion of low speed hard-over tests;
- development of a workaround for cyclic latching on deck;
- closure of the Issue Papers on undercarriage strength; and
- determination of whether or not to use the RAST in any way in the interim (either physically pushing the helicopter in and out of the hangar or using merge and demerge procedures with the RAST).

8.49 The July 2005 Deficiency Review Final Report noted that many of the deficiencies were seen by the Review Team as striking at the fundamental ability of the air vehicle to operate at sea. The review found that a hard-over in the forward axis while over the flight deck of a ship could see the aircraft impact the hangar before the crew could reasonably be expected to react.¹⁷⁹

8.50 An October 2005 Submission by the Operational Airworthiness Authority Representative to the November 2005 Airworthiness Board that was considering the renewal of the Service Release indicated his intent to proceed towards embarkation of the Super Seasprite in the Interim Training Helicopter configuration in 2006.¹⁸⁰ That Submission sought to transfer the restriction on embarked operations from the Type Certificate to the Service Release. This would enable the restriction to be lifted by direct application to ADF Airworthiness Authority rather than through the full Airworthiness Board review process.

8.51 The October 2005 NASPO Submission to the Airworthiness Board also sought to transfer the restriction on embarked operations from the Type Certificate to the Service Release.¹⁸¹ While neither the Operational

¹⁷⁹ The November 2005 Airworthiness Board noted that the Deficiency Review that had been conducted to address a requirement of the December 2004 Airworthiness Board was not independent in nature. All members of the Deficiency Review Team were Naval Officers apart from one civilian. The Team was led by a representative from CANAG and comprised members from the Project Office, 805 Squadron, AMAFTU and DGTA.

¹⁸⁰ The Operational Airworthiness Authority had chaired the Steering Group which oversighted the Deficiency Review.

¹⁸¹ Two of the signatories of the NASPO Submission were members of the Steering Group which oversighted the Deficiency Review.

Airworthiness Authority Representative nor the NASPO submission to the Airworthiness Board referred to the steps outlined in paragraph 8.48, the briefing provided to the Airworthiness Board by the Director of the Project Office indicated that embarkation of the aircraft would be subject to these steps being completed.

8.52 In contrast to the CANAG and NASPO submissions, DGTA'S submission to the Airworthiness Board stated that he did not have sufficient confidence in the integrity of the design [of the Super Seasprite] to conclude that there was a clear basis to enable further expansion of the operations beyond existing limits. The Board did not accept the position of the Operational Airworthiness Authority Representatives and the Director of the Project Office with respect to ship borne activities. Instead, the Board stated that the issues that led to the prohibition of shipboard operations remained namely: the suitability of the ship's RSD; cyclic latching resulting in reduced control margins; and AFCS hard-overs. The Board considered that these issues required resolution prior to a recommendation to remove the restriction on shipboard landing from the Type Certificate.

8.53 The Chief of Navy wrote to the Head Aerospace Systems Division in DMO on 22 November 2005 stating that he was pleased to note the priority of the Project Office to get the Super Seasprite to sea. The Minute outlined that the Chief of Navy remained keen to move forward as quickly as possible and indicated that the timeframe for achieving embarkation by mid 2006 caused him concern. The Chief of Navy indicated that such an evolution would have important symbolic and reputational outcomes and would restore some level of confidence in the wider Navy community.

8.54 In March 2006, CANAG informed the Project Managers Stakeholders Group of the Chief of Navy's goal to have the Super Seasprite to sea by 4 July 2006.¹⁸² CANAG indicated to this meeting that it would be necessary to review the response to this request thoroughly to ensure that the process and outcome of any recommendation would withstand any review, including that by an outside agency. The Minutes of that meeting indicated that the Maritime Commander had agreed to provide a ship, but CANAG indicated that the ship would not be booked until the AFCS hard-over testing was complete.

¹⁸² The person occupying the position of CANAG had changed since the 2005 Airworthiness Board.

8.55 A March 2006 AMAFTU Minute prepared following low speed hard-over testing indicated that the displacement of the aircraft along the longitudinal and lateral axes, following an AFCS hard-over, indicated that flying operations should be restricted to no closer than 50 feet to an obstacle. This was double the 25 feet limit included on the Type Certificate. A December 2005 AMAFTU presentation to the Project Management Stakeholders Group outlined that the associated testing had occurred using control response testing which was regarded as a poor substitute for break-out box testing, as a result assurance could not be provided that a real hard-over case may be worse than testing indicated.

Aircraft crashworthiness

8.56 Crashworthiness of an aircraft is a broad subject. The February 1993 US Army Aeromedical Research Laboratory Report No 93-15, Basic Principles of Helicopter Crashworthiness, offered the following definition:

Crashworthiness can be defined as the ability of an aircraft and its internal systems to protect occupants from injury in the event of a crash. In general, injury in aircraft crashes can be considered to arise from three distinct sources:

- (1) excessive acceleration forces,
- (2) direct trauma from contact with hard surfaces, and
- (3) exposure to environmental factors such as fire, smoke, water, and chemicals resulting in burns, drowning or asphyxiation.

Consequently, effective crashworthiness designs must consider all possible sources of injury and eliminate or mitigate as many as practical for a given design impact limit. This involves considerations of

- (1) strength of the container (cockpit and cabin),
- (2) adequacy of seats and restraint systems,
- (3) energy attenuation,
- (4) elimination of injurious objects in occupants' local environment, and
- (5) post crash factors, principally fire prevention and adequacy of escape routes.

8.57 These factors are consistent with the general crash survival design factors detailed in MIL-STD-1290A, which is the Military Standard Light Fixed and Rotary Wing Aircraft Crash Resistance. It was not a contractual requirement that the Super Seasprite comply with MIL-STD-1290A. This standard was first created in 1988, was made inactive in 1995 before being

reactivated in January 2006. The Super Seasprite was a 1960's design so the legacy characteristics of the aircraft pre-dated this MIL-STD-1290A.

8.58 Of the closed Issue Papers set out in the November 2004 Design Acceptance Certificate, one related to seat crashworthiness not being to the latest standard. The Issue Papers matrix attached to the Design Acceptance Certificate indicated that the Operational Airworthiness Authority Representative had accepted the issues and the Issue Paper had been closed with no further action required. The DMO advised that the crashworthiness of the crew seats had been accepted when the Prime Contract was signed. The 2004 Airworthiness Board which recommended the award of the Type Certificate raised concerns surrounding the crashworthiness of the cockpit and crew seats for which the Board raised an Airworthiness Corrective Action Request. Under this Airworthiness Corrective Action Request, the Project Office was requested to review the Issue Paper on the crashworthiness of the cockpit crew seats, particularly with respect to energy absorption, with the view to reducing the risk of injury to flight crew.

8.59 The issue of crashworthiness has been the focus of two ADF Boards of Inquiry, one following the Sea King Accident at Bamaga, Cape York in 1995, and one following the Sea King Accident at Nias Island, Indonesia in April 2005. The Board of Inquiry into the Nias accident stated as follows:

Although there were scientific studies, research and much effort over the ten year period before the accident, more crashworthy seats were not installed in the Sea King Class of aircraft. A key contributor was the increase in complexity of the task by including all RAN helicopter classes and then the overshadowing consideration of the legal requirement for the ADF to comply with civil safety standards. Additionally, a technical compliance assessment made [in 2003] by DGTA inappropriately provided risk assessment recommendations which were accepted and used as the basis for not proceeding with the Bamaga BOI [Board of Inquiry] recommendation. This matter was not referred to the Chief of Navy for comment or endorsement.¹⁸³

8.60 The 2005 Deficiency Review Final Report specifically identified that the Super Seasprite aircraft system at that time had 20 significant safety related issues. The Team identified that while individually these issues might not

¹⁸³ Budget Paper No.2 2008–09 outlined that the Government would provide \$11 million over four years from 2008–09 to complete the implementation of the Sea King Nias Island Board of Inquiry recommendations which included fitting of energy absorbent seating to the Sea Kings fleet (p.123).

warrant the cost of improved crashworthiness, the Team considered that cumulatively, the likelihood of an incident or accident was such that an incremental improvement in crashworthiness was justified.¹⁸⁴

8.61 The November 2005 Airworthiness Board, which recommended the renewal of the Type Certificate for the Super Seasprite, considered the issue of crashworthiness. The Board's recommendation to the ADF Airworthiness Authority contained the following statement:

The Board expressed concern regarding the continuing uncertainty surrounding the aircraft's crashworthiness standards, particularly in respect of the acceptability of legacy standards and whether the unique modification of the RAN variant might have reduced these standards.

8.62 The 2005 Airworthiness Board raised two Airworthiness Corrective Action Requests in relation to crashworthiness. The first was that a crashworthiness standards review be conducted for the Super Seasprite. The other required the Project Office to provide evidence to the Technical Airworthiness Authority and Operational Airworthiness Authority regarding Super Seasprite crashworthiness; to determine the appropriateness of the legacy certification standard; and to confirm that no regression in Super Seasprite crashworthiness has occurred.

Crashworthiness reviews

8.63 Subsequently two Crashworthiness Reviews were undertaken. The first was undertaken by DGTA personnel and reported in May 2006, the same month the Type Certificate was withdrawn and Navy stopped operating the aircraft. The Second was undertaken by NASPO Personnel. In addition to meeting the Airworthiness Board requirements, the Project Manager requested that the NASPO Review address crashworthiness certification compliance findings and risk assessment, amongst other matters. This Review issued a report in October 2006 which not only assessed the crashworthiness of the Super Seasprite, but also presented further information which showed that the processes in support of design acceptance of the aircraft lacked rigour.

8.64 The May 2006 DGTA report noted that establishing and quantifying the risks with respect to crashworthiness of the Super Seasprite was a complex

¹⁸⁴ The Interim Report of the Deficiency Review had specifically sought to bring a similar group of findings to the attention of the Steering Group that were oversighting the Deficiency Review.

process and the review did not fully address the requirement of the Airworthiness Corrective Action Request. This was attributed to the DGTAs limited access to the Prime Contractor's design documentation and other documentation relating to crashworthiness.

8.65 The DGTAs Review sought to establish the extent to which the Prime Contractor's specifications complied with contemporary crashworthiness standards, in particular MIL-STD-1290A. The standard provided a baseline to identify areas of potential deficiencies that warranted further investigation in order to establish and quantify risk. Table 8.7 shows a number of articles in MIL-STD-1290A that were either not addressed or, were partially addressed which the DGTAs Review Report inferred as being non-compliant.

Table 8.7**Comparison of Super Seasprite to Contemporary Crashworthiness Standards (MIL-STD-1290A)**

Broad requirement	Specific requirement	Result of comparison
Longitudinal impacts	Impact conditions	Addressed
	Earth scooping effects	Partially addressed
	Buckling effects	Partially addressed
	Floor	Partially addressed
Vertical impacts	Impact conditions	Partially addressed
	Design techniques	Partially addressed
Lateral impacts		Partially addressed
Combined impacts		Not addressed
Rollover impacts		Partially addressed
Landing gear		Partially addressed
High mass retentions		Partially addressed
Occupant retention	Pilot and co-pilot seating	Partially addressed
	Cabin seat/passenger Seat	Partially addressed
	Litters	Partially addressed
	Occupant strike envelope	Partially addressed
Cargo and equipment retention		Partially addressed
Post crash emergency escape provisions		Partially addressed
Post crash fire protection	General	Partially addressed
	Hydraulic and oil system	Partially addressed
Electrical systems	Wiring	Addressed
	Batteries and electrical equipment	Not addressed
Airframe and interior material		Partially addressed

Source: May 2006 DGTa Crashworthiness Review

8.66 The DGTa Review identified that there were a number of more concerning aspects about the evidence examined, or the lack thereof, for the Super Seasprite. These concerns included:

- lack of evidence pertaining to the crashworthiness of crew seats, in particular crash force attenuation characteristics. The report indicated

that it appeared that the crew seats provided an unacceptable level of risk of injury as they were non-energy absorbing;

- lack of evidence pertaining to the strength of massed items and relevant systems and structures with simultaneously applied crash loads;
- lack of evidence pertaining to undercarriage crashworthiness;
- areas in which the troop seat did not comply with the General Specification for Helicopter Cabin Crashworthy Seats (MIL-S-85510); and
- caveats contained in evidence pertaining to vertical impacts, and the lack of evidence for the undercarriage retracted conditions.

8.67 The report acknowledged that the aircraft was based on an older design and therefore the crashworthiness should be similarly outdated. However, while it was accepted that the aircraft would retain some of the crashworthiness from its basic design, the aircraft had been heavily modified for the ADF. Therefore it was considered reasonable to expect improvements in the crashworthiness in line with contemporary standards in areas where the aircraft had been modified. Based on the analysis undertaken, minimal improvements had been made to the aircraft design to improve crashworthiness. It was also unclear whether the modifications to the aircraft had caused crashworthiness regression, although a 2003 Compliance Finding Report was identified as supporting concerns in this regard. In April 2009, the Prime Contractor informed the ANAO as follows:

The SH-2G(A) is fully crashworthy and compliant with all crashworthiness requirements of the Prime Contract. The baseline SH-2G from which it is derived has an excellent record of crash survivability and changes from SH-2G to the SH-2G(A) fully considered crashworthiness implications. The resulting SH-2G(A) design sustained the crashworthiness of the parent aircraft and incorporated many new features that significantly enhanced crashworthiness.

Crashworthiness regression analysis

8.68 The crashworthiness regression analysis conducted in October 2006 by NASPO indicated that the Super Seasprite had a number of crashworthiness enhancements as compared to the SH-2G, however it also showed that the Super Seasprite had a number of crashworthiness regressions as compared to the SH-2G. The NASPO Crashworthiness Review contained a table similar to

Table 8.8, which indicated areas in which regression from the SH-2G was believed to have occurred, and an assessment against contemporary standards.

Table 8.8

2006 NASPO Crashworthiness Review regression analysis

	Item	Compared to SH-2G	Compared to contemporary standards
Container	Design crash loads	No regression	Below
	Cabin shell	No regression	Below
	Cockpit longitudinal crush zone	Regression	Below
	Cockpit floor crush zone	Potential regression	Potentially below
	Keel beam modifications	Regression	Potentially below
	Crashworthy main fuel tanks	Potential regression	Potentially below
	External stores pylons	Unknown	Meets
	Composite main rotor blades	Unknown	Unknown
	Radome	Regression	Potentially below
Restraint	Cockpit crew seats	Enhancement and regression	Below
	Passenger/troop/instructor seat	Enhancement	Meets
Energy absorption	Undercarriage	Marginal regression	Below
	Fuselage	Regression	Below
	Cockpit crew seats	No regression	Below
	Cabin passenger/troop/instructor seat	Enhancement	Meets
Environment - local	Cockpit environment	Regression	Potentially below
	Cabin environment	Potential regression	Potentially below
Post crash factors	External fuel tanks	Regression	Below
	Main fuel tanks	Enhancement	Meets
	Crash data recorder	Enhancement	Meets
	Emergency flotation system	Enhancement	Meets

Source: NASPO Crashworthiness Review

8.69 The most notable enhancement to crashworthiness was regarded to be the fitment of crashworthy self sealing main fuel tanks¹⁸⁵ and breakaway valves, whilst the most notable regression was the increased vertical crash load factor due to the strengthened keel beam.

8.70 The NASPO Crashworthiness Review indicated that the increased vertical crash load factor was known to the Prime Contractor and had been declared to DMO. However, it was not linked to the legacy SH-2G by the Prime Contractor, and its significance was not previously recognised nor appreciated by DMO. The NASPO Crashworthiness Review considered that this had invalidated the previous USN SH-2G certification as it pertained to helicopter crashworthiness, and that this had not been identified in the airworthiness certification process. The NASPO Crashworthiness Review indicated that as a result, DMO needed to undertake a full structural crashworthiness assessment of the Super Seasprite in accordance with MIL-STD-1290A so that DMO was fully informed of the helicopter's crash behaviour. The 2005 Deficiency Review had recommended the closure of an airframe crashworthiness Issue Paper for economic reasons.¹⁸⁶

8.71 In addition, the NASPO Crashworthiness Review noted that the increased peak vertical crash load factors invalidated the decision making process during the tender evaluation in relation to cockpit crew seating. The review assessed that the increased peak crash load factors experienced by the Super Seasprite in a 42 feet per second vertical crash were such that the probability of injury to the occupant of the cockpit crew seat would be markedly higher than in an SH-2G. This was regarded as necessitating the urgent replacement of the current cockpit crew seats by a crashworthy energy attenuating seat compliant to MIL-S-58095A, which is a General Specification

¹⁸⁵ MIL-STD 1290A requires that the fuel tanks shall be located away from occupied areas, away from ignition sources and away from areas where structural deformation from the crash impact may cause crushing or penetration of the tank. The NASPO report found that the main fuel tanks are located immediately below cabin occupants in the fuselage lower floor area and the vertical impact crush zone was therefore not compliant with this standard. This suggests that improvements in post crash factors may have contributed to a regression in energy absorption.

¹⁸⁶ This statement was made on the basis that the Deficiency Review Team had determined that the cost of rectification strategies for this Issue Paper were considered to far outweigh the resulting safety or operation improvements.

for Seat System, Crash-Resistance.¹⁸⁷ This was regarded as likely to provide the single greatest return in bringing the crashworthiness of the Super Seasprite closer to contemporary standards. The 2005 Deficiency Review had also come to a similar conclusion.

8.72 The ANAO notes that a significant factor in increasing the peak load was the fitment to the aircraft of the RAST probe structure. The NASPO Crashworthiness Review outlined that the keel beam, which extended along the length of the fuselage had been modified to accept the RAST Probe support structure and to carry the loads induced into the airframe by the RAST probe. Hence, the Super Seasprite lower fuselage was 13 per cent stiffer than the previous two variants of the helicopter and this increased stiffness would result in greater resistance to lower fuselage crushing forces, resulting in higher crash loads being experienced throughout the SH-2G(A) helicopter.

8.73 The DGTA Review had also noted discrepancies between the tender response document and the Prime Contractor's report on the crashworthiness of troop seats. The tender response indicated that the peak load for a 42 feet per second vertical crash was 17.4g.¹⁸⁸ The Prime Contractor's report indicated that the unique modification to the Super Seasprite had increased the load factor for a 42 feet per second vertical crash to 19.7g. While this was within the vertical load factor of 20g set out in the Prime Contractor's Engineering Standard, it was regarded as a regression in crashworthiness with a potential increase to the risk of injury in the event of a crash.¹⁸⁹

Assessment of risk of injury by NASPO

8.74 The NASPO Crashworthiness Review also evaluated the risk of injury. The report indicated that the risk of injury to aircrew in a helicopter accident can be placed into three categories which were as follows:

¹⁸⁷ Four years earlier, in May 2002, DGTA wrote to the Project Office indicating that crew seat crashworthiness for the Seasprite might need to be re-evaluated in light of a report prepared following an AS350BA (Squirrel) accident in May 2001. That report had concluded that the crew seats may not be appropriate for ADF operations, and the legacy certification standards were considered inadequate for what was considered to be a survivable accident.

¹⁸⁸ 'g' denotes a measurement of acceleration.

¹⁸⁹ In April 2009, the Prime Contractor advised the ANAO that analysis of the change to the keel structures impact on energy attenuation for the cockpit seats could have been performed but was never requested by Defence. The Prime Contractor stated:

In the Prime Contractor's opinion, this analysis would have shown either no impact or a completely negligible impact because the keel structural change was localized to the cabin and [was] small in magnitude.

- Category 1 – Acceleration injuries;
- Category 2 – Dynamic injuries; and
- Category 3 – Post crash injuries.

8.75 This review examined the probability of aircrew injury in a crash utilising these categories based on the standard approach of likelihood and consequence to determine the overall risk of injury to aircraft occupants. A summary of this analysis is included in Table 8.9.

Table 8.9

Summary of crash injury risk analysis

Category		Cockpit Crew	Cabin Passengers
1 – Acceleration injuries	Current situation	High	Moderate
	With cockpit crashworthy seats	Moderate	Moderate
2 – Dynamic injuries	All cabin seats fitted	High	High
	Port centre and aft seats not fitted	High	Significant
3 – Post crash injuries	Land crashes with external fuel tanks and all cabin seats fitted	High	High
	Land crashes with external fuel tanks and port centre and aft cabin seats not fitted	High	High
	Land crashes without external tanks and all cabin seats fitted	Moderate	High
	Land crashes without external tanks and port aft and centre cabin seats not fitted	Moderate	Moderate
	Water ditching	Moderate	Moderate

Source: NASPO Crashworthiness Review

8.76 In examining the Super Seasprite against the 2005 Airworthiness Board Airworthiness Corrective Action Requests, the NASPO Crashworthiness Review identified numerous shortcomings in the Super Seasprite's crashworthiness management, beginning with the original Request for Tender and continuing throughout the helicopter's development cycle. The primary reason for these shortcomings identified by the NASPO Crashworthiness Review was a lack of focus on crashworthiness requirements for the helicopter, particularly the omission from the Prime Contract of a requirement for the aircraft to comply with a recognised crashworthiness standard. The Crashworthiness Review considered that it was possible to rectify a number of identified crashworthiness deficiencies, but that it was not either feasible or

possible to rectify all deficiencies. The Crashworthiness Review suggested that the best that could be done was for DMO and Navy to be fully informed of the Super Seasprite's likely crash behaviour, with a view to then developing mitigation strategies. The inability of Defence to confirm compliance against contemporary airworthiness standards for crashworthiness and survivability was a factor in the decision to cancel the Project in 2008.¹⁹⁰

8.77 The ANAO was advised in late 2007 by the Head Helicopter System Division in DMO that ACPA was in the process of developing an ADF Crash Protection Policy. In November 2007, the ANAO sought clarification on the status of the ADF Aviation Crash Protection Policy. That advice indicated that the then Minister for Defence had been advised in May 2006 of the ADF's intention to develop a crashworthiness policy to form the baseline against which to assess ADF aircraft crashworthiness. This advice indicated that following consultation, the Airworthiness Policy Review Committee was to consider the Crash Protection Policy. In September 2008, Defence advised that the policy was expected to be formally promulgated by the second quarter of 2009.

Recommendation No.6

8.78 The ANAO recommends that the ADF Airworthiness Authority require that DMO seek approval from the Technical Airworthiness Regulator prior to any contractual amendments being processed, or modifications to an aircraft being undertaken, that may diminish the crash protection afforded to occupants of an aircraft.

Defence response

8.79 Defence agreed to the recommendation and stated as follows:

Defence will implement this policy change.

Understanding of deficiencies

8.80 The Deficiency Review report contained a finding in relation to the viability of the Super Seasprite as the ANZAC Ship Helicopter.¹⁹¹ This finding

¹⁹⁰ In April 2009, the Prime Contractor advised the ANAO that the SH-2G(A) design met the intent of MIL-STD-1290A with respect to the strength of the container; adequacy of seats and restraints systems; post crash factors, principally fire prevention and adequacy of escape routes; energy attenuation; and elimination of injurious objects in occupants local environment.

¹⁹¹ Both the Restricted and Confidential versions of the report included this finding.

indicated that the review had sought to address individual deficiencies and identify cost effective solutions that could be economically implemented, in a timely manner, such that the Navy received the operational capability originally sought. It further stated that as the Deficiency Review Team continued to explore solutions, it became increasingly evident that the sum of the total deficiencies was of such a magnitude that it was highly unlikely that they will be able to be resolved in the life of the aircraft. Of note, was that many of the deficiencies were seen by the Review Team as striking at the fundamental ability of the air vehicle to operate at sea.

8.81 The terms of reference provided to the Deficiency Review Team required it to categorise the issues in accordance with criteria set by ACPA. The Interim Report stated that the review was being conducted in an environment where action was ongoing to address many of the deficiencies. The Review Team regarded this as impacting on the visibility of issues, as a consequence, the Team determined that categories set by ACPA were insufficient, and developed a refined priority system (see Table 8.5). When requested by the ANAO, Defence was unable to provide evidence that ACPA had been consulted on the changes to the Deficiency Review Team's terms of reference.

8.82 The DGTA Submission to the November 2005 Airworthiness Aboard noted that the Deficiency Review Team had presented a comprehensive report that identified the impact of each individual Issue Paper on the ability of the aircraft to fulfil its operational role. The Submission commented that the recommendations included in the Final Report were specifically targeted towards achieving an acceptable level of capability and not assessing the impact of deficiencies on an airworthiness basis.

8.83 The DGTA Submission to the 2005 Airworthiness Board indicated that, to effectively address the recommendation made to the December 2004 Airworthiness Board that gave rise to the Deficiency Review, a comprehensive approach to addressing all Issue Papers was required. To achieve this, DGTA advised that all Issue Papers, limitations and restrictions required consideration in all combinations, with inter-relationships being investigated and documented. DGTA considered that a specific emphasis on the safety, rather than operational impact of issues was required, to facilitate an expansion of aircraft operations to meet the Statement of Operating Intent for the Super Seasprite.

8.84 DGTA recommended that deficiencies be classified into two categories:

- issues, or combinations of issues, where appropriate risk mitigation is in place to allow for safe flight; and
- issues where a design changes needs to take place to allow for safe flight, with timeframes and costs provided, including a clear articulation of the level of risk being carried by continuing to operate the aircraft and accepted by the appropriate authority for a defined period of time.

8.85 DGTA indicated in his Submission to the Board that the reasoning behind making his recommendation for a further review was that the ADF should not continue to operate the aircraft with possibly unknown or not agreed issues outstanding. DGTA stated that in the event of an incident or accident the ADF Airworthiness Authority may not be in a defensible position to argue the soundness of his decisions to issue a Type Certificate and Service Release.

8.86 The 2005 Airworthiness Board, like DGTA, expressed concern regarding the scope of the Deficiency Review. The Board shared DGTA's concern that the ADF should not continue to operate the Super Seasprite with possibly unknown, or 'not agreed', issues outstanding. The Board accepted DGTA's recommendation for a further review. As a consequence, a further Airworthiness Corrective Action Request was raised by the 2005 Airworthiness Board, effectively for the same reason the December 2004 Airworthiness Board raised an Airworthiness Corrective Action Request.

8.87 The November 2005 Airworthiness Board's recommendation for renewal of the Type Certificate and Service Release for the Super Seasprite was submitted to the ADF Airworthiness Authority through the ADF Operational Airworthiness Authority, the Deputy Chief of Air Force. On the Submission the ADF Operational Airworthiness Authority wrote as follows:

Recommended ongoing AMTC [Australian Military Type Certificate] and SR [Service Release] with current limitations, however the ADF Airworthiness Authority might consider a further [Airworthiness Board] Review in six months given the significant indicator in this report and the wider maintenance standards issues highlighted by the Sea King Board of Inquiry.

8.88 On 2 February 2006, the ADF Airworthiness Authority wrote to the Chief of Navy and the CEO of DMO. This Minute indicated that, notwithstanding the Airworthiness Board recommendation, the ADF Airworthiness Authority remained concerned by the significance of the deficiencies and the burden imposed on aircrew and maintenance personnel

by the deficiencies and limitations. The Minute acknowledged that the Airworthiness Board report also recorded evidence of failures in correct maintenance procedures and a diminishing aircrew confidence in the aircraft. The ADF Airworthiness Authority noted that comments by DGTA surrounding a lack of confidence in the integrity of the design, and the consequent inability to further expand operating limits, were particularly significant.

8.89 The ADF Airworthiness Authority indicated that in light of these issues, and through a keen desire to quickly progress a reduction or removal of limitations so that development of an operational capability could be progressed, the Service Release would apply for six months, not the normal twelve months. This timeframe was intended to allow the next Airworthiness Board review to coincide with the reporting dates for several Airworthiness Corrective Action Requests.

8.90 In February 2006, a Minute was provided to the Operational Airworthiness Authority Representative signed by an officer within DGTA. That Minute stated that DGTA staff had taken on the task of examining all possible deficiencies identified in Issue Papers which presented an increased level of risk over that identified in individual Issue Papers, or which were not accounted for under current risk mitigation strategies or aircraft limitations. The Minute indicated that this analysis concluded that there were no combination of Issue Papers deficiencies that presented a level of risk greater than that currently being accepted, and/or mitigated by the extant Type Certificate and Service Release limitations.

9. Navy Ceases Operating the Aircraft

In 2006 the Type Certificate for the Super Seasprite was withdrawn by the ADF Airworthiness Authority and never reissued. This Chapter examines factors that contributed to this decision which meant that the Super Seasprite could no longer be operated by Navy.

Introduction

9.1 In May 2006, the Super Seasprite's Type Certificate was withdrawn by the ADF Airworthiness Authority. While the frequency of AFCS hard-over events was significant in this regard (see Chapter 1), the large number and slow resolution of aircraft deficiencies was also a contributing factor to this decision (see Chapter 8). As noted in Chapter 6, during the course of the Project Navy transitioned to the ADF airworthiness arrangements, however a decision was taken not to amend the contract to reflect these changes with Defence thereby accepting additional certification risk. Measures to subsequently recertify the aircraft were inhibited by concerns surrounding previous certification activities. While some issues surrounding the aircraft certification emerged over time, there was ongoing concern surrounding certification activities over the life of the Project. These issues are outlined in this Chapter as set out in Figure 9.1.

Figure 9.1

Chapter outline

Navy Ceases Operating the Aircraft

- Type Certificate withdrawn
- Recertification
- Aircraft was not subsequently operated by Navy

Type Certificate withdrawn

9.2 A brief provided to the Chief of Navy by CANAG in March 2006 indicated that a series of factors generated a high risk airworthiness and capability management situation. The brief set out the facts as follows:

- there were a large number of unresolved Issue Papers, several of which were regarded as having an impact on the generation of sea capability,

with a number of Issue Papers not having developed solutions or well defined time lines for resolution;

- there were a significant number of restrictions in place that if not overcome, would prevent the generation of a credible sea capability;
- the software for the Full Capability Helicopter had not been completed and continued to represent medium to high risk;
- the hard-over issue may not be resolved, and represented an unacceptable risk; and
- a further operating restriction was about to be added on top of a range of restrictions already in place, suggesting that as Navy learnt more about the aircraft, confidence was reducing rather than improving.

9.3 The brief indicated that the Type Certificate and Service Release were considered to be at risk at an Airworthiness Board review scheduled for mid 2006. In late March 2006, the then Minister for Defence was informed by the Maritime Commander of DGTa concerns surrounding the frequency of hard-over events. The Minute advised the Minister that, as a consequence, flying had been suspended, but AMAFTU would continue to operate the aircraft in accordance with the constraints set out in the hard-over test flying plan. The previous day the Minister had been informed by the CEO of DMO that the Type Certification for the Super Seasprite may be at risk due to the issues with the AFCS.

9.4 On 8 May 2006, a brief provided to DGTa concluded that the balance of technical deficiencies, together with concerns over previous certification activities provided a lack of confidence in the validity of the Type Certificate for Super Seasprite. The brief outlined a series of issues, including:

- the large quantity and serious nature of technical deficiencies currently extant on the air vehicle;
- the acceptance of legacy specifications in some areas, such as crashworthiness and the AFCS, provided an unacceptable risk to technical certification;
- minimal, and in some cases no progress had been made on the majority of the technical deficiencies since award of the Type Certificate leading to an increased exposure to associated risks;

- at the time there was no appreciation, nor acknowledgement of the potential combinations of technical deficiencies, including lower level deficiencies not covered in Issue Papers; and
- there was evidence pertaining to certification processes that in combination with the technical deficiencies lowered confidence in the Type Certificate.

9.5 In mid May 2006, DGTA wrote to the ADF Airworthiness Authority indicating an absence of progress on many of the deficiencies had resulted in an unacceptable risk exposure. Many of these deficiencies had been known about since the time the aircraft was certified in December 2004. DGTA considered that there was a lack of appreciation for the collective effect of technical deficiencies and an absence of a robust system to support resolution. DGTA indicated that the serious nature, and number of technical deficiencies, underpinned his lack of confidence in the validity of the Type Certificate for the Super Seasprite. Consequently, DGTA recommended the removal of Type Certificate for the Super Seasprite.

9.6 On 19 May 2006, the ADF Airworthiness Authority wrote to the CEO of DMO and the Chief of Navy formally withdrawing the Type Certificate for the Super Seasprite. This Minute stated as follows:

The effect of this withdrawal and the way ahead (should the ADF wish to recommence flying operations) are as follows:

- The ADF is not to fly the Seasprite without first obtaining an airworthiness instrument.¹⁹² This includes test flying under the auspices of AMAFTU flight test authority. This prohibition does not extend to ground-based aircraft preservation.
- Prior to the issue of any airworthiness instrument for Seasprite operations, an Airworthiness Board is to convene to provide me with recommendations regarding scope and limitations in accordance with extant airworthiness practices.

9.7 An e-mail from the Chief of Staff Australian Navy Aviation Group which was forwarded to the Chief of Navy on 26 May 2006 indicated that the CANAG viewed the withdrawal as a positive step, as it would force the numerous issues to be reconsidered from a zero-base. It was considered that

¹⁹² The Chapter in the ADF Airworthiness Manual on ADF Airworthiness Instruments includes Special Flight Permits within its scope.

DMO would now need to address issues in an aggregated way to re-present the aircraft to the ADF Airworthiness Authority to consider the issue of an airworthiness instrument.

Lesson No. 8

Comprehensive management review is essential to avoid a situation where, in order to progress a Project and deliver a capability to the ADF, unidentified significant risk is allowed to build up unchecked which may flow through to the airworthiness system.

Recertification

9.8 Subsequent to the Type Certificate being withdrawn on 19 May 2006, the Super Seasprite needed to be awarded either a Special Flight Permit or a Type Certificate in order for Navy to recommence operating the aircraft. The ANAO found that there had been longstanding concerns surrounding the certification activities previously undertaken by the Project Office.

The engineering management system

9.9 An engineering management system is intended to ensure that engineering is undertaken in a controlled systemic manner with rigour that is appropriate to the airworthiness, capability and programmatic risks associated with the design being undertaken. The engineering management system provides a framework for engineering decisions to be made to ensure risk is documented, managed and appropriate weight is applied in decision-making. The key requirements of an engineering management system are as follows:

- specification of requirement;¹⁹³
- management of changes to specification and engineering data;
- verification of requirement satisfaction;
- determination of competency; and
- a quality system.

¹⁹³ Under Technical Airworthiness Regulation 2.2.3 the Technical Airworthiness Regulator is required to endorse the Statement of Requirements prior to the inclusion of these requirements as part of a formal instrument for the acquisition and related engineering services. As the contract called out the AP (RAN) 10 Navy certification arrangements, which have since been replaced by the ADF Airworthiness Arrangements, the Technical Airworthiness Regulator was not required to endorse the Statement of Requirements, instead this was the responsibility of the Director of Aviation Engineering, Navy.

9.10 Table 9.1 outlines concerns surrounding the Super Seasprite Project Engineering Management System in the period leading up to the Type Certificate being renewed in November 2005.

Table 9.1

Concerns surrounding Engineering Management System

Date	Issue
November 1999	DGTA wrote to the Project Office indicating concern that engineering activities were not being managed with sufficient rigour to facilitate a future recommendation by the Technical Airworthiness Regulator for the issue of a Type Certificate
March 2002	DGTA wrote to the Director-General Rotary Wing Aviation indicating an increasing concern surrounding the Engineering Management System being used to support design acceptance and certification activity for the Super Seasprite. DGTA indicated that while there had been improvement since an audit in 2000 some fundamental deficiencies in the Engineering Management System identified by that audit remained.
April 2002	An internal DGTA Minute raised concerns surrounding the engineering management system being used to support certification of the Super Seasprite. The internal Minute stated that deficiencies within the engineering management system had reached the point where the success of the certification program was in doubt. The Minute indicated that the engineering management system could not provide a controlled environment in which compliance findings ¹⁹⁴ could be effectively undertaken.
June 2002	The Project Engineering Manager advised DGTA that a Seasprite Certification Database had been developed. This database was intended to incorporate and store design acceptance and type certification findings against contract specification and the Project's Type Certification Plan and Certification Basis Description. At that time, the database did not incorporate an up to date version of the ITAS Design Acceptance Database which was to be subsequently released.

¹⁹⁴ A compliance finding is an engineering decision, based on relevant evidence, that an aircraft design satisfies a design requirement, or group of requirements. The relevant evidence may include certifications by national airworthiness authorities; the results of inspections, tests and analyses; or proven similarity with other aircraft designs. Ultimately, the Technical Airworthiness Regulator must be satisfied that compliance with the certification basis has been adequately assured before recommending the issue of a Type Certificate for a new or modified aircraft.

Date	Issue
Mid 2004	DGTA conducted an audit of NASPO. At the time, Aerospace Systems Division was managing the Super Seasprite Project but it was planned that the Project would be transitioned into NASPO after Service Release. The DGTA audit sought to assess the design acceptance strategies for the Super Seasprite. The audit noted that the NASPO Chief Engineer was finding his span of control particularly demanding and challenging, an issue which was compounded by personnel issues. The full transition of the Project to the NASPO Chief Engineer's control was expected to exacerbate this situation. In September 2008, Defence advised the ANAO that the transition, which occurred in June 2005 was delayed to allow NASPO to address audit outcomes. The DGTA audit raised 16 Corrective Action Requests (CARs) ¹⁹⁵ on NASPO that the Project Office. Six were closed by the time the Type Certificate was awarded in late 2004.
October 2005	DGTA conducted a further audit which did not raise any additional CARs but noted that non-compliances were recorded against most open CARs, with overall levels of compliance improving. Three CARs relating to deficiencies in the NASPO Engineering Management System, raised in the 2004 DGTA audit, were regarded as being relevant to the Super Seasprite. ¹⁹⁶
June 2006	An internal NASPO audit was unable to confirm that the observations made in the mid 2004 DGTA audit report on the Project had been adequately addressed.

Source: Defence Documentation

9.11 In recommending that the November 2005 Airworthiness Board renew the Type Certificate for the Super Seasprite, DGTA noted that, notwithstanding improvements in the engineering management framework provided by NASPO and the Prime Contractor, issues relating to refurbishment quality, quality of Original Equipment Manufacturer's advice and inconsistencies in fundamental design analyses had reduced confidence of DGTA personnel in design and production since the Type Certificate was granted.

¹⁹⁵ The Technical Airworthiness Management Manual states that the lead auditor should decide which non-conformances identified by an audit team members are to be raised as CARs. CARs should relate to the root cause of any non-conformance found, rather than just identifying the symptom. Any CARs raised should reflect a specific requirement to rectify a management system deficiency, and hence must be raised against a clearly identified requirement. This may be a Technical Airworthiness Management regulation, or it may be against the organisation's own documentation.

¹⁹⁶ Two of these CARs had been closed the time the Type Certificate was reviewed in 2005. The remaining CAR related to documenting the engineering management of the Super Seasprite in the Engineering Management Plan and Design Support Network. The report indicated that this issue was expected to be closed following verification through a further DGTA audit that was planned to occur in October 2005.

The Design Acceptance Process

9.12 Design Acceptance is the cornerstone of the ADF's technical airworthiness regulatory framework.¹⁹⁷ Design Acceptance is a process resulting in a determination on the technical acceptability of equipment design for service use, regardless of whether the design agency is a Commonwealth organisation or a commercial organisation. A Design Acceptance Representative is an individual with a delegation from the Technical Airworthiness Regulator to undertake Design Acceptance functions in accordance with Regulation 2 of the Technical Airworthiness Regulations. Table 9.2 shows that there were significant delay in finalising key design acceptance documents during which time development activities were proceeding.

¹⁹⁷ As the Prime Contract was executed under AP(RAN) 10 rather than ADF Airworthiness Arrangements the design acceptance arrangements under AP(RAN) 10 applied to the Prime Contract while ADF Airworthiness Arrangements Design Acceptance processes applied to aircraft certification. Defence was responsible for understanding and managing the difference between these airworthiness regimes.

Table 9.2**Development of design acceptance documents**

Date	Issue
June 1997	Contract Signed.
1998	Navy adopts tri-service ADF airworthiness arrangements.
September 1998	Preliminary Design Review conducted.
February 1999	Critical Design Review conducted.
July 2001	Project Design Acceptance Strategy endorsed by DGTA.
November 2001	DGTA endorsed the Certification Basis Description ¹⁹⁸ for the Super Seasprite's Integrated Weapon System.
January 2002	Technical Airworthiness Regulator endorsed the Certification Basis Description for the Super Seasprite, subject to certain caveats.
February 2003	Contract amended to insert provisional acceptance of the interim training helicopter.
October 2003	First aircraft provisionally accepted.
November 2003	Special Flight Permit Awarded to the Interim Training Helicopter configuration.
August 2004	Project Design Acceptance Strategy was restructured to reflect changes in the contract structure relating to the Defence's decision to provisionally accept the helicopter in Interim Training Helicopter configuration.

Source: Defence Documentation

2006 audit of design acceptance process

9.13 A June 2006 NASPO audit noted that several key project management and design acceptance documents for the Super Seasprite Project were out of date or could not be readily located including the Project Design Acceptance Strategy. The NASPO audit made a range of other findings relevant to the Design Acceptance process. These are outlined in Table 9.3.

¹⁹⁸ A Certification Basis Description is a document listing, inter-alia, the individual design requirements and the evidence that demonstrates contractor compliance with the requirements

Table 9.3
Findings of 2006 Engineering Audit of the Project conducted by NASPO

Issue	Description	Findings
Engineering authority	The Design Acceptance system, established in accordance with Regulation 2.5.2 of the Technical Airworthiness Regulations, is required to confirm that personnel are assigned appropriate Engineering Authority to perform Design Acceptance activities relating to the Type Design.	The Project Engineer was the Design Acceptance Representative. The August 2004 Project Design Acceptance Strategy stated that staff undertaking project engineering activities were to be assigned Engineering Authority by the Project Engineering Manager with personnel assessments, authorisations and curriculum vitae's maintained by the Project Engineering Manager. However, engineering staff within the Project had not been formally awarded engineering authority.
Certification Basis Description Database	The ADF Certification Basis Description concept attempts to mirror the US Federal Aviation Administration Compliance Checklist.	Discrepancies were found between the Certification Basis Description Database and the compliance findings. The database did not contain personnel names and the file references were ad-hoc.

Issue	Description	Findings
Original Equipment Manufacturer Audits	The Original Equipment Manufacturer was awarded a Design Authority required under AP (RAN) 10. A surveillance audit was conducted in 2001 which resulted in minor Corrective Action Requests which were rectified and signed off as required.	There had been no further formal oversight of contractors engineering activities since 2001. The 2004 Project Design Acceptance Strategy removed the biennial audit requirement by way of oversight of the contractors operation by DMO resident onsite teams in the US. With the exception of the Business Manager, resident teams returned to Australia in early 2004. ¹⁹⁹
Compliance reports	A compliance finding is an engineering decision, based on relevant evidence, that an aircraft design satisfies a design requirement, or group of requirements.	Records of compliance findings were regarded to be poor. A four part file contained a number of reports, most of which were signed only by the compliance finder. The Type Certification Plan required these to be signed by both the compliance finder and the approver. Evidence was found where compliance reports indicated some level of non-compliance; however the Certification Basis Description Database, from which the airworthiness submission was compiled, recorded the system as compliant. Evidence was found of Project Engineering Manager judgements for fuel tanks, fire extinguisher system and RAST; however documents were not signed. In the supplementary package in support of ADF Airworthiness Authority issue of a Type Certificate the Certification Basis Description stated that the AFCS is "not an airworthiness issue", the outcome states non-compliant.

Source: NASPO engineering audit

¹⁹⁹ DMO advised that during this period the British Standards Institute Incorporated conducted audits against ISO 9001. This audit would have assessed the Prime Contractor's compliance with the procedures documented in the Prime Contractor's quality assurance procedures. The DMO advised that these audits would not have directly assured compliance with AP (RAN) 10 and that it was likely that the audit was conducted without any direct understanding of the requirements of AP (RAN) 10.

The Compliance Finding Process

9.14 As noted in Table 9.3 the 2006 NASPO audit identified weaknesses in the Compliance Finding Processes. The October 2006 NASPO Crashworthiness Review also identified weaknesses in this area. The Review noted that Certification compliance findings were undertaken in accordance with the Project’s Type Certification Plan for the Interim Training Helicopter. As crashworthiness was essentially not a contractual requirement, crashworthiness certification compliance findings were undertaken as an element of other Certification Basis Description items.

9.15 A 2003 Compliance Finding Report was regarded as providing the most comprehensive assessment of crashworthiness, but that Report was limited to reviewing airframe modifications. Table 9.4 provides the NASPO Crashworthiness Review’s comparison of the findings of this report to the final Interim Training Helicopter Accomplishment Summary submitted to the December 2004 Airworthiness Board. The Table shows that there were a number of discrepancies between the Compliance Finding Report and the final Certification Basis Description Accomplishment Summary submitted to the December 2004 Airworthiness Board.

Table 9.4
Comparison of 2003 compliance findings to the 2004 Accomplishment Summary used in support of Type Certification

Description	2003 Compliance Finding Report	2004 Accomplishment Summary
Crash loads and holding doors and other exits open for egress	Not compliant	Compliant
Installation of passenger seat	Not compliant	Compliant
Cargo compartment flooring	Not compliant	Not compliant
Installation of MIL-T-27422 crash resistant fuel tanks	Partially compliant	Compliant
Installation of crew seats and five point harness	Not compliant	Not compliant
Installation of six crashworthy troop seats with four point harness	Not compliant	Compliant
Stretcher support installations	Not assessed	Compliant

Source: 2006 NASPO Crashworthiness Review

9.16 The NASPO Crashworthiness Review indicated that evidence should exist on the decision making process between the 2003 Compliance Finding Report and the 2004 Type Certificate Submission. The Officer conducting the

review was unable to find evidence of this decision making process, and was informed that no document linking the two documents existed. The Crashworthiness Review indicated that the lack of objective evidence of the decision making process upon receipt of a compliance finding report was unsatisfactory and suggested that the decision making process should be fully documented before the Interim Training Helicopter progressed to the Full Capability Helicopter. While the Crashworthiness Review only identified a limited number of instances of this occurrence, the Review suggested that it was possible that the issue was more widespread. Consequently, a complete review of the compliance findings detailed in the Type Certificate Submission compared to actual compliance findings was recommended.

Aircraft was not subsequently operated by Navy

9.17 The Director of the Project Office had informed the November 2005 Airworthiness Board that, in conjunction with the Deficiency Review, the Project Office was developing a ‘roadmap’ for resolution of Super Seasprite Deficiencies and progressing towards achieving Full Capability Helicopter requirements. The March 2006 brief to the Chief of Navy stated that a draft Super Seasprite capability transition map was expected to be ready for consideration in two weeks.²⁰⁰

9.18 In June 2006, DGTA had indicated that, prior to providing a recommendation for a further Special Flight Permit, the AFCS hard-over occurrences would need to be addressed, as would the Crashworthiness Standards. In October 2006, in relation to the preparation of Defence’s 2005-06 financial Statements, the CEO of DMO signed a Super Seasprite Impairment Statement²⁰¹ which stated as follows:

The Super Seasprite will deliver a capability, albeit compromised, that will be in-service with Navy by 2009. The two major technical risks remaining are resolving the Automatic Flight Control System (AFCS) safety issue that

²⁰⁰ The DMO advised the ANAO that the Roadmap and the Transition Map are the same document and that the terminology changed over time. The Seasprite Roadmap was later referred to as the Certification Way Ahead Plan.

²⁰¹ Accounting Standard AASB 136 prescribes the procedures that an entity applies to ensure that its assets are carried at no more than their recoverable amount. An asset is carried at more than its recoverable amount if its carrying amount exceeds the amount to be recovered through use or sale of the asset. If this is the case, the asset is described as impaired and the Standard requires the entity to recognise an impairment loss.

emerged in March 2006²⁰² and the closure of airworthiness Issue Papers in the lead up to re-certification in 2008.

9.19 A June 2007 presentation to the Project Manager Stakeholders Group, prepared by the Project Office, envisaged that Special Flight Permits would be issued in late 2007 and expanded in mid 2008 and in late 2010. These Special Flight Permits were timed to correspond with modifications to the AFCS to address airworthiness concerns and in line with additional functionality being provided by the ITAS. The presentation indicated that the Full Capability Helicopter was planned to achieve Type Certification in late 2011, some nine years after the original Prime Contract was meant to be completed and 14 years after the Prime Contract was signed. This document indicated that the status of the Certification Basis Description for the Interim Training Helicopter was not clear and suggested that it had not been completely endorsed by the Technical Airworthiness Regulator.

9.20 In September 2007, the ANAO sought clarification on issues surrounding the Design Acceptance Process. DACPA provided the following response:

The number of Issue Papers open at the time of the Type Certificate Airworthiness Board was a concern to the Technical Airworthiness Authority at the time which is recorded in the Airworthiness Board Recommendation. The Project Office indicated that the problems would be resolved in a matter of months.

The consideration of risk exposure was a factor in granting Type Certificate. If the real closure time had been presented, I am confident that Type Certificate would not have been granted.

The problems that have since been found with the Seasprite AFCS and ITAS suggest that the Design Approval decisions by the Contractor and the assessment of compliance findings by the Project Office were inadequate.

9.21 The Super Seasprite was never issued with a Special Flight Permit or Type Certificate in the period between when the Type Certificate was withdrawn in May 2006 and the Project was cancelled in early 2008.

²⁰² The ANAO notes that this statement does not comprehensively reflect the history of the AFCS issue. Albeit that the AFCS contributed to the decision to ground the aircraft in early 2006, the AFCS issue that led to this decision had been known about since late 2003. Concerns were first expressed surrounding the approach to developing the AFCS in 1998.

Recommendation No.7

9.22 The ANAO recommends that, to further strengthen the processes supporting issue and renewal of airworthiness instruments, the ADF Airworthiness Authority require that:

- (a) when practical, Technical Airworthiness Regulator audits be timed to inform key decision making processes regarding the issue or renewal of airworthiness instruments;
- (b) where audits identify systemic weaknesses sampling be undertaken to validate that documentation submitted in support of the award of airworthiness instruments can be reconciled to Compliance Finding Reports; and
- (c) the report of any such audit be submitted to the Airworthiness Board as an attachment supporting the Technical Airworthiness Regulator's recommendation to issue or renew a Type Certificate.

Defence response

9.23 Defence agreed to the recommendation and stated as follows:

By 30 June 09, the ADF Airworthiness Authority will:

- (a) amend its compliance assurance processes, so that the Airworthiness Board schedule is considered when the timing of audits is developed;
- (b) propose changes to Airworthiness Board processes, to allow targeted documentation sampling; and
- (c) amend its Airworthiness Board submission process, so that copies of audits identifying systemic airworthiness instrument weaknesses with airworthiness instruments are provided to the Airworthiness Board.

10. Cancellation of the Project

In March 2008 the Government announced that it had decided to cancel the Project. This Chapter outlines factors that contributed to the decision to cancel the Project and the associated financial outcomes.

Introduction

10.1 As noted in Chapter 4, cancellation of the project was considered on a number of occasions in 2001 and 2002. Two briefs to the Under Secretary of Defence Materiel during this time raised the option cancellation, but both recommended against it. The Under Secretary advised that, notwithstanding the recommendations, serious consideration was given to cancelling the project. He advised that while there was deep concern over the performance of the contractor, the following issues militated against cancellation at that stage:

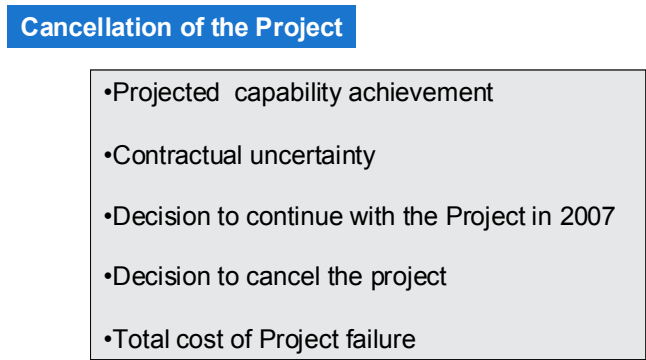
- Navy still required the capability and was pushing strongly for the aircraft to be available;
- The delay involved in cancelling the contract and acquiring new aircraft, assuming that the government was prepared to make funds available, was assessed as being significantly longer than the time required to fix the major issue at that stage, that is the ITAS;
- DMO had concerns about the financial capacity of the contractor and believed that little if any of the \$600 million to \$800 million expended to that point could be recovered;
- The aircraft was operational, albeit in a different form, with the Royal New Zealand Navy, and
- The Government was unlikely to agree to terminate the project at that stage given the above considerations and the fact that, while the problems were serious, there did appear to be a way through them. This view was borne out by the fact that the same Government declined to cancel the project over five years later in 2007 when the cumulative effect of the problems was far greater than in 2001.²⁰³

²⁰³ E-mail to ANAO from Mr Michael Roche former Under Secretary of Defence Materiel to ANAO dated 21 May 2009

10.2 Accordingly the decision was taken to seek to allow for the provisional acceptance of the Super Seasprite in the Interim Training Helicopter configuration, with the Prime Contract amended to allow this to occur in 2003. From late 2003 to mid 2005, nine aircraft were accepted under these arrangements. The aircraft was operated in this configuration from late 2003 to late March 2006, initially under a Special Flight Permit and then under a Type Certificate. Achieving the desired rate of effort for the aircraft during this period proved problematic which in turn impacted on the capacity to undertake flight testing required for aircraft certification. In May 2006, the Type Certificate was withdrawn and never reissued. No Super Seasprite was ever accepted in its final configuration. This Chapter focuses on the period from mid 2005 to when the Project was cancelled including associated settlement arrangements, as outlined in Figure 10.1.

Figure 10.1

Chapter outline



Projected capability achievement

10.3 In March 2005, the Project Director assessed the status of the Project against the Detailed Operational Requirements for the ANZAC Ship Helicopter. The Detailed Operational Requirements included 138 essential requirements with the Project Director confident in March 2005 that the Prime Contractor had demonstrated achievement of 73 per cent of these requirements at that time. Achievement of most of the remaining requirements was yet to be demonstrated.

10.4 The Deficiency Review Team used the 1995 Detailed Operational Requirements²⁰⁴ as part of its methodology in classifying issues. There were two versions of the July 2005 Deficiency Review Final Report — a version classified as Restricted and a Confidential version. The Restricted version of the report included a finding that as the Team continued to explore solutions it became increasingly evident that the sum of the total deficiencies was of such a magnitude that it was highly unlikely that they will be able to be resolved in the life of the aircraft. The Restricted version contained a series of recommendations intended to achieve some degree of resolution of these deficiencies.

10.5 The Confidential version contained a finding and associated recommendation that were classified as Confidential at the time. The finding is set out below:

The Team firmly believes that it was time to for the ADF to consider an alternate platform to fulfil the intended roles of the ANZAC Ship Helicopter/littoral strike weapon.

10.6 Consequently, the Team recommended as follows:

The Team strongly recommends the SH-2G(A) not be further pursued as the ANZAC Ship Helicopter/littoral strike weapon.

10.7 In September 2005, the acting CANAG provided a version of the Deficiency Review Report to the Chief of Navy and the Maritime Commander at a Restricted level, which consequently did not include the above mentioned paragraphs which were classified as Confidential. DMO advised the ANAO in February 2009 that the members of the Steering Committee had not provided the Confidential version to the Chief of Navy and the Maritime Commander because the finding and recommendation set out in paragraph 10.5 and 10.6 were beyond the terms of reference of the Deficiency Review.²⁰⁵

²⁰⁴ The Detailed Operational Requirements primary purpose is to define the broad specifications and capability of the capital equipment being acquired and as such is not focused on airworthiness issues.

²⁰⁵ The terms of reference were defined by DACPA to CANAG in a minute dated 15 February 2005. CANAG then provided a minute to the Deficiency Review Team on 25 February 2005 which used the word capability rather than the word safety, which is the focus of the airworthiness management system. The interim report by the Deficiency Review Team to the Steering Group over sighting the deficiency review identified that the Deficiency Review team had modified the categorisation system set out in the DACPA minute of 15 February 2005. DMO was unable to provide any evidence indicating that the Steering Group consulted with DACPA surrounding this change. Both the DGTA minute to the 2005 Airworthiness Board and the Airworthiness Board report itself noted that the Deficiency review was capability focused, and as such had not fulfilled its intended purpose in an airworthiness context.

10.8 However, the ANAO notes the finding of the Deficiency Review Team as contained in the Restricted version of report described in paragraph 10.4 alludes to the same issue. The minute to the Chief of Navy and the Maritime Commander specifically drew attention to this statement. This minute noted that ‘while a holistic capability statement was beyond the reviews terms of reference, it was concerning that after considerable deliberation the team were unanimous in requiring its inclusion and the subsequent conclusion and recommendations drawn from it.’ In contrast to the Deficiency Review Team findings as set out in the Confidential version of the report, the minute advised that, from a strategic perspective, the Steering Committee assessed that the platform would meet most of the Detailed Operational Requirements and the contractual requirements, albeit with potentially with some limitations and at a higher risk than contemporary aviation platforms.

10.9 A brief to the then Minister of Defence was signed by the Director-General Navy Aviation Systems 10 days after the Team issued its Final Report in July 2005. The signature block indicated that the brief had been cleared by the Head Aerospace System Division and the CEO of DMO. The brief stated that it remained Defence’s assessment that the Super Seasprite, although less capable than expected in some areas, would meet minimum requirements specified in the Detailed Operational Requirements for the ANZAC Ship helicopter.

10.10 The ANAO notes that the advice provided to the then Minister in this brief is inconsistent with the findings contained in the Deficiency Review Final Report, in terms of the anticipated capability achievement. The advice contained no reference to the finding and recommendation of the Deficiency Review set out in paragraphs 10.5 and 10.6. Comments made on a cover sheet attached to the brief by personnel within CANAG expressed serious reservations surrounding the statement made by DMO on behalf of Defence surrounding the capability expected to be provided. In March 2009 Defence advised the ANAO as follows in relation to the inconsistency between the findings of the Deficiency Review and the Ministerial brief:

This inconsistency is not agreed. The advice to the Minister was not inconsistent with the outcomes of the Deficiency Review. It remains true that the Seasprite, given sufficient time and resources, could meet the minimum requirement of the Detailed Operational Requirements document, although it would remain a compromised capability.

10.11 On 2 February 2006, the Chief of Air Force signed a Minute in his role as Senior Aviation Advisor. This Minute was addressed to the Chief of Navy and the CEO of DMO, with an information copy provided to the Chief of Defence Force. This Minute indicated that, notwithstanding that the Airworthiness Board normally refrains from making capability determinations, several issues were raised in the November 2005 Airworthiness Board for the Super Seasprite that highlighted fundamental deficiencies in the capability of the aircraft.

10.12 Further, the Chief of Air Force advised that the findings in the July 2005 Deficiency Review were regarded as providing a worrying outlook for progression of the Super Seasprite toward a capability fit for its intended purpose. The ANAO notes that this Minute was based on the information derived from the Restricted version of the Deficiency Review Final Report.²⁰⁶ On 28 March 2006, in a brief to the Chief of Navy CANAG indicated that the time for considering the broader capability, personnel and financial impact of the program had arrived.

Senior Officer Review

10.13 In May 2006, a Senior Officer Review was undertaken of the Project involving the CEO of DMO, the Chief of the Capability Development Group, the Chief of Navy and the Chief of Air Force. A presentation to this review prepared by NASPO contained the capability projections for the Super Seasprite set out in Table 10.1.

Table 10.1

Capability projections for Super Seasprite - May 2006

Primary mission	Capability projection (per cent)
Surface surveillance	95
Anti surface warfare	70
Anti submarine warfare	80

Source: May 2006 NASPO Presentation to Senior Officer Review of the Super Seasprite Project

²⁰⁶ In March 2009, Defence informed the ANAO that the fact the Chief of Air Force was making capability statements based on the Defence Deficiency Review report indicates that capability managers were able to draw their own capability conclusions, free from contractual considerations, from the Restricted version of the Final Report.

10.14 That presentation also included a schedule for the Project. Table 10.2 compares the schedule provided to the May 2006 Senior Officer Review of the Project with a schedule subsequently provided to the Parliamentary Secretary for Defence Procurement in January 2008. This comparison shows that over the period from May 2006 to January 2008 the Project continued to encounter ongoing slippage. During this period contractual negotiations for the remainder of the Project had not been finalised through contractual amendments and Navy had been unable to utilise the Super Seasprite in any capacity since May 2006 given that the Type Certificate had been withdrawn.

Table 10.2

Projected schedule slippage May 2006 to January 2008

Description	May 2006 schedule	January 2008 schedule
Limited test flying resumes	Jan 2007	2 nd half 2008
First of Class Flight Trials	Feb-Apr 2007	2010
First Full Capability Helicopter accepted	Apr 2007	1 st quarter 2009
Flight Simulator acceptance	Apr 2007	2008
AFCS Phase 2	Jun 06 and Nov 2007	1 st quarter 2008 – 3 rd quarter 2010
Final certification	Jan 2008	Late 2010
Initial Operational Capability	2009	Late 2011

Source: May 2006 NASPO Presentation to Senior Officer Review of the Super Seasprite Project and January 2008 advice to Parliamentary Secretary for Procurement

10.15 In May 2006, the CEO of DMO provided the then Minister for Defence with a brief on the outcome of the Senior Officer Review. This brief reflected the relevant schedule outlined in the May 2006 column of Table 10.2. The brief also outlined a two phase program to address design and reliability issues with the AFCS noting that DMO may have to fund part of this program, as opposed to requiring the Prime Contractor to undertake all of this work at its own cost. On 15 May 2006, the then Minister for Defence indicated in a doorstep interview that he had asked the Chief of the Defence Force and the Chief of Navy to provide all options the Government might consider with respect to the Project. In late May 2006, during Estimates hearings, the Chief of the Capability Development Group advised the Senate Foreign Affairs and Defence Committee that three options were being considered for the ANZAC Ship Helicopter and these were:

- continuing with the Super Seasprite;

- procuring Sikorsky 60R Seahawks; or
- procuring Eurocopter NH90 maritime or naval combat aircraft.

10.16 A September 2006 Minute to the Chief of Navy and the CEO of DMO from the Chief of the Capability Development Group advised that the Defence Capability Investment Committee had agreed that the Super Seasprite would only be capable of providing an interim capability and that there would be merit in bringing Project Air 9000 Phase 8 (Seasprite and Seahawk replacement) as far forward as practicable. That Minute further stated that the Defence Capability Investment Committee required an understanding of the options to provide an interim capability from late 2008 until the delivery of Project Air 9000 Phase 8, which was estimated to be between 2012 to 2017. The Chief Capability Development Group stated that Business Cases for the following options needed to be developed:

- (a) Super Seasprite in-service until 2025;
- (b) Interim capability provided by Super Seasprite and Seahawk mix; and
- (c) Interim capability provided by Seahawk alone.

10.17 The October 2006 Business Case prepared for option (a) stated that 11 Super Seasprites could not achieve six flights (that is operational, manned helicopters) at sea and that four embarked flights was the maximum that could realistically be achieved. The Business Case included the results of a general flying assessment of the Super Seasprite that had been conducted and these are set out in Table 10.3. The Business Case outlined that the assessment was subject to a number of conditions being met which are also outlined in the Table 10.3.

Table 10.3

General flying capability assessment – October 2006

Flying condition	Capability (percentage)	Conditions
Visual Meteorological Conditions	90	Assessment was subject to the rectification of AFCS safety with a real cost increase of less than \$20 million being regarded as required.

Flying condition	Capability (percentage)	Conditions
Instrument Meteorological Conditions	80	The aircraft was yet to demonstrate its capability to operate in conditions of poor visual reference where control of the aircraft was exercised by reference to the aircraft's internal instrumentation. ²⁰⁷
Embarked – central centre of gravity	75	Assessment was subject to the rectification of the RAST but notwithstanding this it was expected operations would be limited to top of sea state 4.
Embarked – asymmetric centre of gravity ²⁰⁸	30	Project Office analysis indicated that when returning to a ship with a single Penguin Missile and minimum land on fuel, which generates the worst case lateral centre of gravity, the aircraft may not be able to be recovered with wind over the flight deck from directly ahead. ²⁰⁹

Source: Defence Business Case

10.18 The Business Case indicated that, within the general flying limitations set out in Table 10.3 the same projections of capability could be achieved as are were assessed in May 2006. These projections, as set out in Table 10.1, were that the Super Seasprite would achieve 95 per cent of the surface surveillance

²⁰⁷ In April 2009, the Prime Contractor indicated that its disagreed with Defence's assessment of the Super Seasprite's capability in Instrument Meteorological conditions stating that:

The SG-2G(A) was qualified by the Prime Contractor for operation in IFC, or IMC in accordance with Prime Contract requirements and military standard MIL-H-8501A, General Requirements for Helicopter Flying and Ground Handling Qualities.

²⁰⁸ See paragraph 10.21.

²⁰⁹ In April 2009, the Prime Contractor advised the ANAO as follows:

Regarding the lateral cg [centre of gravity], this issue was discovered, and rectified, during build-up testing to the final handling qualities and performance flight tests. During these tests the Prime Contractor determined that the original Anti-Surface Warfare Mission configuration was not optimum in that operations with a single Penguin missile were stipulated with that missile on the wrong side of the aircraft but that this could be corrected simply by reversing the stipulation. By way of explanation, carrying a single Penguin Missile, which weighs in excess of 1000lbs produces lateral cg offset. This, in turn, creates the need for the cyclic stick to be trimmed in the opposite direction to maintain level attitude, using some lateral control margin. Single rotor helicopters, with tail rotors, like the SH-2G(A), are already asymmetric relative to the lateral control position, because the need to counteract the tail rotor thrust uses some lateral control. In the original Anti-Surface Warfare Mission configuration with a single missile the Prime Contractor had inadvertently located the missile on the side of the aircraft where these two effects would be additive and this was found in flight test, to be unacceptable. Moving the single missile to the opposite stores station was found to completely correct this problem, again proven through flight testing.

capabilities, 70 per cent of the anti-surface warfare capabilities and 80 per cent of the anti-submarine capabilities required to undertake its primary missions.

10.19 Subsequently, in April 2007, a report prepared by NASPO to Defence's Aerospace Systems Design Advisory Board was presented with information that indicated that the Surface Surveillance and Anti-Submarine Warfare capabilities would be achieved. The table in that report providing this information is replicated in Table 10.4.

Table 10.4

Projected Achievement of Key User Requirements - April 2007

Key User Requirements	Achieve	Forecast Performance
Surface Surveillance	Yes	
Anti-Surface Warfare	No	Aircraft handling qualities will likely restrict the Ship Helicopter Operating Limits, reducing the availability of the system in less than ideal environmental conditions.
Anti-Submarine Warfare	Yes	
Boarding Party Operations	No	Aircraft will carry and deploy 5-man boarding party, in light patrol order, in accordance with the contract. Fleet requirement is now eight-man boarding parties. The aircraft cabin is too small to carry the three additional personnel.

Source: April 2007 Report to Aerospace Systems Design Advisory Board

10.20 The April 2007 Aerospace Systems Design Advisory Board was advised that the following activities needed to be undertaken to complete the Project:

- completion of tactical system software development;
- flight control system remediation and associated flight test activities;
- addressing navigation system anomalous behaviour identified prior to the suspension of flying;
- addressing aircraft/ship interface, compatibility issues identified during initial First of Class Flight Trials; and
- acceptance and introduction of the Flight Simulator and Software Support Centre.

Impairment calculated based on projected capability

10.21 The Super Seasprite Statement of Impairment²¹⁰ endorsed by the CEO of DMO in October 2006 stated the following in relation to the aircraft's capability:

Defence has conducted an extensive review of Seasprite with a view to developing a current impairment figure. When the outstanding milestones, including the AFCS remediation is complete, Defence estimates that the delivered product will be over 95% contractually compliant. Less than 5% of flying operations at sea, and less than 10% of flying operations on land will be affected once the safety issue is resolved. The most severe restriction (asymmetric loaded missile with minimum fuel and restricted ship manoeuvrability) will only affect operations on the rarest occasions and Defence expects to have 95% of the primary and most important surface surveillance role, over 70% of anti-surface warfare capability, over 80% of the anti-submarine warfare capability, and around 95% of the important training roles. When an increased weighting is placed on the more important roles of surface surveillance and training, Defence estimates that due to the above limitations and restrictions, Seasprite will represent a limited and impaired capability of 10%, irrespective of the ongoing remediation work.

10.22 The Statement of Impairment concluded as follows:

As the Defence senior procurement officer, I assess that impairment against the Seasprite helicopter can be reasonably assessed as 10% of the current spend. You might like to assess the portion of the project, SME [Specialist Military Equipment], and AUC [Assets Under Construction] balances this applies to.

10.23 However, following further consideration by the Defence Capability and Investment Committee and other Senior Defence representatives taking into account additional factors, a decision was made by the Secretary of Defence and the Chief of the Defence Force in consultation with the CEO of DMO²¹¹ to impair the Super Seasprites by 15.5 per cent.

²¹⁰ Accounting Standard AASB 136 – *Impairment of Assets* prescribes the procedures that an entity applies to ensure that its assets are carried at no more than their recoverable amount. An asset is carried at more than its recoverable amount if its carrying amount exceeds the amount to be recovered through use or sale of the asset. If this is the case, the asset is described as impaired and the Standard requires the entity to recognise an impairment loss.

²¹¹ 16 March 2009 advice from CEO of DMO to ANAO.

10.24 In this light, DMO wrote off \$49 million from the Project's Assets Under Construction balance at 30 June 2006. Defence also wrote off \$66 million from the Specialist Military Equipment balance at 30 June 2006. This resulted in a total impairment adjustment for 2005–06 of \$115 million.

10.25 The status of the Project, as at June 2007, indicated a significant risk of impairment, given that there had been little progress in addressing technical issues and progressing ongoing negotiations with the Prime Contractor. While there were indicators of risk regarding impairment, no dollar value of impairment was able to be quantified for 2006–07 until crystallisation of contract negotiations and resolution of technical issues.

Contractual uncertainty

10.26 The June 1997 Negotiating Report identified that no liquidated damages were included in the Prime Contract but did identify a package of Performance Measures including:

- the financial guarantee deed having a component for performance;
- a deed of novation whereby Kaman Aerospace Corporation was obliged to stand in the stead of Kaman Aerospace International Corporation if the latter did not perform;
- a cost schedule control system with earned value payments; and
- identified key contract milestones, with cessation of all payment when critical milestones not achieved.

10.27 By late 2007, the opportunity to utilise a number of these arrangements had passed as critical milestones had been paid and the bulk of expenditure against the Prime Contract had occurred (see Chapter 3), or applying the arrangements was considered to be of marginal benefit or contractually problematic. Under the provisions of the 2008 Settlement Deed signed by the parties following the cancellation of the Super Seasprite Project, the Deed of Novation and Indemnity and the Financial Security Deeds are terminated on conditions surrounding securitisation of future payments under the Settlement Deed being met .

10.28 A late 2002 brief to the then Under Secretary of Defence Materiel identified that in implementing changes to the Prime Contract in accordance with the May 2002 Statement of Principles some rights the Commonwealth had under the existing contract would change significantly. The May 2002

Statement of Principles was given effect in the Prime Contract through CCPs 53 and 56 in early 2003.

10.29 DMO documentation surrounding CCP 56 indicated that the preservation of rights was the subject of intense negotiations between DMO and the Prime Contractor with the subsequent contract amendment included a clause which was intended to preserve pre-existing rights. The ANAO notes that in early 2002 there was uncertainty as to what rights existed at that time and by early 2007 there were varying views on the extent that clauses inserted with intent of preserving the Commonwealth's rights had achieved this outcome.

10.30 Legal advice obtained by DMO in 2002 recommended that DMO conduct a thorough examination of the entire course of dealings with the Prime Contractor to come to a more settled position about what rights DMO had in relation to the Prime Contract and the ISS Contract. That advice was not implemented at the time. DMO documentation from mid 2006 indicated ongoing contractual uncertainty contributed to by arrangements being agreed other than through contractual amendments, such as AFCS Phase 1 and Phase 2 remediation work, and poor record keeping. These issues created significant difficulty in determining the precise terms of the legal relationship between the Commonwealth and the Prime Contractor.

Measures to retain rights and improve contractual certainty

10.31 In late 2006, DMO General Counsel provided advice to the CEO of DMO about the termination options and suggested the Commonwealth and the Prime Contractor were now in substantially the same position as was the case in 2002. Consequently, the General Counsel recommended that an approach similar to that recommended in the advice provided in 2002 be followed which was:

- pursuing a negotiated solution including outstanding claims;
- conducting a more thorough investigation of the course of dealings between the parties; and
- commencing a formal dispute process.

10.32 In late October 2006, DMO General Counsel advised the Secretary of Defence that, under Australian Capital Territory legislation,²¹² DMO would be statute barred if claims were not made within six years from the date the breach was made. The DMO General Counsel advised that the first delay breach for delivery of the first helicopter occurred in March 2001 meaning that, to preserve DMO's rights, proceedings needed to be commenced no later than March 2007. To achieve this, a Notice of Dispute had to be issued by 17 January 2007 to enable the steps specified in the Prime Contract to enable arbitration to commence prior to 1 March 2007.

10.33 The DMO issued a Notice of Dispute on the Prime Contractor on 17 January 2007. The Notice set out matters in dispute or differences between the Prime Contractor and DMO as set out below:

- Failure to deliver helicopters by the dates provided in the Contract;
- Failure to provide adequately for the proper design of the helicopters and failure to meet or comply with specifications for the helicopters;
- Failure to provide adequately for proper safe design of the helicopter, and so far as they have been delivered, failure to deliver helicopter which are safe; and
- Failure to properly design the helicopters for use with the RAST system in use on the ANZAC-class of ship.

10.34 These matters had been longstanding issues for the Project, noting that the last 10 helicopters were to be delivered in their final configuration in November 2005. In March 2009 DMO advised the ANAO that it had not issued a Notice of Dispute before this time as it was seeking a negotiated settlement with the Prime Contractor.

Coordination of legal activities

10.35 The Notice of Dispute was issued during a period when DMO was in the process of negotiating a Deed of Variation with the Prime Contractor to resolve outstanding matters relating to the Prime Contract, including issues associated with the AFCS. A different legal firm was advising on the Deed of Variation negotiations to that which was advising on the dispute process. DMO documentation suggests that the firm advising on the Deed of Variation

²¹² *Limitation Act 1985 (ACT)*

was not informed of the intent to commence dispute proceedings. The Prime Contractor subsequently sought the insertion of a provision that made the operation of the Deed of Variation contingent on the satisfactory resolution of the Dispute.

10.36 An e-mail in late January 2007 from the Director General Naval Aviation Systems, which was copied to a number of senior DMO personnel, indicated that the Prime Contractor was also seeking to address the statutory limitation period. That e-mail stated that the Prime Contractor was seeking a mutual agreement which protected their rights, as well as those of the Commonwealth. On 1 February 2007, a Deed of Standstill was signed putting in place an agreement to preserve any cause of action, for either party, which might otherwise have been precluded due to the expiry of a limitation period.

10.37 In December 2006, prior to execution of the Deed of Standstill, DMO conducted a thorough review of contractual arrangements for the Project. This review addressed a number of matters set out in the Notice of Dispute and identified a level of uncertainty against all of these matters. The review also outlined termination options and identified issues potentially significant to the consideration surrounding the Deed of Standstill. Two days later a mutual Deed of Standstill was signed that allowed the Prime Contractor to make claims against the Commonwealth, notwithstanding that a statutory limitation relating to the claim may have lapsed.

Lesson No. 9

Where consideration is given to invoking contractual dispute provisions, a strategic review should be undertaken to evaluate the extent that the proposed action will:

- promote the achievement of planned objectives;
- preserve existing legal rights;
- address contractual ambiguity; and
- not create or expand the opportunity for counter claims.

Decision to continue with the Project in 2007

10.38 In May 2007, the then Minister for Defence announced that following a review of the Project, the then Government had decided to continue with the Project subject to satisfactory contractual arrangements being reached. In April 2009, the former Minister informed the ANAO as follows:

The only comment that I would make is that following the hard-over of the Automatic Flight Control System (AFCS) I convened a meeting with the CEO of the DMO, Chief of Navy, Chief of Air Force and other relevant senior personnel to discuss the future of the Seasprite project. I made it clear to them that three alternatives needed to be actively considered and that I would expect a comprehensive report on each of them.

The first option was to continue with the project. What would that cost, what would a reasonable timeframe look like and what technical outcomes might be expected?

The second option I requested was modification of the aircraft to a lesser capability than originally envisaged. Again, what would that cost, what capability could be delivered and in what timeframe?

The third option I wanted examined in detail was not continuing with the project, the cost to the Commonwealth of not doing so and alternatives for the development of this capability.

I received a preliminary report several months later in 2006 with which I was not satisfied. I then sought much more detailed information and it was not then until early 2007 that I was ready to take a submission to the National Security Committee.²¹³

10.39 In March 2008, the then Shadow Minister for Defence, who was the Minister for Finance at the time the decision was taken to continue with the Project, issued a media release in which he stated that the then Minister for Defence had recommended to the National Security Committee of Cabinet that the Project be cancelled.²¹⁴ The former Minister for Finance outlined that the National Security Committee of Cabinet was concerned about the potential cost to taxpayers with more detailed advice being sought from the Department of Defence on the Government's liability.

²¹³ Letter from the Hon. Brendan Nelson MP, Minister for Defence from 2006 to 2007, 20 April 2009.

²¹⁴ Seasprite Cancellation, Media Release by the Shadow Minister for Defence – 5 March 2008.

10.40 In taking the May 2007 decision to continue with the Super Seasprite Project, the then Government agreed to a real cost increase to the Project of \$110 million (January 2007 prices). The real cost increase was to fund the certification of the AFCS to contemporary standards and resolution of other issues including anthropometric restrictions.

Acquisition Overview Report - May 2007

10.41 The Acquisition Overview Report is a high level status report produced for each of the Projects being managed by DMO that is provided monthly to Government. The ANAO reviewed the Acquisition Overview Report for May 2007 which coincided with the then Government's announcement that the project would continue. This report indicated that the project was in significant difficult. A copy of the Acquisition Overview Report for the Project is reproduced in Figure 10.2.

Figure 10.2

Acquisition Overview Report May 2007

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35

SEA01411 PH1		Nov 05	Apr 07	May 07
		R ↔	R ↔	R ↔
ANZAC Ship Helicopter		MAA (\$m)		CATEGORY
		1,001		ACAT II
PROJECT DESCRIPTION:		REPORTING REQUIREMENT		
Purchase of 11 Super Seasprite helicopters for the Anzac class frigates. The helicopters will be fitted with fully integrated Radar, Forward Looking Infra-Red and Electronic Support Measures systems and the Penguin anti ship missile.		Of Interest		
PRIME CONTRACTOR: Kaman Aerospace Corporation		CONTRACT TYPE		
		Firm Price		
Cost	Schedule	Capability		
R ↔	R ↔	R ↔		
PROJECT DELIVERY DATES:		IN SERVICE DATE: Mar/10		
Contract Signature	Current Contract (CCP)	Current Forecast	Months to Project Completion	
Mar/02	Nov/05	Dec/09	37	
REPORTING PERIOD: May 2007				
Seasprite flying remains suspended. The Government announced on 25 May that the Seasprite program would continue subject to acceptable contractual arrangements. Commonwealth position for contract negotiations in early Jun 07 continued to be refined. ITAS code re-work and dry runs continued. Regression testing, scheduled by Kaman to commence during the period will now not start before late June. Completion of Formal Qualification Testing still anticipated in 3rd quarter 2007, at the earliest.				
ISSUES OF INTEREST:				
Technical Aspects - Certification of the Seasprite requires rectification of flight control system deficiencies. Phase 1 is essentially complete with some documentation outstanding. Phase 2, will be negotiated over the coming period. Phase 2 is anticipated to take a further 29-35 months from approval. This period will also provide an opportunity to address additional, less critical issues identified during initial Commonwealth testing prior to the suspension of flying.				
Project Management - Preparations for negotiation of the Deed of Variation continues. The quality/detail of Kaman's schedule for completion, particularly in light of past performance, remains a significant risk to the Commonwealth. The Project Office is providing significant support to progress ITAS to Formal Qualification Testing. This effort remains appreciably higher than would normally be the case, due to Kaman's continuing reliance on the Commonwealth to provide Quality Assurance of the documentation.				
Schedule - Initial phase of mission system testing stalled on 15 Mar 07. This has further delayed completion of software testing until 3rd quarter 2007, at the earliest. Kaman continue to under-estimate the level of effort required to close Software Trouble Reports and establish an acceptable documentation baseline. Whilst an updated schedule for ITAS completion has been provided for review, Kaman's ongoing performance provides the Project Office little confidence that the Company can achieve.				
Cost - The Phase 2 Automatic Flight Control System enhancement forecast expenditure (\$0.87m) during FY05/07 has been delayed to FY07/08. The impact on underspend has been ameliorated by increased expenditure on contractors and forecast cost of additional legal advice to DMO and the Government.				
Contractor Commitment - Kaman continues to affirm their commitment to successfully completing the project.				
Project Manager:				
Director General/Program Manager:				
Brief Signed Off By:				
Div Head Comments - The Government has agreed to continue SEA1411 PH1 subject to successful negotiations with the Contractor. These commenced at the Kaman facility in the US on 12 June 2007 and are focused on rectification of the Automatic Flight Control System as well as resolving contractual issues with the in service support contract.				
Brief Cleared By:				

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14/06/2007 08:00:08

Source: Department of Defence

10.42 The Project Maturity Score is an initiative of DMO implemented following the 2003 Defence Procurement Review. The associated assessment process is intended to quantify in a simple and communicable manner the risk in capital equipment projects as they progress through the capability development and acquisition life cycle. The Project Maturity Score incorporates technology readiness levels required by the Defence Procurement Review, and comprises a matrix of seven attributes that are assigned a score between one, representing the lowest level of maturity, and 10 representing the highest level. These attributes include schedule; requirement; technical understanding; technical difficulty; commercial; and operations and support. The project maturity score, appears on reverse side of the Acquisition Overview Report. Table 10.5 includes a break down of the components of the Project Maturity Score for the Project for April 2007 to June 2007 and includes ANAO comment on the status of the Project in these areas at that time.

Table 10.5**Project Maturity Score composition May 2007**

Element	April 2007	May 2007	June 2007	ANAO Comment
Schedule	2	2	3	At the time the contractual schedule for the delivery of the last 10 helicopters had passed. Delivery of the capability to Navy was contingent on aircraft certification for which a schedule was contingent on the rectification of the AFCS, which was the subject of ongoing contractual negotiations.
Cost	7	7	7	These Acquisition Overview Reports coincide with the Government agreement to fund a \$110 million (January 2007 Prices) or 10 per cent real cost increase to the Project.
Requirement	6	6	6	The October 2006 Impairment Statement for the Project had noted that Defence estimated that the Project was 95 per cent contractually compliant.
Technical understanding	6	6	8	ITAS testing was ongoing, there were ongoing issues with AFCS and the Full Capability Helicopter was yet to be subject to flight testing by DMO.
Technical difficulty	6	6	3	The full ITAS was yet to be accepted, which was an area which had been a significant difficulty since early in the Project. There was a large number of Airworthiness Issue Papers which remained open and either needed to be resolved or mitigated for aircraft certification to be achieved.
Commercial	6	6	6	The status of the contractual arrangements between DMO and the Prime Contractor were uncertain.
Operation and Support	8	8	9	The aircraft had never been utilised operationally. In the short period the aircraft had been operated the rate of effort was well below planned levels.
Total	41	41	42	

Source: Acquisition Overview Report and ANAO analysis

10.43 The May 2007 Acquisition Overview Report indicated a Project Maturity of 41 against a benchmark of 55 for the Super Seasprite Project. Under the Project Maturity Score model, a Project with a maturity score of 41 would be expected to be at the stage of entering contract whereas a project with a score of 55 would be in the system integration and testing phase. In June 2007, the overall score increased to 42 which included marginal increases in some

areas offset by a significant increase in the risk associated with technical difficulty.

2008 decision to cancel the project

10.44 In early 2008, a series of briefs were prepared for the Chief of the Defence Force, the Secretary of Defence and the CEO of DMO on the status of the Project. These briefs outlined a series of inadequacies in the Super Seasprite Capability and these are summarised in Table 10.6. The ANAO notes that the majority of these areas had been issues of concern in the Project for some time.

Table 10.6

Inadequacies in the Super Seasprite Capability early 2008

Issue	Status
Schedule	The Project was already 7 years behind with best estimate that the aircraft would be 10 years late for initial operational capability. There was ongoing risk and uncertainty surrounding the aircraft certification schedule.
Confidence	The DMO and Navy Crew had no confidence in Prime Contractor's engineering rigour or ability to achieve schedule.
ITAS	There was ongoing disagreement between DMO and Prime Contractor on the extent of testing required. Issues surrounding spare capacity and throughput of the Mission Data Processor in the ITAS had not been resolved.
AFCS	Phase 1 AFCS was complete but DMO were still reviewing the test report. Phase 2 was required to be completed in order for the aircraft to achieve certification.
Anthropometrics	There was no simple engineering fix to resolve anthropometric restrictions within the cockpit. This was likely to result in a life of type restriction on air crews able to operate the aircraft.
Crashworthiness	Aircraft was not designed to meet contemporary crashworthiness standards and there may have been regression when compared to the previous version of the aircraft. It was considered by Defence that the Seasprite community would face a greater risk of sustaining injuries or fatality in any given accident than their peers in other aircraft types.
Embarked operations	RAST interface issues ongoing. Lack of agility over flight deck coupled with growth in maximum take off weight would likely limit the maximum Sea State at which the aircraft would be able to safely conduct operations to Sea State 4.

Source: Defence Senior Officer briefings and ANAO analysis

10.45 DMO provided a brief to the Parliamentary Secretary for Defence Procurement in January 2008 which provided the same capability projection as outlined in Table 10.1. This brief outlined the factors impacting on the General

Flying Capabilities of aircraft. In addition to those issues set out in Table 10.6, other issues were identified including that:

- problems with the navigation system, radar altimeter and electrical system warning alert system which impacted on the capacity of the aircraft to undertake night flying and flying in Instrument Meteorological Conditions; and
- issues with handling qualities, control margins and landing gear strength were impacting on the capacity to undertake embarked operations.

10.46 On 5 March 2008, the then Minister for Defence issued a Media Release announcing that the Government had decided to cancel the Project.

The 2008 Settlement Deed

10.47 On 19 March 2008, DMO and the Prime Contractor executed a Settlement Deed which put into effect the Government decision to cancel the Project. The execution of the Settlement Deed occurred some 12 years after the RFT for this Project was released, 11 years after the Prime Contract and ISS Contract were signed, and six years after the final aircraft was to be delivered under the original Prime Contract. At the time the Deed was signed, no Full Capability Helicopters had been accepted by DMO and the Super Seasprite had never been deployed operationally aboard an ANZAC Ship.

Key aspects of the March 2008 Settlement Deed

10.48 Under the Settlement Deed the Prime Contract and the ISS Contract were terminated on the date that the Deed was executed. A key provision in the Settlement Deed involves the transfer of title of 'equipment for sale' from DMO to the Prime Contractor. The 'equipment for sale' is set out in Table 10.7. The transfer of title in the original Deed was subject to Defence obtaining US Government approval for transfer of the equipment to the Prime Contractor, without qualifications or conditions that would render it nugatory for the Prime Contractor to seek approval from the US Government for any sale of that equipment. To effect the transfer, the Prime Contractor was required to comply with certain conditions set out in the Deed primarily relating to parts and Government Furnished Materiel to be retained by, or returned to, DMO. An equipment for sale list was agreed between the Prime Contractor and DMO on 10 February 2009.

Deed of Amendment

10.49 In August 2008, the US State Department awarded approval for the temporary importation of the equipment for sale to the US. Following discussions with the US State Department, the original intent of the Deed of Settlement requirement to obtain US Government approval was to be achieved through a two part process under a Deed of Amendment that was executed on 19 September 2008.

10.50 In line with the Deed of Amendment approval was provided by the US State Department to temporarily take title of the equipment for sale on 6 February 2009.²¹⁵ Transfer of title occurred on 12 February 2009. Under the Deed of Settlement following the transfer of title outstanding matters such as the Deed of Standstill signed on 1 February 2007 was terminated and the Notice of Dispute issued by DMO on 17 January 2007 was withdrawn.

Expenditure on Equipment transferred

10.51 ANAO analysed the expenditure against relevant items in the Prime Contract and identified that \$855 million had been spent by 30 November 2007 under the Prime Contract in procuring the equipment to be transferred to the Prime Contractor under the Settlement Deed.²¹⁶ A further \$58.87 million had been spent acquiring parts for the Super Seasprites outside the Prime Contract and \$4.69 million (April 1998 prices) was spent acquiring second hand airframes which were stored in the US. Table 10.7 provides a break down of expenditure on the equipment for sale. The value of equipment transferred under the Settlement Deed is less than this amount, as some parts are to be retained by DMO, and some have been consumed during the period where the helicopters were operated by Navy.

²¹⁵ The purpose of the transfer of title is to facilitate the sale and marketing of the equipment for sale and only provides for the temporary importation of the goods. The Prime Contractor would need to apply to the US Bureau of Alcohol Tobacco and Firearms for approval to permanently import the goods.

²¹⁶ A January 2008 brief prepared for the Parliamentary Secretary for Defence Procurement indicated that the contract approval was to \$932 million with 96 per cent spent and \$37 million remaining.

Table 10.7**Indicative expenditure by DMO on Equipment transferred to the Prime Contractor**

Equipment to be transferred	Indicative expenditure as at November 2008 \$ million
11 Helicopters refurbished and upgraded under the Prime Contract and software including Forward Looking Infra-Red electro-optical device, Electronic Support Measures, AFCS and ITAS.	563.24
Flight Simulator.	63.62
Technical data, operating manuals, training manuals and maintenance manuals.	21.37
Part Task Trainers, Mission Planning Station and Mission Debrief Facility and technical content and systems of the Software Support Centre and all software for their operation and support.	41.13
Spares and Support Equipment (Prime Contract).	165.86
Total Prime Contract	855.22
Spares procured outside the Prime Contract.	57.94
Seven Airframes owned by DMO and stored at AMARC in the US. ²¹⁷	4.69
Total	915.72

Source: Deed of Settlement and DMO Spreadsheet²¹⁸

10.52 Under the Settlement Deed, DMO is entitled to receive a minimum payment from the Prime Contractor totalling \$A39.52 million.²¹⁹ This amount is payable in three instalments commencing in March 2011 as set out in Table 10.8, and is payable regardless of whether or not the Prime Contractor is able to secure the sale of the helicopters and other equipment transferred to it under the Deed. No price indexation is applied to these amounts.

²¹⁷ The DMO authorised the collection of the seven airframes which were stored in the US at AMARC on 13 November 2008.

²¹⁸ On 27 October 2008 the DMO authorised the transfer of certain items of equipment for sale to third parties pending and subject to the requirements of the Settlement Deed being met.

²¹⁹ In line with the requirement of the Deed of the Settlement the Prime Contractor provided DMO with evidence of a bank undertaking for the amount of \$A39.52 million with effect from 12 February 2009.

Table 10.8**Initial amounts payable to DMO under the Settlement Deed (\$A million)**

Description	Payment date	Amount \$A million
Payment to DMO by the Prime Contractor in anticipation of sale (nominal)	14 March 2011	26.70
	14 March 2012	6.41
	14 March 2013	6.41
Total payable to DMO in anticipation of sale		39.52²²⁰

Source: Deed of Settlement

10.53 Under Proceeds of Sale Arrangements set out in the Deed, DMO is entitled to a share of the total cumulative net proceeds²²¹ derived from the sale of the equipment to be transferred to the Prime Contractor. This share is calculated based on stepped values as set out in Table 10.9 with the \$39.52 million set out in Table 10.8 offset before any amount is payable under this arrangement.

Table 10.9**DMO's Share of any net proceeds secured by the Prime Contractor**

Total Cumulative Net Proceeds	Agreed Percentage
Up to US\$50 million	50%
Greater than US\$50 million and up to US\$100 million	60%
Greater than US\$100 million	70%

Source: Deed of Settlement

10.54 The Settlement Deed contains a definition of the 'Net Proceeds' and worked examples. The Net Proceeds against which the Agreed Percentages, as set out in Table 10.9 are to be applied, are to be calculated as follows:

- Net Proceeds **equals**
 - Sale Price; **less**
 - a fixed percentage of the sale price as full compensation for the Prime Contractor; **less**

²²⁰ This amount is in Australian dollars and is not adjusted for fluctuations against the US dollar.

²²¹ Excluding the proceeds from the sale of certain new parts.

- agents' fees; **less**
- reconfiguration costs;²²² **less**
- a fixed percentage of the reconfiguration costs as the Prime Contractors' profit margin for carrying out the reconfiguration.

10.55 Under the Settlement Deed DMO agreed that, subject to certain limitations associated with Australian constitutional or democratic processes, the Commonwealth would not disparage the 'equipment for sale'. Further the Deed requires that, except as required by an applicable law or the requirement of a regulatory body or Ministers of the Government of the Commonwealth, all press releases or public announcements in relation to the Deed or the Project must be in terms agreed by the Prime Contractor and DMO.

Further payments required by DMO under the ISS Contract

10.56 The 19 March 2008 Settlement Deed also terminated the ISS Contract. DMO is required to make payments of up to \$12.5 million to the Prime Contractor under the Close-out arrangements in the Deed for the ISS Contract. The terms of this Deed require the Commonwealth to make further payments up to a maximum of \$10 million, excluding GST, in respect of:

- the total amount due and payable in relation to open invoices and supplier obligations under the ISS Contract and the Prime Contract, in respect to actions under both contracts, up to 17:00 hours on 14 March 2008 Australian Eastern Standard Time;
- the total amount due and payable in relation to Management Fees under the ISS Contract prior to the Effective Date;
- the total termination costs relating to employees, suppliers and sub-contractors under the ISS Contract; and
- continuing activities.²²³

²²² Reconfiguration includes the design, procurement, manufacture, test and installation in the aircraft of any different system to those already installed in the aircraft or modification to existing systems to meet the needs of the customer. It does not include the refurbishment, repair or bringing into operational service of any existing system including the AFCS and the ITAS.

²²³ The parties agreed that there was a need for the ISS Contractor to continue, at a reducing level, to perform some of the activities under the ISS Contract for a limited time after the Effective Date of the Deed.

10.57 In relation to continuing activities, and subject to verification, the ISS Contractor may receive payment up to an amount of \$2.5 million, in addition to the \$10 million outlined above.

10.58 As part of the Deed, and subject to US Government approval, the title for equipment held at the KAISC will be transferred to the Prime Contractor as equipment for sale. This equipment included the following training and support items:

- the Flight Simulator;
- the Part Task Trainers;
- the Mission Planning Station;
- the Mission Debrief Facility;
- the technical content and system of the software support centre and all software for their operation and support; and
- operating, maintenance and training manuals.

10.59 The DMO advised the ANAO that by November 2008, \$6.85 million had been spent under the Settlement Deed continuation arrangements. Under the provisions of the Settlement Deed, certain parts were not offered as equipment for sale but were retained by DMO. The DMO advised that these parts were suitable for use in other aircraft operated by the ADF and advised that the value of these retained parts was \$30 million.

Total cost of Project failure

10.60 With the cancellation of the Project in 2008, significant work was required by DMO and Defence for 30 June 2008, to finalise the necessary write-downs for the 2007–08 financial statements. These write-downs are set out in Table 10.10.

Table 10.10**Write-downs in the Defence Annual Report 2007–08**

Description	Write-down amount \$ million
Penguin Missiles	228.1 ^A
Platform	336.8
Repairable items	108.0
Assets under construction	273.8
Total Write-downs associated with the Super Seasprite	946.7

Notes: ^AIn March 2009, Defence Advised the ANAO that the \$228.1 million figure for the Penguin Missiles had been incorrectly calculated during the compilation of data in the Defence Annual Report and it contained approximately \$25 million which was inadvertently included as both assets under construction and inventory. A further variance of \$2 million is due to the difference of cost recording between COMSARM and assets under construction.

Source: Defence Documentation

10.61 The Assets Held for Sale reported in Defence's Annual Report 2007–08 included an amount of \$124.5 million relating to the settlement arrangement for the Project. This amount is subject to the Prime Contractor securing a purchaser of the aircraft and an estimated sale price being achieved.

10.62 The Defence Portfolio Budget Statements for 2008–09 report that some \$953 million or 86 per cent of the Project budget of \$1.108 billion had been expended.²²⁴ The \$953 million expenditure on the Project did not include other expenditure specifically related to the aircraft including:

- \$201.13 million in expenditure on Penguin Missiles which no other ADF platform is capable of deploying, outlined in Chapter 2.
- \$134.53 million in expenditure against the ISS Contract for the Super Seasprite, outlined Chapter 5;
- \$58.94 million in expenditure for spare parts procured outside the Prime Contract, outlined in Chapter 5;
- \$0.61 million for modifications to the ANZAC Ships to cater for the Super Seasprite and modifications to the FFGs to provide interoperability;

²²⁴ The Portfolio Budget Statements for 2008–09 anticipated the potential for a further \$13 million in costs associated with concluding the Prime Contract which may include legal fees.

- \$5.56 million Net Personnel and Operating Costs for APS and ADF staff located at the In-Service Support Centre; and
- \$46.9 million²²⁵ in costs for 805 Squadron, which was to operate the Super Seasprite, that was commissioned in February 2001 and decommissioned in June 2008; and

10.63 These figures combine to indicate a total expenditure associated with the ANZAC Ship Helicopter capability in excess of \$1.4 billion. However, this figure is incomplete as not all costs associated with the Project were able to be quantified by DMO, including:

- Salary Costs for staff within the Project Office for a Project that experienced significant schedule slippage; and
- costs of work undertaken by the relevant technical regulatory authorities and services provided by the Defence Science and Technology Organisation for a Project that required significant effort in these areas.

10.64 The expenditure on the Super Seasprite Project may be partially offset against recoveries under the 2008 Settlement Deed should the relevant provisions of that Deed be activated. However, there will also be further costs associated with the winding up of the project and costs associated with filling the resulting capability gap. In August 2008, DMO advised the ANAO that addressing the gap left by the Project involves a two phased approach:

- firstly, maximise availability of Seahawk by focusing funding and resources to this platform with \$10 million per annum transferred from Seasprite Sustainment to Seahawk Sustainment commencing 2008-09; and
- secondly, bringing AIR 9000 Phase 8 forward which was intended to replace the Seasprites and the Seahawks when they reached their life of type. This phase is subject to White Paper deliberations, This Phase 8 has an estimated expenditure in Defence Capability Plan 2006–16 of

²²⁵ Defence advised the ANAO in April 2009 that this figure comprises personnel costs such as salary, allowances, superannuation, housing and administrative overheads; Defence Service Group supplier expenses which includes stationery, cleaning products and miscellaneous items; and Force Element Group supplier expenses which includes unit travel; travel accommodation, meals and incidental expenses together with items such as office equipment. Due to the limitations in Defence's information systems, the personnel expenditure is based on approximations based on sampling and averaging of personnel numbers.

\$2500 to \$3500 million and was not planned to be considered by Government until 2015–16 at the earliest.

10.65 The Defence White Paper 2009, released on 2 May, states as follows:

As a matter of urgency, the Government will acquire a fleet of at least 24 new naval combat helicopters to provide eight or more aircraft concurrently embarked upon ships at sea. These new aircraft will possess advanced [anti-submarine warfare] ASW capabilities, including sonar systems able to be lowered into the sea and air-launched torpedoes, as well as an ability to fire air-to-surface missiles.²²⁶



Ian McPhee
Auditor-General

Canberra ACT
17 June 2009

²²⁶ *Defending Australia In the Asia Pacific Century: Force 2030 – Defence White Paper 2009*, p. 72

Appendices

Appendix 1: Lessons

Set out below are 10 key lessons from the Project identified by the ANAO. They focus on providing visibility of the key issues which contributed to this Project delivering an unsatisfactory outcome, to provide a broader understanding and appreciation of issues which may have relevance to other major capital equipment acquisitions.

Lesson No.1

**See paragraphs
1.16 to 1.22**

Defence major capital equipment procurement is a complex long term venture that is heavily reliant on the skills of personnel employed within DMO. Careful consideration is required in the planning of major capital acquisition projects to confirm that personnel with the requisite skills will be available, in sufficient numbers, to facilitate the smooth conduct of procurement and technical activities required to support capability delivery.

Lesson No.2

**See paragraphs
2.6 to 2.11**

Due to long term planning requirements, it may not always be possible to avoid linking an approved major capital equipment procurement to a project that is yet to be approved by Government. However, care should be exercised to avoid allowing any such linkages to increase the risk profile of the procurement under way such that the primary objective of that procurement is potentially compromised. Where linkages to an unapproved project do exist, they should be regularly reviewed to confirm that the benefits intended to be provided remain valid from a risk management and value for money perspective.

Lesson No.3

**See paragraphs
2.12 to 2.20**

Where a project's success is dependent on systems and software development and integration activities, independent analysis of the risks associated with this development activity is highly desirable. This should include identification of the extent to which the systems and software solution offered comprises proven technology and the record of the contractor(s) in undertaking the development of similar software and systems. This analysis should form a key input to tender selection and contract negotiation processes.

Lesson No.4

**See paragraphs
3.8 to 3.35**

Where a project's success is contingent on software and systems development activities, significant effort should be focussed on retaining financial leverage over the contractor until the project has demonstrated, through formal review processes, that the development activities will deliver software and systems that meet both contractual and technical regulatory requirements.

Lesson No.5

**See paragraphs
4.12 to 4.65**

The delivery of the desired capability to the ADF on a timely basis is a critical indicator of the success of a major capital equipment acquisition. Where an acquisition encounters ongoing difficulty, the acceptance of equipment at a lesser capability may be considered as a measure to progress the project and meet the needs of the ADF on an interim basis. As this potentially involves the acceptance of significant ongoing risk by DMO, a sound understanding of these risks needs to be obtained to ensure appropriate protections are established through contract amendments.

Lesson No.6**See paragraphs
5.14 to 5.27**

Where in-service support arrangements are entered into at the same time as an acquisition contract, clear linkages need to be established and maintained between delivery against the acquisition arrangements and the commencement of payments under the in-service support arrangements. In-service support payment arrangements, once activated, should have clearly established linkages to the achievement of desired rates of effort.

Lesson No.7**See paragraphs
6.2 to 6.48**

The type certification process is an essential element in providing an airborne capability to the ADF. Contractual arrangements that do not adequately allocate the responsibility for achievement of type certification to the contractor can significantly increase both the risk profile of the procurement of an airborne capability, and the level of effort required to achieve type certification.

Lesson No. 8**See paragraphs
9.2 to 9.7**

Comprehensive management review is essential to avoid a situation where, in order to progress a Project and deliver a capability to the ADF, unidentified significant risk is allowed to build up unchecked which may flow through to the airworthiness system.

Lesson No. 9**See paragraphs
10.31 to 10.37**

Where consideration is given to invoking contractual dispute provisions, a strategic review should be undertaken to evaluate the extent that the proposed action will:

- promote the achievement of planned objectives;
- preserve existing legal rights;
- address contractual ambiguity; and
- not create or expand the opportunity for counter claims.

Appendix 2: Glossary

ADF Airworthiness Authority	The Chief of Air Force was appointed as the ADF Airworthiness Authority following the 1998 RAASM.
ADF Airworthiness Management System	The 1998 RAASM recommended that an ADF airworthiness structure be developed based on: a single ADF Airworthiness Authority; the development of a framework for ADF regulations to regulate operational and technical airworthiness; the conduct of ADF aviation activities in accordance with the new framework; and an independent safety and investigation body.
Airworthiness Board	The role of the Airworthiness Board is to examine the airworthiness of each ADF aircraft type, operating as a State Aircraft. An Airworthiness Board is co-chaired by two reserve officers of at least one star rank, directly appointed by the ADF Airworthiness Authority. As both operational and technical aspects are reviewed, Board members are selected that have appropriate operations and engineering backgrounds. Prior to initial type certification of an aircraft type, an Airworthiness Board considers both operational and technical requirements, and then reports their findings to the ADF Airworthiness Authority. The Airworthiness Board also conducts periodic reviews of each aircraft type. A successful periodic review results in the continuation of the Service Release.
AFCS induced hard-over	An AFCS induced hard-over is a potential failure condition resulting in a control input occurring that was not initiated or directed by the Pilot. The risk of hard-over is mitigated by designing a system so that the chance of one occurring is low and by putting in place a process to control the outcome should one occur.

Anthropometric restrictions	The term Anthropometric restrictions is used to describe space limitations within the Super Seasprites cockpit which impacted on the ability of air crew, depending on their physical dimensions, to exercise full control authority over the aircraft.
AP (RAN) 10	Up until 1998, Navy's airworthiness policy was derived from Royal Navy processes as reflected in AP (RAN) 10 - Policy for Certification and Acceptance of New Aircraft and Major Aircraft Modifications. The contract for the procurement of the Super Seasprite reflected these arrangements and was not amended in 1998 when Navy transitioned to the ADF Airworthiness Management System.
Autorotation	An autorotation is used to perform power off landings from altitude. An autorotation is used when the engine fails, or when a tail rotor failure requires the pilot to effectively shut down the engine.
Crashworthiness	The February 1993 US Army Aeromedical Research Laboratory Report No 93-15, Basic Principles of Helicopter Crashworthiness defined crashworthiness as the ability of an aircraft and its internal systems to protect occupants from injury in the event of a crash.
Critical Design Review	MIL-STD-1521B outlines that a Critical Design Review for Computer Software Configuration Items will focus on the determination of acceptability of the detailed design, performance and test characteristics of the design solution; and on the adequacy of the operation and support documents.
DEF(AUST) 5657	The Australian Cost Schedule Control System Implementation Guide.
FAR 29	US Federal Aviation Regulation Part 29 (FAR 29) for the certification of Transport Category Rotorcraft.

Collective lever	The collective lever (collective), which pilots manipulate with their left hand, alters the pitch of all the main rotor blades by the same amount at the same time. Pulling the collective lever up increases the pitch and the helicopter ascends, lowering the collective lever reduces the pitch and the helicopter descends.
Compliance finding	A compliance finding is an engineering decision, based on relevant evidence, that an aircraft design satisfies a design requirement, or group of requirements. The relevant evidence may include certifications by national airworthiness authorities; the results of inspections, tests and analyses; or proven similarity with other aircraft designs.
Critical milestone	The provisions of the Prime Contract provided that where the contractor failed to complete a critical milestone identified in the Payment Schedule on or before the relevant date, the Commonwealth shall be entitled to withhold, at its discretion, the whole or part of the claim and all subsequent payments until the critical milestone was achieved. ²²⁷
Cyclic column	The cyclic column (cyclic), which pilots manipulate with their right hand, varies the pitch on the main rotor blades over the period of one revolution, enabling pilots to tilt the rotor disc. Pushing the cyclic column forward tilts the rotor disc forward, pitching the helicopter's nose down and moving the aircraft forward. Pushing the cyclic column to the left tilts the rotor disc to the left, rolling the helicopter to the left and so on.

²²⁷ Original Prime Contract Clause 3.4.5

Cyclic latching	Cyclic latching was a characteristic of the Super Seasprite whereby the cyclic may become unpredictably displaced in either the lateral or longitudinal axis, or both, during a take off resulting in reduced control margins.
Design Acceptance	Design Acceptance is a process resulting in a determination on the technical acceptability of equipment design for service use. A Design Acceptance Representative is an individual with a delegation from the Technical Airworthiness Regulator to undertake Design Acceptance functions in accordance with the Technical Airworthiness Regulations.
ITAS	The ITAS was a key component of the Super Seasprite's Integrated Weapons System, which was to integrate the helicopters systems for navigation, weapons, communications and sensors. The ability of the aircraft to achieve its desired capability with a two person crew was predicated on the successful delivery of the ITAS. The ITAS comprised three major components being: the Mission Data Processor; Smart Display Unit; and Colour Multifunction Displays.
MIL-STD-498	A US Military Standard which was intended to establish uniform requirements for software development and documentation.
MIL-STD-882C	A US Military Standard for system safety program requirements.
MIL-STD-1290A	A US Military standard for light fixed and rotary-wing aircraft crash resistance.
MIL-STD-1521B	A US Military standard for technical reviews and audits for systems, equipment and computer software.

MIL-S-85510	US Military Specification that establishes the design requirements for certain types, classes and sizes of lightweight, folding, crashworthy seats for troops/passengers in helicopters.
Offshore Patrol Combatant	Also known as Offshore Patrol Vessels which can range in size from coastal patrol vessel boats or fast attack craft (about 500 tons) up to corvette or frigate-sized vessels (2500 tons). ²²⁸
Preliminary Design Review	MIL-STD-1521B outlines that a Preliminary Design Review for Computer Software Configuration Items will focus on: the evaluation of progress, consistency, and technical adequacy of the selected top-level design and test approach; compatibility between software requirements and preliminary design; and on the preliminary version of the operation and support documents.
RAST	This system is used to secure the aircraft to the deck and to move the aircraft between the hangar and the flight deck via a probe fitted to the aircraft. Aircraft may either be hauled down into a RSD on the flight deck by a cable, or the pilot may land the aircraft into the RSD. The Australian version of the Seasprite was the only version to be fitted with the RAST. The RAST was regarded as necessary in order for helicopter operations to occur up to the high end of Sea State 5.
RTCA DO-178B	A commercial aviation standard, issued in December 1992, which sets out requirements for designing and testing safety related systems software.

²²⁸ *Janes Defence Weekly*, Volume 45, Issue 43, 22 October 2008, pp. 38-45.

Service Release	A Service Release is a declaration that the technical and operational airworthiness management requirements have been implemented to ensure that the aircraft type can be operated safely in approved roles whilst maintaining the airworthiness of the type design.
Software Hazard Risk Index	The Software Hazard Risk for the Super Seasprite is derived from US Military Standard MIL-STD-882C and is based on a matrix of control category and hazard category. Software exercising higher degrees of control and having more extreme consequences attract a higher software hazard risk index under MIL-STD-882C.
Special Flight Permit	A Special Flight Permit is required to enable Defence to operate an ADF aircraft that does not have a valid Service Release, or an ADF aircraft that has been modified beyond its certification basis.
State Aircraft	The ADF operates aircraft that are either registered on the Australian Register (Australian Aircraft) or State Register (State Aircraft). The State Register is the register of aircraft operated by the Commonwealth for military use. The Director of the Airworthiness Coordination and Policy Agency is the custodian of the State Register under the authority of the ADF Airworthiness Authority.
Tail rotor pedals	The tail rotor pedals, which pilots manipulate with their feet, alter the pitch of the tail rotor. The tail rotor controls the direction in which the helicopter points and balances the torque generated by the spinning main rotor.

Type Certificate

An Australian Military Type Certificate (Type Certificate) formally attests that an aircraft is airworthy if it conforms to a specific type design; is operated in accordance with approved operating instructions; is maintained in accordance with approved instructions for continuing airworthiness; and is operated within approved and defined roles.

Appendix 3: Defences comments in response to audit recommendations

	ANAO Recommendation	Defence and DMO Response
1	<p>The ANAO recommends that where tender prices quoted by tenders significantly exceed the budget for the project approved by Government, Defence:</p> <p>review the tender documentation to verify the risk profile of the procurement is not higher than what was anticipated during the process to obtain Government approval for the project;</p> <p>ensure that where capability is traded off to constrain costs within an approved budget that the reduction capability will not significantly compromise the overall capability to be provided by the equipment being acquired; and</p> <p>ensure that where a material reduction in the overall capability to be acquired is negotiated, approval for the reduced scope is obtained from Government prior to contract negotiations being finalised.</p>	<p>Agreed.</p> <p>Recommendations (a) and (b) are standard practice in undertaking a Defence tender evaluation process.</p> <p>Recommendation (c) is consistent with existing Defence processes.</p>
2	<p>The ANAO recommends that DMO:</p> <p>only pay critical milestones where it has been demonstrated that all the requirements of that milestone have been met; and</p> <p>ensure that the financial leverage provided by critical milestones is not materially diluted where payment schedules are amended.</p>	<p>Agreed, with a proviso as to recommendation (a) as follows:</p> <p>Recommendation (a) is consistent with existing Defence contracting templates which requires milestone entry and exit criteria to be met before a milestone can be achieved. However, templates permit Acceptance of a milestone to occur where only minor aspects of the milestone requirements remain outstanding. Suggest recommendation (a) be revised to read ‘... all the key requirements ...’</p>

	ANAO Recommendation	Defence and DMO Response
3	<p>The ANAO recommends that DMO improve acceptance arrangements for major capital equipment projects by:</p> <ul style="list-style-type: none"> reviewing its checking and verification procedures to ensure they are sufficiently robust as to identify, and where appropriate resolve, deficiencies prior to acceptance; and employing appropriate contractual safeguards that seek to provide Defence with effective protection where issues affecting the capability are known at acceptance or are identified subsequent to the acceptance. 	<p>Agreed.</p> <p>Existing Defence contracting templates and practices comply with these recommendations. Contracting templates require milestone entry and exit criteria to be met before Acceptance can occur.</p> <p>Formal Acceptance Certificates require the recording of any outstanding issues or items that must be met or remedied. The Acceptance of Supplies is subject to the issues or items being met or remedied.</p> <p>Defence also uses deeds of settlement or similar documents to record the agreed outcomes in relation to matters identified at Acceptance and how they will be dealt with post Acceptance.</p>
4	<p>The ANAO recommends that, before amending a contract to change acceptance arrangements for a major capital equipment project, DMO, in consultation with the Capability Development Group and the relevant Service, ensure that:</p> <ul style="list-style-type: none"> a. changes in risk allocation between contractor and the Commonwealth resulting from associated contract amendment are clearly identified and evaluated within a risk management context; b. the issue of any previously accrued rights of the Commonwealth which may be affected by changes to the acceptance arrangements is appropriately addressed such as through settlement arrangements or by preserving these rights to the extent practicable; and c. amendments of this nature require the written approval of the CEO of DMO, the Capability Development Group and the relevant Service Chief. 	<p>Agreed, with a proviso that this applies to instances where proposed changes are significant.</p>
5	<p>The ANAO recommends that DMO, in conjunction with the airworthiness authorities and preferred tenderers, develop appropriate plans for certification of airborne capabilities being acquired for the ADF and ensure that processes required to achieve certification are clearly established in the relevant acquisition and sustainment contracts.</p>	<p>Agreed.</p> <p>Existing Defence contracting templates provide for detailed verification and validation plans.</p>

	ANAO Recommendation	Defence and DMO Response
6	The ANAO recommends that the ADF Airworthiness Authority require that DMO seek approval from the Technical Airworthiness Regulator prior to any contractual amendments being processed, or modification to an aircraft being undertaken, that may diminish the crash protection afforded to occupants of an aircraft.	Agreed. Defence will implement this policy change.
7	<p>The ANAO recommends that, to further strengthen the processes supporting issue and renewal of airworthiness instruments, the ADF Airworthiness Authority require that:</p> <ol style="list-style-type: none"> when practical, Technical Airworthiness Regulator audits be timed to inform key decision making processes regarding the issue or renewal of airworthiness instruments; where audits identify systemic weaknesses sampling be undertaken to validate that documentation submitted in support of the award of airworthiness instruments can be reconciled to Compliance Finding Reports; and the report of any such audit be submitted to the Airworthiness Board as an attachment supporting, the Technical Airworthiness Regulator's recommendation to issue or renew a Type Certificate. 	<p>Agreed. By 30 Jun 09, the ADF Airworthiness Authority will:</p> <ol style="list-style-type: none"> amend its compliance assurance processes, so that the Airworthiness Board schedule is considered when the timing of audits is developed; propose changes to Airworthiness Board processes, to allow targeted documentation sampling; and amend its Airworthiness Board submission process, so that copies of audits identifying systemic airworthiness instrument weaknesses with airworthiness instruments are provided to the Airworthiness Board.

Appendix 4: Response to proposed Section 19 Report by Kaman Aerospace International Corporation (the Prime Contractor)

The Prime Contractor was provided with the complete proposed Section 19 Report and provided the following comment.

EXECUTIVE SUMMARY

Kaman Aerospace International Corporation (KAIC), as the Prime Contractor to the Commonwealth of Australia Department of Defence (Defence) provides this response to the ANAO Audit Report of Project SEA 1411 (the Project) for the procurement of eleven SH-2G(A) Super Seasprite maritime helicopters (the Report).

KAIC is a subsidiary of Kaman Corporation (Kaman), headquartered in Bloomfield, Connecticut, U.S.A. Founded by aviation pioneer Charles Kaman in 1945, the company has a long history in the rotorcraft industry. Most notably, relative to the Project, Kaman is the manufacturer of the H2 series of maritime helicopters. The SH-2F was the first shipborne helicopter in the U.S. Navy and was operated for nearly 30 years from all aviation-capable classes of Naval combatants, and was additionally qualified for operations from the small decks of U.S. Coast Guard Cutters. Additionally, Kaman manufactures the K-MAX civil helicopter that is used in the logging, firefighting, and construction industry for vertical lift and transport.

Over its history, Kaman has developed, tested, and placed into service diverse helicopter types and variants. As a result, Kaman staff have developed and maintained the skills and processes necessary to progress an aircraft from conceptual design to realized product. This has led Kaman to qualify or certify aircraft with a variety of agencies, including qualification of the HH-43B for the U.S. Air Force, the SH-2F, the SH-2G, and the SH-2G(E) for the U.S. Navy, the SH-2G(NZ) for the Royal New Zealand Navy (RNZN), and certification of the K-MAX for the U.S. FAA. These aircraft have compiled an outstanding record of safety and capability, and each aircraft type retains airworthy status today.

The Report documents the history of the Prime Contract with KAIC. At the same time, KAIC undertook development of a similar SH-2 variant for the RNZN. The most significant difference in these two aircraft types today is that the four New Zealand aircraft, SH-2G(NZ), have accumulated more than 7,500 hours of service since introduced to the fleet in 2001. The nine SH-2G(A) aircraft, introduced in the Interim Training Helicopter (ITH) version in 2003, have virtually none. The SH-2G(NZ) shares basic characteristics with the SH-2G(A). Both are operated by a 2-person crew and have Surface Surveillance and Anti-ship as their primary missions and they use the identical Composite Main Rotor Blade (CMRB) to accommodate an increased all-up weight of 14,200 lbs compared to 13,500 lbs for the U.S. Navy versions.

Some differences between the aircraft - which are discussed in the Report - are that the Australian aircraft was created by restoration of existing airframes, employed a new-development digital Automatic Flight Control System (AFCS), and featured a glass cockpit that integrated somewhat more advanced avionics items than were fielded in the New Zealand aircraft. The Prime Contractor evaluated each of the above-mentioned features before it was included in the offer, and ultimately the Prime Contract:

- The restoration of existing airframes was considered low-risk by both parties by virtue of the extensive experience that the Prime Contractor had in the conversion of the SH-2F series to the SH-2G. Throughout the course of the Project, there were no significant issues raised as a result of this cost saving decision.
- The digital AFCS was intended as a maintenance enhancement, replacing the older analog AFCS, which demanded a higher maintenance workload than desired. Neither

the analog AFCS nor its digital emulation was considered to be flight critical by either party at the time of contract signing.

The Prime Contractor viewed the integration software as the greatest program risk. The Integrated Tactical Avionics System (ITAS) development represented the greatest non-recurring cost in the offer. To mitigate this risk the Prime Contractor engaged the services of a recognized software subcontractor familiar with the U.S. Navy SH-2G tactical software who, in turn, employed the world's leading company to develop the tactical data exchange part of the ITAS software; the Prime Contractor augmented these efforts by contracting a recognized Human Factors expert to inform the man-machine interface design element of ITAS.

The Prime Contractor committed significant human and financial capital to the Project, over and above that which was required under the Prime Contract, in an effort to bring it to a successful conclusion. From its inception in 1997 until its cancellation in 2008, the Project accounted for the most staff-hours of labor and the greatest annual expense in the Prime Contractor's operation. When the original software subcontractor was unable to deliver the required ITAS software capability, the Prime Contractor rebid the remaining development and funded the completion of the task as part of its fixed price obligation to Defence. Between the fiscal years 2002 to 2007, the Prime Contractor reported over \$100M USD in losses against the Prime Contract. Despite the obstacles to completing the Project, the Prime Contractor persevered in the effort - even to the extent of completing the remaining aircraft development tasks after Defence decided to cancel the Project. The Project deliverables, including the aircraft, other equipments, and documentation were built and managed in compliance with all Prime Contract and Project requirements.

The result of this effort is an outstanding aircraft unmatched in performance of the maritime missions for which it was designed. In any aircraft development project, there are a number of deficiencies that require correction; they sometimes involve tradeoffs against other desired capabilities in order to deliver the overall desired performance. The Prime Contractor is confident that the development process was conducted professionally, and the product of the process is now ready to be fielded for its intended mission.

The Prime Contractor views the issues raised in the Report to be significant to its current and future interests and has responded accordingly. Although the Prime Contractor acknowledges that it has some concerns and issues regarding other sections of the Report, it has elected to address only those key issues that it believes are critical to correct the Project record. The Prime Contractor's response is separated into two parts:

Part A: addresses several issues relating to the contractual process, and the Prime Contractor's performance.

Part B: addresses issues of the safety and/or capability of the delivered product.

A top level summary of each point follows in this Executive Summary. A Detailed Response to each issue follows thereafter. The Prime Contractor has also provided in this Executive Summary a response to the ANAO's reasons that the Project was unsuccessful.

Part A: Contractual/Process-Related Issue Responses

Airworthiness Certification

Defence's inability to achieve airworthiness certification of the Project was not due to the level of safety inherent in the product as designed and built, or to the Prime Contractor failing to satisfy its obligations. Airworthiness certification was the responsibility of Defence. The Prime Contract was designed to support the airworthiness documentation, analysis, and test requirements of the then-prevailing Australian military airworthiness rules, which mirrored recognized standards for military rotorcraft certification.

As the Report states at paragraph 38 [Paragraph 39] (page 22), the fact that Defence did not seek to amend the Prime Contract to reflect contemporary civil airworthiness management

practices created a disparity between contractual and Australian certification requirements which Defence ineffectively addressed and which contributed to the unsatisfactory outcome for the Project.

Airworthiness Issue Papers

The preparation and use of Airworthiness Issue Papers (IP's) was not contemplated or addressed by the Prime Contract. All testing required to demonstrate compliance to contractually accepted performance standards is included in the agreed Test and Evaluation Program Plan; the Prime Contractor had no obligation to demonstrate any characteristic beyond those specifically included therein.

Notwithstanding this, the Prime Contractor found none of the IP's that were outstanding in the Defence system at the time of the cancellation of the Prime Contract represented a flight safety issue. All had been addressed by hardware or software design, or procedural changes or were found to be enhancements that could be effected through a contract change, which was never authorized.

Lack of Confidence in OEM Supplied Data

The Prime Contractor is confident that the Original Equipment Manufacturer (OEM) supplied data across the Project, in fact, met or exceeded all Project requirements. There is no support that the alleged lack of confidence is the result of the quality of OEM supplied data.

The Report, at paragraph 5.48 (page 141) refers to a lack of confidence on the part of Defence in the Prime Contractor's technical data. The Report cites two examples: the lateral stability for asymmetric loading, and procedure for autorotation blade trimming (see Figure 6.4, page 162). In relation to these two examples, as the only examples provided, of deficient Prime Contractor data cited in the Report, Defence had yet to consider the fully satisfactory test results and data provided by the Prime Contractor prior to cancellation of the Project.

In relation to the lateral stability for asymmetric loading, the Prime Contractor has demonstrated the required control margin for this case during contractually required performance and handling qualities tests.

In relation to the procedure for autorotation blade trimming, the adjustment procedure had been used satisfactorily by the Prime Contractor for all test flights of the SH-2G(A) performed in the U.S. and the RNZN employed it for trim adjustment on the SH-2G(NZ) using the same rotor blade and accommodating the same all-up aircraft weight. When Defence operators discovered some aircraft behaviour that diverged from the anticipated set point performance, the Prime Contractor undertook an extensive test program to refine the trim set points. This resulted in an improved process, but did not suggest that the previous procedure was unsuitable for the purpose.

During the course of the Project, the Prime Contractor provided hundreds of technical analyses, component test plans and results, and flight test plans and reports that fully satisfied the technical requirements and substantiated the aircraft design.

Quality Control

The Prime Contractor disagrees with the allegations from paragraph 5.47 onwards (page 141) in the Report that it provided poor quality of OEM supplies and delivered aircraft or poor quality of technical manuals.

In relation to the allegations of poor quality of OEM supplies and delivered aircraft, the Prime Contractor's quality system was routinely and repeatedly inspected by an outside agent and found satisfactory. The Prime Contractor's quality system was certified to the ISO 9001 standard within 5 months of signing the Prime Contract. The Prime Contractor's maintenance facility at HMAS Albatross was likewise certified after it was established. Routine semi-annual inspections of the Prime Contractor's ISO certification were performed through the life of the Prime Contract

and there were no significant findings at any time. At no time was there a "breakdown" of the Prime Contractor's quality system as reported at paragraph 5.47 of the Report.

In relation to the quality of the delivered technical manuals, the Prime Contractor's technical manuals are of the highest quality and meet all Prime Contract and Project Requirements. The technical manual validation by the Prime Contractor was intentionally abbreviated for two reasons:

- For the ITH version, they were generally reformatting of U.S. Navy manuals to conform to certain requirements of Defence;
- Expediting the Prime Contractor's Validation process facilitated the release of Maintenance Manuals to an existing cadre of 805 Squadron maintenance personnel, who could exercise them in the Verification process under the tutelage of Contractor Field Service Representatives. Errors or omissions discovered during this process were then remedied by use of Publication Improvement Report and Reply (PIRR) forms, which were processed by the Prime Contractor who prepared revision pages for the affected manual. This was a deliberate process agreed by both parties.

As the Report states at paragraph 5.50 (page 142), "Defence indicated that the PIRRS were mainly attributable to the addition of Critical Maintenance Operations". These PIRRS added an independent quality check of certain maintenance steps that could affect flight safety. Removal of independent quality checks from individual maintenance procedures was directed by Defence in favor of a general requirement for such checks to be done for any flight critical procedure. Reinserting them to maintenance procedures was then subsequently mandated by changes to the Defence maintenance manual format.

Throughout this process, the Prime Contractor supported the changing requirement by providing the appropriate review and processed changes in a timely manner.

Part B: Safety/Product-Related Issue Responses

Crashworthiness

The SH-2G(A) helicopter is fully crashworthy and compliant with all crashworthiness requirements of the Prime Contract contrary to the claim at paragraph 70 [Paragraph 71] (page 34) of the Report. The baseline SH-2G helicopter from which it is derived has an excellent record of crash survivability and changes from the SH-2G to the SH-2G(A) fully considered all crashworthiness implications. The resulting SH-2G(A) design retained the crashworthiness of the parent aircraft and incorporated many new features that significantly enhanced crashworthiness including:

- Provision of energy absorbing seats in the crew cabin
- Crashworthy fuel system design
- Retention of internal components to crash loads of 20g in the vertical and longitudinal direction, and 10g in the lateral- as required by contemporary standards
- Addition of 5 point harnessing for pilot and TACCO
- Flotation
- Helicopter Emergency Egress Lighting.

ITAS Reserve Capacity and System Response Time

The ITAS software development program was completed by the Prime Contractor after the Project was cancelled. The ITAS software meets software performance specification requirements and is ready for fielding. The Prime Contractor continues to operate this version of ITAS software - safely and effectively - on the Bloomfield test and development aircraft.

The Report, at paragraph 4.59 [Paragraph 4.59] (page 118) cites software spare capacity and system response time as factors contributing to cancellation of the Project. The amount of spare memory capacity in all ITAS computing devices; the CMFD, MDP, and SDU; greatly exceeds that which is required by specification. The reserve is sufficient for any surge demand and provides for future growth as may be needed.

The spare throughput capacity for the devices meets specification except for one of the twelve display screens available to the CMFD. In this case, a conscious decision, articulated to Defence as early as 2004, was made to allow the Tactical Operator to manage display density. It was demonstrated, at that time, that the display screen became saturated with objects before the throughput limit was reached, and that the operators could manage the number and density of objects through the controls available to them. The software architecture allowed for a graceful degradation in performance, and even if the operator neglected to manage the object density there was no possibility of system malfunction or software stoppage.

In relation to the system response time, this was found to be satisfactory by an internationally respected authority on Human Factors who was engaged by the Prime Contractor, and well known to Defence, to evaluate software performance. Defence's own operators, engaged in system integration testing, confirmed to Defence that system response time was satisfactory. Despite this advice, Defence declined to accept the software performance.

AFCS Safety

The digital AFCS system is safe and effective. The AFCS system was designed and tested in accordance with contractual requirements that were consistent with recognized military standards for flight control system qualification and continues to be flown in the Prime Contractor's test and development aircraft in the U.S.

The digital AFCS system emulated the function of its analog predecessor, which has logged over 600,000 hours of safe operation in the U.S. Navy, RNZN and Navies of Egypt and Poland. A design issue discovered in a peripheral AFCS component, the Air Data Computer, was diagnosed, corrected, tested, and fielded in the fleet, thereby relieving the primary source of system performance concern. The U.S. Navy has endorsed the safety of the AFCS system by qualifying it for use in the Egyptian Seasprite variant.

Handling Quality Issue Due to Increased All Up Weight and Lateral Center of Gravity (CG)

The Prime Contractor disagrees with the finding in paragraph 62 [Paragraph 63] of the Report that there was any impact caused by an increase in the all up weight. The all up weight of both the SH-2G(NZ) and SH-2G(A) variants was increased from 13,500 lbs to 14,200 lbs during the development program to accommodate the weapons and sensors required by the terms of both contracts. This change was effected with no change in aircraft performance due to the greater efficiency of the CMRB. The New Zealand variant continues to operate without limitation.

The Prime Contractor performed all the contracted handling qualities testing successfully, demonstrating ample control margin for all aircraft weight and mission configurations. Included in the configuration matrix was the case of a single Penguin missile (or MK 46 torpedo) mounted on the prescribed side of the aircraft. The Prime Contractor demonstrated the required control margin in all cases. Further, the Prime Contractor, at the request of Defence, performed additional testing to demonstrate control margin at additional environmental conditions. Again, this testing confirmed that adequate margin was available.

RAST Incompatibility

This issue, as described at paragraph 60 [Paragraph 61] (page 30) of the Report, remained unresolved due to the fact that Defence refused to move forward on a modification which had been designed and which did not compromise performance.

The Recovery Assist Secure and Traversing (RAST) system provides a means to recover an aircraft to the deck in severe weather conditions. The design and testing of the aircraft, and its

interface to the deck components of the RAST system were performed in accordance with contract requirements - including full-scale aircraft recovery at the U.S. Navy test facility at Lakehurst New Jersey, U.S.A. However, during First of Class Flight Trials, it was found that an interference condition could occur between the aircraft undercarriage and the shipboard element of the RAST. The Prime Contractor recognized an obligation to address the requirement to recover an aircraft under stipulated conditions of aircraft alignment.

Under an agreed approach to the problem, the Prime Contractor designed a modification to the shipboard gear that would relieve the potential interference. The design change was coordinated with the RAST OEM who found that the modification was feasible and did not compromise the performance of the RAST system. The modification further addressed extreme aircraft misalignment that was beyond the requirement of the Prime Contract.

The Prime Contractor engaged in extensive discussion, formal design review, and response to queries by various Defence staff. Defence, nevertheless, declined to move ahead as agreed, with the procurement of a proof of concept demonstrator.

Instrument Flight Capability

The SH-2G(A) helicopter is required by specification to fly in Instrument Meteorological Conditions (IMC). Defence's failure to certify the aircraft for IMC flight is attributable to a conscious decision to avoid this task, not to a failure of the aircraft to perform to the recognized airworthiness standard of the Prime Contract.

Instrument Flight Capability (IFC) issues raised by Defence in the "VMC Report" as an obstacle to IMC certification testing were not based on the aircraft specification or contract compliance issues. Rather, they were based on Defence's interpretation of U.S. FAA rules for civil airworthiness.

The Prime Contractor performed the test program agreed in the Test and Evaluation Program Plan, passing all the test requirements for IMC. Additionally some of the "preconditions" to IMC testing established by Defence - even if agreed by the Prime Contractor as "issues" - had no relation to flight in IMC and would have in no way precluded the conduct of IMC testing. In particular, findings against FAA FAR Part 29 - not a contractual requirement, and, as discussed elsewhere, not a prerequisite to flight safety - were allowed to interfere with the aircraft test regime.

Landing Gear Strength

The landing gear design is a legacy feature of the aircraft and the structural integrity of the landing gear is confirmed by decades of service including fleet service with the RNZN.

The Report makes various references to landing gear structural integrity (see paragraphs 8.28 [Paragraph 8.28] and 10.43 [Paragraph 10.45] for example). In one case, the Report cites as evidence of this concern an incident in a New Zealand Seasprite, while at the same time acknowledging that the landing was performed outside the rate of descent limits imposed on the aircraft. The Prime Contractor adds that this testing was performed to confirm the limit of the specification, and the pilot (a Defence pilot engaged for the purpose) performed the testing incorrectly by significantly exceeding the rate-of-descent limit. The Prime Contractor has imposed rate-of-descent limits for the purpose of protecting the aircraft and crew and does not subscribe to testing outside the limits. The structural capability of the SH2G(A) landing gear was analyzed as required by the Prime Contract and in accordance with Naval Air Systems Command structural design requirement. An additional analysis, performed at the request of Defence, confirmed the structural adequacy.

Radar Altimeter Warning System (RAWS)

During the course of the Project, Defence requested various changes to the RAWS software. None of them affected the safety of the aircraft but were merely enhancements to an otherwise safe functionality. The RAWS software implementation eventually chosen by Defence operators

has been retained in the final version of the ITAS software and has been operated in the Prime Contractor's test and development aircraft since software acceptance in 2005.

In 2001 a Human Engineering Working Group recommended some changes to the contractually agreed RAWS implementation to improve crew situational awareness. These were incorporated to ITAS software and delivered with the ITH software. Defence operators subsequently required additional changes in May of 2003. The Prime Contractor effected these changes in software and tested them to the satisfaction of Defence. These changes were available for fielding, but Defence did not elect to incorporate them to the delivered aircraft.

None of these changes were demanded from a flight safety perspective. They were instead enhancements intended to improve crew situational awareness and any of them should have allowed the aircraft to proceed to IMC testing.

Tie-bar Strength

Defence expressed concern about the tie bar strength in the SH-2G(A) application and ultimately performed testing to resolve these concerns and this testing showed the part to be more than adequate. This is not reflected in the Report which describes this as a "Technical Risk" at Table 8.6 (page 212).

The Prime Contractor completed all structural analyses required by the Prime Contract confirming the structural integrity of the tie-bar. The load differential between the SH-2G(A) and that of the U.S. Navy was extensively analyzed and the structural margin was found to be satisfactory. Defence, in accepting this analysis, agreed. The Same tie-bar with the same Main Rotor Blade, undergoing the same additional load, has been in fleet service with the RNZN since 2001. The independent testing performed by Defence was reported to the Prime Contractor as having been completed satisfactorily.

Wheel Brake Overheating

There is no safety issue associated with wheel brake overheating. The Issue Paper (IP) associated with this condition recommended a manual warning or caution advising against routine use of brakes in run-on landings. The Prime Contractor understood from Defence that this was anticipated to be an acceptable mitigation of Defence's concern and the IP remained with Defence for closing action at the time the Project was cancelled.

Navigation System Error and Drift Rate

The Prime Contractor continues to operate the aircraft in the U.S. and has not observed, nor been able to force the condition which led to the complaint on a properly initialized aircraft navigation system.

Defence operators on several occasions reported that the Navigation System Drift Rate was "excessively high". These observations led to extraordinary limitations being placed on the use of the ITH aircraft, and effectively prevented Defence from continuing the aircraft operational testing. In the case study at Figure 8.5 [Figure 8.6] (page 218), the Report seems to suggest that the aircraft experienced positional errors when this condition was observed. This is incorrect. The LN-100G is a hybrid navigation system using an inertial navigation system to "dead reckon" aircraft position between positional updates from the Global Positioning receiver that is imbedded in the device. The GPS provides an update every 1 second, so the aircraft position is never compromised regardless of the inertial drift.

Regardless, if the system reports a high inertial drift, it is an indication that the inertial system is not performing satisfactorily, and could provide erroneous aircraft altitude information. Therefore, an investigation of these reports and an explanation of the causal condition were considered important.

Extensive testing of the test aircraft in Bloomfield Connecticut U.S.A. failed to reproduce the condition when the navigation system was operated as required by procedure. The Prime Contractor could approximate Defence's experience by improperly aligning the inertial reference

system. Defence's pilots denied that their alignment was deficient. Aircraft positional information was not compromised, and each of the missions where the condition was reported was completed safely.

The LN100G navigation system employed on the SH-2G(A) is in wide use by a variety of platforms, including rotorcraft, fighter jets, fixed-wing transport aircraft, and UAV's. The application on the SH-2G is not unique. Defence was never able to substantiate its claims by providing data to the Prime Contractor. The reported condition was not repeatable even by the crews who experienced it. The Prime Contractor concludes that this is not an issue.

Cyclic Latching

As stated in footnote number 128 to paragraph 7.32 (page 181) of the Report, the software fix for this issue was implemented in a production build of AFCS software and was available for release to Defence at the time the Prime Contract was cancelled. This software build is now in use by the Prime Contractor.

Cyclic latching refers to a condition whereby the aircraft is operated from a sloped field, and the AFCS "latches in" the slope as the aircraft reference attitude. At take-off, the aircraft attempts to retain the slope as its neutral in-flight attitude. The pilot, in this case, must use controls to overcome the AFCS command to achieve level flight. The SH-2G(A) was not designed for slope landing and take-off, so this condition was not initially considered in the design.

Upon being reported by Defence operators, the Prime Contractor analyzed the source of the condition and designed a software fix.

Prime Contractor's Response to ANAO Reasons That Project Sea 1411 Was Unsuccessful

The Report's view of underlying causes of the eventual failure of the Project in paragraph 9 [Paragraph 10] (page 12) provides a list of specific causes for the failure of the Project. Some of these views are not supported by available documentation.

- *The risk profile of the Project was substantially increased by seeking to upgrade a second hand platform to provide the required helicopter capability for the ANZAC ships²²⁹*

This conclusion is not supported by anything presented in the Report. With regard to the Prime Contract requirements, the use of a proven small ship naval platform greatly reduced risk and the use of reconditioned airframes was neutral relative to risk and lowered program cost. Nothing in the Prime Contractor's performance or in the eventual performance of the aircraft suggests that re-using U.S. Navy airframes had any negative effect on the outcome.

- the risks accepted for the project were further increased by the decision to seek to incorporate extensive capability enhancements into a smaller helicopter than the ANZAC ship is designed to operate

This conclusion is not supported by anything presented in the Report. The decision to procure a "smaller" helicopter was dictated by the need, at the time, to operate this helicopter from Offshore Patrol Combatants (OPC's). Even though the OPC development never eventuated, the enhanced SH-2G(A) features nevertheless satisfied Defence requirements and the Prime Contractor asserts that the aircraft would have served commendably had the Project been completed. By Defence's Own accounting a majority of the program requirements had already been confirmed as satisfied, including the vast majority of requirements that related in any way to the air vehicle itself. The vast majority of requirements that remained unconfirmed at the time

²²⁹ Removed from final report.

the Prime Contract was cancelled were related to capabilities of the ITAS software and these were in no way related to platform size.

In summary, the Prime Contractor views the project's failure as a consequence of process shortcomings. That a viable world-class Maritime Surveillance and Anti-surface Helicopter was developed became secondary to agreeing on a method for proving it by a certification standard acceptable to Defence. The Prime Contractor, nevertheless, completed the development effort to contractually agreed requirements and recognized standards of military helicopter qualification. The Prime Contractor is confident that the aircraft provides unmatched capability and reflects the outstanding safety and reliability characteristic of the SH-2 ancestry.

DETAILED RESPONSES

Part A: Contractual/Process Related Issue Responses

Airworthiness Certification

Defence's inability to achieve airworthiness certification of the Project was not due to the level of safety inherent in the product as designed and built, or to the Prime Contractor failing to satisfy its obligations. It was the failure by Defence to resolve the issue and request a contract change proposal to implement revised airworthiness standards rather than any safety concerns in the product as designed and built by the Prime Contractor that was the issue and which remained unresolved at the time the Prime Contract was cancelled.

The Prime Contractor's Statement of Work and accompanying Aircraft Specifications and Test and Evaluation Program Plan were designed to support aircraft certification under the then existing rules. As the Report states at paragraph 38 [Paragraph 39] (page 22), the Commonwealth airworthiness system was overhauled within one year of the Prime Contract being signed. At that time, the contractual requirement was no longer in consonance with the Commonwealth's airworthiness regulation.

The first communication that the Prime Contractor records on this subject occurred in a letter from Defence forwarding a proposed "Compliance Matrix" in June of 2000. The matrix presented over 1,000 individual requirements for an airworthiness finding. The correspondence solicited the Prime Contractor's assistance in completing the matrix, but offered no contractual change to recognize additional effort. The subject was raised at a Program Review in August 2001. At that time the Prime Contractor's Chief Engineer communicated to Defence that a change in the Prime Contract would be required to effect these new requirements.

Defence chose not to pursue a contract change (see paragraph 38 [Paragraph 39], page 22, of the Report). It estimated in 2001 that a contract change only for the purpose of making the AFCS compliant to the revised airworthiness requirement, which was not a requirement of the Prime Contract, could cost as much as 2 million AUD.

By 2007, Defence placed the cost of AFCS compliance at \$50 million. The early estimate, however, may have been more achievable had a change been incorporated at the time the airworthiness rules were changed. Certification programs rely on technical data gathered during the analysis, test, and development process. Instituting the change later in the program and trying to produce the required data in retrospect required that significant testing and analysis needed to be repeated, thereby increasing the costs significantly.

Defence adopted a tacit assumption that strict application of anything other than the most contemporary standards automatically implied a compromised level of airworthiness. The Prime Contractor disagrees with this view. For example, later sections of this response point out that instrument flight, the actual requirements for handling qualities for flight in IMC of the contractually applied military specification, MIL-H-8501A, are not substantially different to those of U. S. FAA FAR Part 29, but in applying U. S. FAA FAR Part 29 as part of the certification baseline, Defence required strict adherence with the FAA's associated advisory material. The FAA clearly states that the advisory material suggests a means for showing compliance, but not

the only means to do so. In instances where direct compliance is not achievable the U. S. FAA has a process for equivalent level of safety findings. Under this process the applicant is allowed to propose alternative characteristics, applicable field experience or other factors that demonstrate that the product meets the rules intent and achieves the desired level of safety, even if it does not strictly comply with a provision of the regulation. Defence's approach interfered with the Prime Contractor's ability to offer alternative existing data as a means for showing compliance. For example, Defence's refusal to consider the safety record of the legacy aircraft, particularly the successful application of the pilot in the loop as a mitigation in the AFCS system, was in direct conflict with this FAA practice.

The points made herein were highlighted to Defence in late June 2006. At that time the DMO Project Office sponsored a meeting in Ft. Worth Texas, at the FAA Rotorcraft Directorate. The purpose of the meeting was to gain an independent expert opinion of the feasibility of applying all or portions of FAR Part 29 to the Project, with particular attention to the certification of the Digital AFCS. The Manager and Assistant Manager of the Directorate, the Certification Manager of the Directorate, and their Test Pilot attended the meeting. Also attending were representatives from the DMO Project Office, DGTA, and the Prime Contractor. The FAA representative expressed a strong sentiment that Defence's approach in applying Part 29 to the Project was flawed. He stated that in any U.S. civil certification program, the FAA relies heavily on the expert opinions of the OEM's technical staff. This consideration is not just for staffing considerations, but also recognizes that the OEM staff are far more expert on the particular product than the certification agency. The FAA mainly determines how the regulations should be applied in joint discussions with the applicant, and then lets the applicant show compliance with the agreed certification baseline.

The FAA staff also pointed out that the application of the civil standards to a military program was an approach that did not recognize the fundamental differences in how civil and military aircraft are managed. Specifically, they stated that civil regulations were intentionally conservative due to the realization that once certified, regulators had very little influence on how the aircraft were operated, maintained, and the level of crew training. Recognizing these considerations, civil regulations put a high degree of reliance on the rigor of the certification process. They explained that Defence had control of these factors, which in the opinion of the FAA was far more effective in achieving the desired level of safety. Specifically with respect to the AFCS they stated that Defence's ability to mitigate risk through maintainer and pilot training and practices, and flight operating practices was far more effective than changes in software design. They concluded that in their judgment, given those controls, along with the safety record of the legacy system, they could reach a favorable airworthiness finding.

FAA staff also discussed in particular the flaws in DGTA's application of RTCA standard DO-178B to the AFCS software. It was stated that DO-178B actually contains several levels for software certification based on the safety implications of the system. DGTA was applying the highest level to the DAFCS. The FAA stated that it was not their practice to require the highest levels for flight control systems, since in their judgment the failure of the software did not necessarily result in a catastrophic event. It was their practice only to apply the highest level of DO-178 to Full Authority Digital Electronic Control (FADEC) for engines due to the fact that the operator did not have the ability to intervene directly to override those systems.

Airworthiness Issues Papers

The preparation and use of Airworthiness IP's was not required or addressed by the Prime Contract. All testing required to demonstrate compliance to contractually accepted performance standards was included in the agreed Test and Evaluation Program Plan; the Prime Contractor had no obligation to demonstrate any characteristic beyond those specifically included therein.

The Report, at paragraph 57 [Paragraph 58] (page 29) states that Airworthiness IP's were "the primary mechanism used within the Airworthiness Management to record significant airworthiness deficiencies... ". The use of IP's was promulgated after the ITH version of the

aircraft was Provisionally Accepted to document any finding by a Defence operator of a perceived deficiency.

Notwithstanding that IP's were not a contractually recognized process and the Prime Contractor had no obligation to address them, the Prime Contractor undertook an analysis and response to each one that could be potentially perceived as affecting a contractual obligation. The Prime Contractor's response to IP's was repeatedly disregarded by Defence. Defence Project managers advised the Prime Contractor that resolution of IP's was a Defence internal responsibility.

At paragraph 58 [Paragraph 59] (page 30) the Report states that there had been 11 IP's prepared by October 2003, and that only 2 of these had been rectified by November of 2004 when a total of 37 Issues Papers were open. The Report also states at paragraph 58 [Paragraph 59] (page 30) that all of these 37 Issues Papers remained open in "early 2001" and that 20 of them "required resolution by the Prime Contractor".

The Prime Contractor was first notified of the existence of open IPs in a letter dated 13 July 2006, and then only at the express request of the Prime Contractor. This was a full 20 months after the Report states that they had been promulgated. In a letter dated November 2006, Defence advised that 19 (vice 20 as reported in paragraph 58 [Paragraph 59] of the Report) were the responsibility of the Prime Contractor. The Prime Contractor undertook an analysis of each of the 19 reported IP's. In January 2007, the Prime Contractor replied that 6 of the 19 IP's had been resolved and were awaiting Defence retest, 5 were enhancements awaiting contractual modification for implementation, and that 8 had been addressed by some other means and actioned to Defence. Between January 2007 and May 2007, Defence informed the Prime Contractor that IP's were an internal Defence issue and that no action was required on the Prime Contractor's part noting that "the Issue Paper process is iterative and as such the Commonwealth continues the review and update of all issues papers". In late February, Defence acknowledged that "in general, further progress of the underlying issues is awaiting either, flight test, flight data gathering and fault diagnosis or, in the case of AFCS Phase 2, contract signature and system design/test".

None of the IP's that were outstanding in the Defence system at the time of the cancellation of the Prime Contract were deemed to represent a flight safety issue. All had been addressed by hardware or software design, or procedural changes or were found to be enhancements that could be effected through a contract change, which was never authorized.

Lack of confidence in OEM Supplied Data

The Prime Contractor disagrees that it provided deficient or inadequate data. During the Project, the Prime Contractor prepared hundreds of deliverable technical analyses, component and flight test plans and reports. These were routinely reviewed and accepted by Defence. They were professionally prepared, responsive to the Prime Contract requirement, and satisfied the technical objective. The Report, at paragraph 5.48 (page 141) in referring to a lack of confidence in OEM supplied data cites the autorotation trimming procedure and the lateral control margin in asymmetric flight as examples of deficient advice provided by the Prime Contractor.

Autorotation Trimming Adjustment

The procedures originally provided in the Project maintenance documentation for adjusting the autorotation rpm were based on the procedures used successfully by the U.S. Navy for the SH-2. These procedures allow for the results of actual rpm data from autorotations performed during maintenance test flights to be compared to flight manual charts to determine whether rigging adjustments are required based on actual operating conditions. These procedures involve correcting the acquired data for aircraft gross weight and atmospheric conditions (altitude and temperature).

During Defence's conduct of aircraft acceptance flights, as well as maintenance check flights, it became apparent that Defence's interpretation of the maintenance procedures as written were different than how these procedures were historically used by the U.S. Navy. It was also noted

that the operating doctrine of Defence dictated more frequent changes in operating conditions and could be better supported by providing a finer adjustment for rigging which would result in an increased margin for autorotation rpm, and reduce the frequency at which adjustments needed to be made. This was a desirable objective, one that was endorsed by the Prime Contractor however it had no safety implication. At the insistence of Defence, the Prime Contractor, at its own expense, performed additional instrumented flight tests where autorotations were performed in a wide range of configurations and flight conditions to modify and validate the autorotation trimming procedures. The results of this testing were provided to Defence as change pages to the Aircrew Flight Manual in November of 2005. This revised procedure was used by the Prime Contractor for the remainder of the aircraft acceptance flights. As stated in the Report, Defence did not evaluate them before the Project was cancelled.

Lateral Control Authority in Asymmetric Flight Conditions

In 2004, Defence raised concerns about the potential for limited lateral control authority when the aircraft was operated at high density altitudes in configurations that produced asymmetric lateral CG conditions (ASuW), Single Penguin Configuration). In order to resolve this concern Defence funded the Prime Contractor to perform flight testing at high density altitudes (8000 ft DA) in the ASuW configuration with lateral CG's at the extremes of the envelope (6.12 inches left CG displacement from center), as well as low speed handling qualities evaluations to determine adequate wind envelope for hover. Testing was performed with the AFCS system engaged and with it disabled.

The testing was performed to an agreed test plan, and flown by both Prime Contractor test pilots and Defence AMAFTU Test pilots. The results of the testing demonstrated that the lateral control authority was satisfactory throughout the envelope. No anthropometric restrictions were identified. The data was submitted to Defence by the Prime Contractor in correspondence in October and November 2004. Despite the satisfactory findings reported therein, Defence maintained lateral CG control authority as an open "issue" until the Project was cancelled.

Quality Control of QEM Supplied Parts and Tech Manuals

The Prime Contractor disagrees with the inference in paragraph 5.47-5.51 of the Report that aircraft spares and manuals delivered to Defence were of substandard quality, and that the Prime Contractor's quality system was somehow deficient.

The Prime Contractor was required, as a condition of the contract, to establish ISO 9001 certification; this requirement conformed to the Prime Contractor's existing plan as it was in the process of certification prior to contract award. Within the period required by the Prime Contract, the Prime Contractor achieved the requisite certification at its Bloomfield Connecticut facility as well as the Maintenance Support facility at HMAS Albatross. The Prime Contractor thereafter underwent semi-annual inspection by the certifying agency. The Prime Contractor retained its certification throughout the period of the Prime Contract and continues to hold certification today; no significant findings were recorded against the Prime Contractor's quality system in any of the recertification procedures. Because software development is not performed at the Prime Contractor's premises, the certification did not extend to these activities. The software subcontractors maintained their own ISO 9001 certification. In addition to ISO 9001 certification, the Prime Contractor, and its major subcontractors provided Quality Plans specific to the Project that were approved and periodically audited by Defence. At no time was there a "breakdown" in the Prime Contractor's quality system as reported at paragraph 5.47 of the Report.

Aircraft Acceptance was a joint process between the Prime Contractor and Defence. Prime Contractor personnel completed aircraft build after delivery to HMAS Albatross. The Prime Contractor's completion effort consisted of final assembly by Prime Contractor technicians and acceptance flight test by Prime Contractor pilots. Aircraft were then turned over to Defence staff for inspection and flight testing. Any discrepancies that were found during this process were either fixed by the Prime Contractor, or, if they were considered - by both parties - not to interfere with the functionality of the aircraft, they were recorded in the acceptance documentation for

later corrective action, which was also agreed in the acceptance documents. The Prime Contractor retained responsibility for the corrective action.

Requests for deviations were reviewed and approved by the Prime Contractor's Project Manager, and were approved by the following Defence personnel;

- (1) Defence QA representative
- (2) The Chief Engineer as the Design Acceptance Authority
- (3) The Project Manager as the Contract Authority, and
- (4) Chief Australian Naval Aviation Group as the User Authority

Provisional Acceptance of Aircraft #11 occurred in June of 2005. During the acceptance process the Digital Interface Unit (DIU) was found to be unserviceable. The DIU is an element of the BAU-3000 Crash Locator / Cockpit Voice and Data Recording System. In the event of an aircraft crash, the system provides a radio signal to facilitate aircraft location and records cockpit voice and flight control data for post-crash analysis. As such it is considered Safety Equipment. The DIU provides for the data recording function. An unserviceability of the DIU does not affect the crash locator function. It was therefore not considered to be a condition that warranted interfering with the Provisional Acceptance of the aircraft.

The unserviceability of the DIU was duly recorded as a deviation and the aircraft was accepted with the agreement that Defence would withhold full payment of the Acceptance Milestone until the Prime Contractor remedied the deficiency. The Prime Contractor returned the DIU to its OEM for repair, and restored the system to full functionality in October 2005. This was never a safety concern. It was fully disclosed prior to Provisional Acceptance, and the parties made a considered decision to proceed with the process. It is not an example of a shortcoming of the Quality system.

Technical publications for the Project were prepared in accordance with a Tech Pubs Plan reviewed and approved by Defence. The Tech Pubs Plan calls for manuals to be subjected to a Validation / Verification process before considered final. Validation is the responsibility of the Prime Contractor. Verification is performed by the user after receipt of the manuals; the Tech Pubs Plan allowed for a 6 month period for Verification to take place.

During the negotiation that culminated in a contract change for Provisional Acceptance of the aircraft, it was recognized that the Verification period would be abbreviated. In consideration for this, the Prime Contractor agreed to retain staff to support Defence's Verification, and to provide an amendment service for 2 years following the completion of the Verification process. Further, the Prime Contractor agreed to upissue any manual in which more than 10% of the pages contained changes. This was tacit acknowledgement that the abbreviated Validation period could result in a greater than expected number of corrective actions.

The Prime Contractor was satisfied with this arrangement for several reasons:

- The manuals being produced were substantially reformatting of U.S. Navy publications to satisfy RAN requirements. The content was the same, only the organization was changed for most of the content.
- The Prime Contractor's Field Service Representatives would be on-site to assist in the resolution of any issues discovered during Defence's Verification process
- Early delivery of the manuals allowed for squadron maintenance personnel, who would otherwise be idle, to commence practical application of their maintenance training.

The Project's acceptance of Validated publications in November of 2004²³⁰ constituted acknowledgement that the Prime Contractor had performed Validation in accordance with its obligation.

Subsequent changes to Tech Pubs were effected through the RAN's Publications Improvement Report and Reply (PIRR) process. The Report at Table 5.4 on page 142, shows an apparent backlog of PIRR's. The Prime Contractor observes that the data presented is a snapshot showing a condition shortly after a large quantity of submittals had been received, and says that it liaised with Defence's maintenance manager to move through the backlog in a quick but professional manner. The Prime Contractor considers that its staff performed its obligation expeditiously and effectively, and that it provided:

- (1) Quick identification of field maintenance concerns regarding technical publication write-ups and technical content.
- (2) Means to research, develop, and implement corrected technical data to quickly incorporate it into the fielded manuals.

The Report dedicates several paragraphs in Section 5 to the absence of independent checks on Critical Maintenance Operations. Inclusion of such checks has long been the Prime Contractor's standard practice. This increased diligence assures that full safety and quality measures are adhered to. Maintenance checks are required by U.S. Navy manuals for the SH-2G aircraft and, during the early phases of publication development, the Prime Contractor recommended to Defence that they be retained.

Defence's direction to the Prime Contractor in this matter varied over the period of the Prime Contract. Initially, the Prime Contractor was directed to exclude them from individual maintenance procedures in favor of a general requirement for independent maintenance checks. After flight operations began, it was evident that this decision needed to be revisited, and Defence decided that maintenance checks would be added back into the maintenance publications. With the Prime Contractor's direct technical guidance, a program was established to include these previously omitted Critical Maintenance Operations into the applicable manuals. This initiative allowed for an increased level of maintenance diligence on the part of the squadron maintenance and QA personnel.

This program accomplished the following:

- (1) Created a higher level of confidence in the maintainers that flight critical maintenance tasks were adequately addressed by secondary inspections.
- (2) Resulted in a decrease in the frequency of Publications Improvement Report and Reply (PIRRs) initiated by the maintainers.
- (3) Increased overall quality of the maintenance manuals as a result of researching, developing, and incorporating all PIRR requested publication actions submitted at that time.

At this point, all necessary critical inspection tasks - those that the Prime Contractor had earlier recommended be included in its maintenance documentation - have been restored to the publications.

Part B: Safety/Product Related Issue Responses

SH-2G(A) Crashworthiness

The SH-2G(A) helicopter is fully crashworthy and compliant with all crashworthiness requirements of the Prime Contract. The baseline SH-2G helicopter from which it is derived has

²³⁰ NASPO letter serial NASPOIOUT/4107 dated 10 November 2004

an excellent record of crash survivability and changes from the SH-2G to the SH-2G(A) fully considered all crashworthiness implications. The resulting SH-2G(A) design sustained the crashworthiness of the parent aircraft and incorporated many new features that significantly enhanced crashworthiness.

The Report provides a focused discussion of crashworthiness in Paragraphs 8.52 [Paragraph 8.56] through 8.74 [Paragraph 8.77]. At paragraph 8.52 [Paragraph 8.56] the report quotes a U.S. Army report which stated:

"... effective crashworthiness designs must consider all possible sources of injury and eliminate or mitigate as many as practical for a given design impact limit. This involves consideration of

- 1. strength of the container (cockpit and cabin).*
- 2. adequacy of seats and restraint systems.*
- 3. energy attenuation,*
- 4. elimination of injurious objects in occupants' local environment, and*
- 5. post crash factors, principally fire prevention and adequacy of escape routes."*

Paragraph 8.53 states that "... these factors are consistent with ... MIL-STD 1290A" and the Report gives the clear implication that compliance with MIL-STD-1290A would have satisfied all Defence concerns about crashworthiness. This same paragraph notes, however, that MIL-STD-1290A was not applied to the Prime Contract and states that, since it was not applicable, the SH-2G(A) "...would more than likely be deficient to MIL-STD 1290A." The Report provides no basis for this conclusion. The Prime Contractor's view is that a review of the SH-2G(A) design relative to MIL-STD-1290A shows compliance and supports the conclusion that the SH-2G(A) was crashworthy and safe to operate.

The following paragraphs describe the most significant elements of SH-2G(A) crashworthiness and relate these to Defence's five essential considerations for effective crashworthy design.

Strength of the container (cockpit and cabin)

It is the Prime Contractor's view that the structural design of the SH-2G(A) provides for excellent structural integrity throughout, and it specifically provides for the low deformation in occupied areas that is essential to achieving high crash survivability. Furthermore, this structure complies with the intent of MIL-STD-1290A.

The structure that surrounds the occupants, in the cockpit and cabin, must be structurally sound such that there is a high probability that crash loads will not deform those spaces to the extent that occupants are crushed. From its inception in the 1960's (as noted in Paragraph 8.53 [Paragraph 8.56] of the Report) the H-2 helicopter structure has been designed to appropriate applicable military standards for structural integrity. These standards focus on crash survivability and, since the H-2 has always conformed, it has a well-deserved reputation for being a crash survivable helicopter.

Although it was initially developed in the 1960's, the H-2 has undergone much evolution since then. Every time a major structural change was made contemporary standards, which became more and more rigorous over time, were applied to the modification. The most recent major H-2 variant, the SH-2G, was developed in the late 1980's and it incorporated significant and extensive structural changes including the incorporation of a totally new roof structure. These changes, which significantly impacted crashworthiness, were conforming to the most current contemporary structural design standard at that time and compliance was demonstrated to the satisfaction of the U.S. Navy, without deficiency.

Structural changes were made in moving to the "A" model of the SH-2G but these changes were not as extensive as the roof change mentioned above. However, the Prime Contractor again

applied the most current contemporary structural design standards to these changes and supplied structural substantiation to Defence, who noted no deficiencies.

Adequacy of seats and restraint systems

Regarding the "*adequacy of seats and restraint systems*" consideration for effective crashworthy design, the Prime Contractor's view is that the design of the cockpit flight crew seats and the cabin passenger/troop seats and their respective restraint systems provide the occupant restraint necessary to achieve high crash survivability and that these features comply with the intent of MIL-STD-1290A.

Crashworthy design requires seats and restraint systems to support and restrain their occupants during crash conditions such that they are held essentially in place and not allowed to come free and impact other occupants or other parts of the airframe. In the SH-2G(A), seats and restraint systems are provided in the cockpit, for the pilot and co-pilot/TACCO and in the cabin, for passengers/ troops and for an instructor. These seats and restraint systems are fundamentally different and they are discussed separately below.

Two flight crew seats are provided in the cockpit and each seat is provided with a 5-point harness. The seats themselves are rigidly attached to primary aircraft structure and are essentially unchanged from the baseline SH-2G. The 5-point harnesses are an enhancement from the baseline which were added in compliance with the Prime Contract. The seats and their support structure are designed and qualified to contemporary structural design requirements under the auspices of the U.S. Navy who certified their structural integrity. The combination of these seats and the 5-point harnesses provides assurance that the flight crew will be adequately restrained in the event of a crash.

The cabin is provided with a set of removable passenger/troop seats and each seat is provided with a 3-point harness. These seats and their harnesses were added to the SH-2G(A) in accordance with a Prime Contract requirement and their characteristics conform to a set of specifications that were jointly agreed between the Prime Contractor and Defence. Substantial analysis was performed under the Prime Contract that confirms these seat installations and restraints provide assurance that each occupant will be adequately restrained in the event of a crash and this adequacy was evaluated and confirmed by cognizant Defence technical evaluators who judged these installations to be fully compliant.

Energy attenuation

The Prime Contractor asserts that the "energy attenuation" consideration for crashworthiness was fully considered and adopted for the cabin seating but rejected by Defence for practical considerations. The resulting design is crashworthy and safe and it meets the intent of MIL-STD-1290A.

Defence chose to proceed with energy attenuating passenger/troop seats in the cabin but did not choose to add energy attenuating seats in the cockpit for the flight crew. The cockpit seating configuration is common to other military aircraft in use worldwide today, and does not represent a safety deficiency.

In the cabin, the SH-2G(A) provides energy attenuating seat installations for five passengers/troops and for one instructor. These installations conform to contemporary requirements for such installations and the Prime Contractor performed all structural and design analyses required for certification by Defence who determined the design to be fully compliant.

The Report makes several references to an analysis performed by the Prime Contractor that purportedly shows that the cockpit seat energy attenuation characteristics were compromised (i.e. "regressed") due to a change in the keel structure (see paragraphs 8.64 -8.65 [Paragraphs 8.68-8.69] (page 227-228 of the Report). This conclusion is not supported by the Prime Contractor's analysis which was done to assess the efficacy of the cabin seat energy attenuation and is not applicable to the cockpit seats in any way. Such an analysis could have been performed however Defence did not request such an analysis. In the Prime Contractor's opinion,

this analysis would have shown either no impact or a completely negligible impact because the keel structural change was localized to the cabin and small in magnitude.

Elimination of injurious objects in occupants local environment

The structural design for crash loads is comprehensive, fully compliant with applicable contemporary standards, and meets the intent of MIL-STD-1290A.

The presence of loose objects that can become missiles in a crash situation is unacceptable and inconsistent with effective crashworthiness design. For the SH-2G(A) this factor was given careful consideration and such objects are provided secure means of restraint or are specifically precluded from being carried in flight.

Beyond this obvious consideration however, this factor includes the requirement to securely attach any and all pieces of equipment that could become hazardous and provide these with adequate attaching structure that withstands the accepted crash loads. For the SH-2G and the SH2G(A) all such objects were analyzed for crash loads resulting from 20-20-10 g crash conditions (i.e. 20g loads in the longitudinal and vertical plane and 10g in the lateral plane). This was the requirement of the U.S. Navy going back many years and it was the requirement of the Prime Contract. The results of all crash load analyses performed under the Prime Contract were reported to Defence as were the results of any and all relevant underlying analyses performed for the U.S. Navy. These analyses were accepted by Defence and the crash load design was determined to be fully compliant.

Post crash factors, principally fire prevention and adequacy of escape routes

The SH-2G(A) helicopter meets or exceeds the intent of current requirements for crashworthiness and it provides the crew and passengers/troops with a high degree of crash survivability. Its basic structural design is robust and proven through many years of operation in the U. S. Navy and features have been added that substantially enhance both crash and post crash survivability. The SH-2G(A) meets the intent of contemporary standards for crashworthiness, such as MIL-STD1290A, and it provides occupants with a high degree of crash safety and survivability.

The baseline SH-2G helicopter addressed a number of significant post crash factors and several additional features were added to the SH-2G(A) that enhanced post crash survivability. The SH-2G includes jettisonable doors in both the cockpit and cabin that can be activated either from the inside or outside of the aircraft. The SH-2G also includes a HEELS (Helicopter Emergency Egress Lighting System) that activates on impact and provides emergency lighting to facilitate aircrew egress. These features materially improve the ability of the crew and passengers/troops to safely exit the aircraft in the event of a crash.

The SH-2G(A) added a crashworthy, self-sealing fuel system which significantly reduced the possibility of post crash fire and an emergency flotation system that assured the aircraft would stay on the surface in the event of a water landing or crash. The SH-2G(A) also added a self deploying emergency locator beacon and a crash recorder. All of these features were evaluated by Defence who determined them to be in compliance with Prime Contract requirements.

The design of the SH-2G(A) incorporates significant features that promote post crash survivability making a post crash fire unlikely, making it more likely that occupants can egress the aircraft safely and making it much more likely that help will be dispatched quickly and to the right location. This set of features, taken together, greatly enhances safety and survivability and clearly meet the intent of MIL-STD-1290A.

ITAS Response Time and Spare Capacity

The ITAS system software is complete and meets the software performance requirements and is ready for fielding (see paragraph 4.63 [Paragraph 4.65] (page 119 of the Report).

The ITAS system software was designed specifically for the SH-2G(A) aircraft. The detailed implementation of the general software requirements that Defence contracted for were

developed by Human Engineering Working Group of which Defence's aircrew comprised a significant element.

As the features of the software were being developed it became evident that the original estimate for the size of the software operational program, and the functions it would perform, had grown far beyond the software design conceived at the contract signing. Eventually, the software for the Mission Data Processor (MDP) grew from an estimated 64,000 lines of code at contract signing to 460,000, and the software for the Colour Multifunction Displays (CMFD's) had grown from 52,000 lines of code to over 130,000.

Early in the program, the Prime Contractor recognized that the CMFD's and MDP data throughput processing and memory capacity would need to be increased to accommodate the capabilities of the emerging software design. Consequently, the Prime Contractor implemented a design change to increase the data processing capacity (i.e. speed of the microprocessor) of the MOP by tenfold, and of the CMFD by more than 2 times. Additionally, the storage capacity of the MOP was doubled and its dynamic memory (Random Access Memory) was increased by a factor of 16. The CMFD storage capacity was increased fourfold and its dynamic memory was likewise quadrupled.

Managing the throughput and reserve memory budget was a primary concern throughout the software development program. In August 2004, the Prime Contractor reported at a Program Review that the storage capacity reserves of the MDP and CMFD would be satisfied, and that, though reserve of the dynamic Random Access Memory would be less in terms of percentage than the specification, nevertheless the total reserve memory, expressed as Mbytes of reserve would far exceed that required by specification and would be satisfactory for any conceivable peak demand as well as future growth needs.

At the same time the Prime Contractor reported that the throughput reserves would meet the specification for the MDP and for the CMFD with the exception that the operator could invoke a CMFD display for certain screen functions that could saturate its capacity. The Prime Contractor and its Software integrator performed parametric testing to determine if a limit on the operator's ability to display graphic symbology, so as to retain a processing reserve for these screens, could be justified. This study led to the determination, also reported in 2004, that the operator would be allowed to manage these specific displays as desired. This decision was guided by the study finding that:

- 1.) Tactical operators naturally managed the symbol population to avoid clutter and maintain a tactically useful screen (i.e. one that was not unreadable due to density of symbols) that met the throughput requirement; and
- 2.) Even in the event that the operator allowed a screen to consume the reserve capacity of the CMFD processor, the software continued operating in a satisfactory manner. From 2004 to the program's end, both Prime Contractor and Defence's own operators engaged in software testing found the performance of the system satisfactory in this area.

System response time is a measure of the time that elapses between a software input, either by the operator or in reaction to an external event, and the desired response. MIL-STD-1472D provides guidelines for system response times based on the type of input stimulus, and the manner in which the response is achieved (e.g. whether the software is accessing internal or external data, or whether the response is an echo of an input or requires system processing). The tabled values range from 0.2 sec to 2 sec. The ITAS software requirements were based on these values, although the specific responses were selected from tabled values prior to the software design based on assumptions of how functions would be automated.

Actual software response times depend on the speed of the microprocessor, time required to access the required data, and the computational demand to achieve the desired output. The growth in the software complexity and added functionality that was demanded of the ITAS software through the working of the Human Engineering process inevitably put a strain on achieving the specification response times. At the time of the first test of the fully integrated ITAS

software in 2005 - 2006, outages against several of the response time specification values were found. Tailoring of the software design was successful in improving the response time in several areas, but did not achieve the specification values. At the conclusion of this effort, the alternatives available to achieve specification response times were considered to be another hardware upgrade, or the removal of functions that were not required by the software specification, but that provided for enhanced aircraft capability nonetheless.

The effect of slower than specification response times could be: 1.) reduced operator productivity through a lower number of operations performed in a time period, 2.) increased error rate as the operator loses continuity of thought, and 3.) increased operator frustration due to sense that the system is not responding to inputs. The Prime Contractor performed a literature review and analysis to evaluate the potential for these effects to manifest themselves based on the final measured software response times. This analysis concluded that the actual system response times were still below the threshold for any of these effects and that no degradation in crew effectiveness ought to be anticipated.

In addition, the Prime Contractor commissioned an independent analysis of the ITAS system response times by an internationally recognized authority on Human Factors. This study, reported to NASPO in February 2007, concluded that only one software feature, the response of the screen cursor to movement commands, needed to be addressed. The study further recommended that the software specification be modified based on alternative values tabled in MIL-STD-1472. As a result of the study, the Prime Contractor undertook a software modification that improved the cursor response time and tested the software change to the satisfaction of the software development team and Defence's operators who were assigned to the test program.

The Prime Contractor sponsored software test completion subsequent to the cancellation of the Project. The final testing confirmed, again, that the software performance met requirements. But more importantly, this test program confirms that the software is fully ready for fielding. The Prime Contractor continues to operate this version of ITAS software - safely and effectively - on the Bloomfield test and development aircraft.

Automatic Flight Control System (AFCS) Safety

The AFCS is safe and effective. This conclusion is supported by the extensive operational experience of the U.S. Navy and RNZN with similar systems. More significantly this conclusion is supported by the decision of the U.S. Navy to go forward into service with a very similar digital AFCS for the SH-2G(E) and by their declaration that this system meets all necessary Airworthiness requirements.

Furthermore, operation of the AFCS is not essential to safe operation of the SH-2G(A) as the aircraft may be safely operated without this system throughout the flight regime. This capability was demonstrated in accordance with MIL-H-850 IA, the same standard used for the Sea King and Seahawk certification.

The Report, in section 7, concluded that the AFCS was unsuitable for Defence use because it was not demonstrated that it would provide for safe operation under all flight regimes and conditions. The primary basis for this conclusion is a concern that the pilot would not always be able to safely transition from AFCS engaged to disengaged modes in the event this disengagement resulted from a sudden failure involving a significant uncommanded control input, i.e. A "hardover" (see paragraph 47 [Paragraph 48], page 26 of the Report). Note that the AFCS is a limited authority system - at any given time, the roll, pitch, and directional actuator movements are limited to a smaller percentage of the overall travel.

In support of this conclusion, several contributing factors are cited including: failure to use a contemporary software development standard, namely U. S. FAA standard RTCA DO-178B; a higher than anticipated rate of "hardover" events experienced in the initial SH-2G(A) RAN flight program; existence of a system fault referred to as "cyclic latching" which could reduce effective controllability under certain conditions; and restriction in the cyclic control effective range due to anthropometric considerations. Defence's view was that these considerations, taken together,

rendered the AFCS unsafe. The Prime Contractor's view is that there is no doubt that the most significant factor was Defence's need to see DO-1788 used for software development and, ultimately, Defence's failure to impose this standard made it impossible to complete the program and put the SH-2G(A) in service. Paragraph 42 [Paragraph 43] (page 24) of the Report identifies that a key difficulty for certification for the AFCS was the disparity between standards that were defined in the Prime Contract and those that were applied by Defence despite not being requirements under the Prime Contract.

The Prime Contractor disputes Defence's contentions regarding the AFCS and states that, not only is that system safe and suitable for all intended Defence operations, but that the ultimate safety of this system was proven unequivocally through a battery of bench, ground, and flight testing prescribed under the Prime Contract, and conforming to recognized aircraft qualification standards. Defence's concern for AFCS transition states was further tested in a flight test program specifically for the purpose and performed jointly by the Prime Contractor and Defence in November 2007. This flight testing specifically addressed controllability, showing that adequate control was available for all flight conditions and aircraft configurations (including the most adverse lateral CG) even when allowance was made for possible cyclic control range limitations due to anthropometric considerations. This testing also demonstrated the ability of the pilot to safely transition from AFCS engaged to disengaged modes resulting from sudden failures involving significant uncommanded control inputs ("hardovers"), again considering the full range of operating conditions and anthropometric constraints. In this case, "cyclic latching" was considered also, even though the cause of this condition had been previously identified and an effective design change had been made eliminating the possibility of this condition occurring in the future.

Regarding the excessive rate of hardover events experienced in early Defence flight operations, the Prime Contractor agreed at the time to undertake immediate cause and corrective action. Two of these events were determined to be caused by the Air Data Computer which was new to the SH-2G(A) and which was found to have design flaws (see paragraph 50 [Paragraph 51] of the Report). These flaws were corrected thereby eliminating this source of hardover events. One of the two remaining events was caused by a maintenance error in the collective system and an appropriate maintenance manual change was made to prevent recurrence. The final event was, in fact, not a spurious event at all but was caused by a deliberate in-flight procedural violation. Nevertheless, a design change was made that would prevent a hardover from occurring if this condition were to recur in the future. These changes, taken together addressed all known causes for hardover conditions.

The AFCS is a single channel system which relies on the "pilot in the loop" to achieve the necessary measure of flight safety. This system operated safely in the U.S. Navy for a period exceeding 20 years and it accumulated, conservatively, over 600,000 flight hours. Most significantly, this experience included a great deal of time operating from the smallest U.S. Navy ships, including Destroyers and Frigates, in high sea-states and all climates. As noted, this system operated safely with no known instances of an AFCS induced aircraft accident or loss. This system, in fact, continues to operate today in SH-2G(NZ) helicopters used by the RNZN and in this case operation is from ANZAC Frigates essentially identical to those in use in the RAN. Again, no incidence of an AFCS induced aircraft accident or loss has been reported for SH2G(NZ) operations which have, to date, accumulated over 7500 flight hours.

In addition to the earlier U.S. Navy and ongoing RNZN experience with the SH-2G AFCS the Arab Republic of Egypt currently operates a fleet of SH-2G(E) helicopters. These helicopters have been in service for over fifteen years and, again, there has been no reported accident or aircraft loss associated with the AFCS. Originally these aircraft utilized the basic analog AFCS however, the Arab Republic of Egypt recently undertook a mid-life upgrade which included adoption of a digital computer based AFCS very similar to that which is used on the SH-2G(A). While this system has not been in use for an extensive period of time there have been no incidents with the system and it is operating safely and reliably with no indication of the kinds of problems anticipated by Defence. In addition, and most importantly, this system was developed

and tested for the SH-2G(E) application under the auspices of the U.S. Navy²³¹ who certified that the modified SH-2G(E) with its digital AFCS was Airworthy and suitable for service release.

Handling Quality Issue Due To Increase In All Up Weight And Lateral Center Of Gravity (CG) Offset

The Prime Contractor's view is that if the SH-2G(A) had been put into service, it would have satisfied all mission requirements.

The Prime Contractor demonstrated through its flight testing reported in the Prime Contractor Report T-4039-1, that the SH-2G(A), at an all up weight of 14,200 lb., meets all Prime Contract requirements for handling qualities and that it will be safe to operate through Sea-State 5. The Prime Contractor further considers that Defence's projections of reduced capability presented in the Report at Table 10.1 and elsewhere, are erroneous and based on lack of understanding of the principles of helicopter operation. Finally, the Prime Contractor concludes that if it had been allowed to go into service the SH-2G(A) would have satisfied all mission requirements.

The SH-2G(A) helicopter has handling qualities and agility that are entirely consistent with operation from small ships in high sea states. This mode of operation is demanding and these demands have been met by the SH-2GIF helicopter over and over in many thousands of at-sea operating hours with the U.S. Navy, the Navies of Poland and the Arab Republic of Egypt and, most significantly by the RNZN. Experience with the RNZN is particularly relevant because New Zealand operates in the same difficult "lower 48" sea environment and from ANZAC Frigates that are essentially identical to Australian ANZAC Frigates. Handling qualities have not been a mission limiting issue for any of these other SH-2G/F operators but the Report notes that lack of adequate handling qualities was going to severely limit mission effectiveness (see paragraph 6.42 page 164 of the Report).

The Report notes, in paragraph 62 [Paragraph 63] (page 31) for example, that" ... the increase in all-up aircraft weight, combined with a lack of agility over the flight deck would limit operations of the Super Seasprite at sea to Sea State 4" noting further that the original requirement was operation through Sea State 5. It can be inferred from additional information presented in Section 8 of the Report that this conclusion is based on assertions that handling qualities in the Anti-Surface Warfare configuration were compromised by increased all up weight and by poor lateral control authority due to an adverse lateral center of gravity (cg) when carrying a single Penguin missile or, by extension, a single torpedo. [n Defence's view the increased all-up weight reduced agility, the adverse lateral cg used-up an excessive amount of available control and the two factors taken together degraded handling to the extent that operations would need to be restricted.

Defence in-service capability projections, provided in Table 10.1 of the Report support this interpretation. These project almost full (i.e. 95%) attainment of Surface Surveillance Mission capability, which requires no external stores and has a lower all up mission weight, with substantially less capability attainment in the Anti-Surface and Anti-Submarine Missions (70% and 80% respectively), which do require external stores and which have greater all up mission weights. As explained below however, Defence reasoning regarding the effects of increased all up weight and lateral cg is completely erroneous and neither characteristic, either taken individually or in concert, produces unacceptable handling qualities.

Very early in the program it became apparent that the all up weight of the SH-2G(A) would need to grow to accommodate all of the new mission equipment and still carry sufficient fuel to satisfy the mission performance requirements. While this was not a desirable thing to do, no alternative

²³¹ The SH-2G(E) program is a US Foreign Military Sales (FMS) program and the U.S. Navy, as the cognizant U.S. Government agent has continuing responsibility to provide Engineering and other support, as they did for this mid-life upgrade.

existed and, consequently, the Prime Contractor proposed a change from the originally specified 13,500lb. all up weight to an all up weight of 14,200 lbs. Defence approved this change only because the Prime Contractor was able to show that the effect of this increase would be completely offset by improved performance of the CMRB, a benefit that was not considered in the original specification but that had recently been measured during flight testing of the new rotor. This new rotor was more aerodynamically efficient, requiring the same power in hover at 14,200lbs that the earlier rotor required at 13,500lbs and it was slightly higher in flapping inertia, a characteristic that directly related to control effectiveness. This increased flapping inertia assured that controllability, including agility, at 14,200lb would be at least as good as it had been at 13,500lb with the earlier rotor. The Prime Contractor went on to prove this by performing a complete and comprehensive handling qualities flight test which verified that the 14,200 lb SH2G(A), with the new CMRB, met or exceeded all mandated handling qualities requirements.

Regarding the lateral cg, this issue was discovered, and rectified, during build-up testing to the final handling qualities and performance flight tests. During these tests the Prime Contractor determined that the original Anti-Surface Warfare Mission configuration was not optimum in that operations with a single Penguin missile were stipulated with that missile on the wrong side of the aircraft but that this could be corrected simply by reversing the stipulation. By way of explanation, carrying a single Penguin missile, which weighs in excess of 1000lbs produces a lateral cg offset. This, in turn, creates the need for the cyclic stick to be trimmed in the opposite direction to maintain a level attitude, using up some lateral control margin. Single rotor helicopters with tail rotors, like the SH-2G(A), are already asymmetric relative to lateral control position, because the need to counteract tail rotor thrust uses some lateral control. In the original Anti-Surface Warfare Mission configuration with a single missile the Prime Contractor had inadvertently located that single missile on the side of the aircraft where these two effects would be additive and this was found in flight test, to be unacceptable. Moving that single missile to the opposite stores station was found to completely correct this problem, again as proven through flight testing.

RAST (Rotorcraft Alighting, Secure And Traverse System) Integration

This issue remained unresolved due to the fact that Defence refused to move forward on a modification which had been designed and which did not compromise performance.

The SH-2G(A) helicopter includes all necessary provisions to enable the use of a RAST shipboard landing assist system. The RAST system, which includes both aircraft elements and ship landing deck elements, helps the pilot to land the helicopter during high sea-state environments and, once on the deck, the RAST provides a secure attachment and a means to readily move the helicopter from the deck to the hangar. RAST was a new feature for the SH2G(A) as no previous version of this aircraft had incorporated such a device. Since RAN ships utilized RAST, Defence directed that the Prime Contractor provide aircraft features that would enable its use with the SH-2G(A).

Proceeding from this direction, and relying on Defence supplied ship interface and operational characteristics data, the Prime Contractor designed, fabricated, incorporated and tested the RAST aircraft changes which were agreed by all parties to satisfy the relevant requirements. Despite these actions, ship integration testing revealed the potential for interference between the on-deck RAST structure (RSD) and the SH-2G(A) landing gear structure (see paragraph 60 [Paragraph 61] of the Report). While this problem could have been solved through a minor modification of the RAST RSD, which was developed by the Prime Contractor, Defence was unable to complete their evaluation of this approach in a timely manner and could not arrive at a decision on the way forward. This fact notwithstanding, RAST is a perfectly viable capability of the SH-2G(A) that can enhance operational capability and there is no doubt it would have been a capability of the SH-2G(A) if the program had gone forward.

The Prime Contractor's RAST development effort relied on Defence supplied Engineering defining the ship side of the RAST system, and operational data defining the range of landing conditions that the system would need to accommodate. The operational requirement was

limited to accommodating up to 15° angular aircraft misalignment to the ship's longitudinal axis. Given this information the Prime Contractor designed the RAST installation to accommodate such landings. The Prime Contractor's RAST modification process proceeded successfully through several Design Reviews, through prototype fabrication and through a preliminary ground based fit and function test followed by full-scale interface testing at the U.S. Naval Air Station in Lakehurst NJ, U.S.A. During this development and test program no discrepancies were discovered. In spite of this, difficulties were encountered during initial sea trials when the aircraft side of the RAST was first mated with the ANZAC Ship side of the RAST. At this point it was determined that interference could exist between the ship's RSD and structural parts of the landing gear for a limited range of landing conditions. More importantly, however, it was also determined that the range of possible landing conditions considered in the design (as supplied by Defence) was much too restricted and that consideration of the real, full range of such conditions would show that landing gear/RSD interference could occur frequently and could be expected to cause unacceptable damage to the landing gear structure.

With this information in hand the Prime Contractor and Defence agreed to move forward to jointly find and implement a solution. This agreement provided that the Prime Contractor would identify a solution and develop a detailed design for implementing this solution and Defence would fabricate and test this design. This effort proceeded with the Prime Contractor identifying a solution, involving a modest change that could be added to the (shipboard) RSD, and developing a detail design for this change. The Prime Contractor also conferred with the RAST manufacturer, who agreed that the change could be implemented without affecting RAST functionality. Finally, the Prime Contractor worked with Defence's technical community in an attempt to address their numerous questions and concerns and this is where the process ultimately stopped moving forward.

With the detail design of the RAST change in hand, the Prime Contractor participated in two Design Reviews and several "off-line" technical discussions with various members of Defence's technical community. Many questions were asked and, in the Prime Contractor's opinion, all questions were answered without identifying a serious problem with the proposed solution. In spite of this, Defence continued its design review process, requesting ever more sophisticated (and unnecessary) analyses. The agreed way to resolve design questions, provided for in the original joint development agreement, was to build a prototype and test it. But this proved to be outside of Defence's ability to progress and the program ended with question/answer process still ongoing.

Instrument Flight Capability

The Prime Contractor disagrees with the assessment referred to in paragraph 88 [Paragraph 89] (page 40) of the Report which found that the aircraft had 80% capability in IMC.

The SH-2G(A) was qualified by the Prime Contractor for operation in IFC, or IMC in accordance with Prime Contract requirements and military standard MIL-H-8501A, General Requirements for Helicopter Flying and Ground Handling Qualities. This specification has been the basis for helicopter flying qualities for several decades and prescribes quantitative requirements for stability and control power for both VFR and IFR flight conditions. Although this specification does date back to the 1960's, the requirements it defines for IFR conditions are the same as those required by FAA FAR Part 29 Appendix B for Instrument Flight Conditions. Furthermore MILH-8501 is the basis for which the Sea King and the Seahawk helicopters, currently operated by Defence, were deemed suitable for IFR operations.

The Prime Contractor demonstrated compliance with these requirements through the conduct of the contracted test program that included demonstrating IMC capability. The outcome of these tests, including all the data necessary to substantiate IMC flight capability, is documented in the Prime Contractor report T-4039 and its attachments. This testing was conducted using the procedures detailed in U.S. Navy Test Pilot School Flight Test Manual 107 (USNTPS FTM-107), for Rotary Wing Stability and Control. The data demonstrating compliance with these

requirements was provided to Defence for review and approval. During the Formal Qualification Review (FQR) for the ITH, the Defence technical team found these characteristics acceptable.

The Report cites five findings of the 2004 VMC report, at paragraph 8.16 [Paragraph 8.17] (page 203) that prevented the Australian test organization from performing the required tasks of the ITH, and, in turn, from progressing to IMC testing. These included:

1. Aircraft response following AFCS servo hard-over or boost related failures;
2. Control margins;
3. Problems associated with the aircraft electrical system;
4. Absence of warning/caution indications following AFCS related failures; and
5. Crew survivability following a crash.

The Prime Contractor's comments on each of these findings are set out below:

- *Aircraft response following an AFCS servo hardover or boost related failure and control margins*

The testing conducted by AMAFTU was flawed and led to invalid conclusions. First, as noted in the report, the test technique was flawed in that the results were not based on the response of the aircraft during an actual hard over or boost failure event. The conclusions reached in the report were based on an assumption of what control would be required to recover the aircraft after a failure and overlaying those assumptions over the normal trimmed flight control positions required for flight, and added other incorrect assumptions to determine that the remaining control margin would be inadequate to restore controlled flight, and/or the departure of the aircraft from the intended flight path would result in a hazard.

As previously described, the design of the AFCS system assumes that the pilot is the primary mitigation for a control system failure. The system is designed so that as soon as the pilot senses that the aircraft is not responding to control inputs, there are provisions to immediately disengage the AFCS or boost system. In the event of an uncommanded servo hardover these provisions immediately restore full control authority to the pilot.

Defence's testing failed to recognize those features, in that:

- a. the assumed time for the aircrew to respond based on "attentive" or "passive" hands on flight rather than "active" hands on flight, which would be consistent with the operating procedures and training for H-2 operations. In addition, the assumption that the pilot would not be actively in control of the aircraft during conditions where operations are in close proximity to obstructions such as operations in close proximity with the ship is unrealistic.
- b. the extrapolation assumes that the servo hardover remains for the duration of the event and needs to be overcome by the pilot and limits his control authority. This again is inconsistent with the design and operating procedures for the aircraft. The emergency procedures dictate that the aircrew immediately disengages the AFCS (and the boost if required) when the aircraft is not responding to pilot inputs.

The handling qualities testing performed by the Prime Contractor in accordance with MIL-H8501A included specific test conditions to examine controllability during AFCS and boost disengagements. This testing, conducted in accordance with industry standard procedures (USNTPS FTM-I07) clearly demonstrated the acceptability of the SH-2. These characteristics were later confirmed through testing where actual hardovers were induced and the ability to recover the aircraft was demonstrated to be within acceptable quantitative limits and with manageable pilot workload.

- *Problems associated with aircraft electrical system*

The Report details concerns with the annunciation of failures of the electrical generating system when compared to the requirements of FAA FAR Part 29. Notwithstanding that this regulation was not part of the Prime Contract, the FAR Part 29 requirements for annunciation of failures are determined based on the likelihood of the failure and the resulting hazard that the failure could create. In the case of a new design where no experience exists, these conditions would be determined analytically. In the case of the SH-2, a significant body of experience exists where the probability of an electrical system failure can be determined, and the adequacy of the failure annunciation provided to the crew can be assessed. Using this successful experience, the level of failure annunciation provided in the SH-2G(A) was the same as had been successfully used in previous models. To further reduce the implications of electrical system failures, the SH-2G(A) had incorporated a third generator driven by the APU. This was in addition to the two generators and the battery that were provided in the baseline model. The resolution of this concern was put forward in an IP that was acknowledged by Defence as their action to be closed.

- *Absence of warning/caution indications following AFCS related failures*

To address this concern, the Prime Contractor developed design changes to enhance the level of AFCS failure annunciation. These changes were fully tested and available for fielding in the Full Capability Helicopter.

- *Crew Survivability following a Crash*

Independent industry studies have shown that crew survivability in the event of a crash is not solely a function of structural energy absorption characteristics. These studies have found the incorporation of energy absorbing seats alone do not enhance survivability in that most lives are lost due to post crash egress issues or post crash failures. The SH-2G(A) incorporates several features that enhance those characteristics. First are the three large jettisonable sliding exit doors that can be opened to maximize egress prior to exit for both the crew and the occupants of the cabin. Second is the incorporation of a flotation system to maximize the time afloat to provide opportunity for egress in the event of a water ditching. Finally, the incorporation of a crash resistant internal fuel system to contain the fuel in the event of a crash, minimizing the probability of a post crash fire and its hazards to egress.

Landing Gear Strength

The landing gear design is a legacy feature of the aircraft and the structural integrity of the landing gear is confirmed by decades of service.

The landing gear structural capability was substantiated to the requirements of AR-56, Naval Air Systems Command Structural Design Requirements for Helicopters. This specification is the industry standard for substantiation of landing gears for shipboard use. The landing gear for the SH-2 is designed for landings up to 12 ft/sec descent rate, which represents a hard landing. The ability to meet this requirement was demonstrated by test to the U.S. Navy. This testing included landings up to the equivalent of 13.1 ft/sec and that margin is part of the justification for the increase in gross weight from 13,500 lbs to 14,200lbs. This substantiation, in combination with the successful operation of the helicopter in the U.S. Navy, demonstrates that the structural basis and the resulting H-2 design are satisfactory for shipboard use.

Prior to the First of Class Flight Trials in 2004, DGTa, concerned that the requirements of AR-56 were inadequate, imposed an additional conservatism of requiring an analytical margin of 150% on ultimate strength, which, applied to the undercarriage design, resulted in a 6 ft/sec landing sink rate limit for initial testing. As a result the Prime Contractor conducted additional landing analyses using ship motions with specific outcomes defined as outlined by Defence structural analysis staff. The results of that analysis were briefed prior to the FOCFT at a Program Review in March 2004. This analysis substantiated the original work performed in accordance with AR-56 that showed acceptable strength up to the operational limit of 12 ft/sec descent, and that the DGTa imposed restrictions were overly restrictive and not consistent with the previously accepted shipboard landing techniques for the SH-2G aircraft. Defence undertook to confirm the

results of the analysis during the FOCFT however AMAFTU's inability to field an inflight data system prevented that task from being closed.

Radar Altimeter Warning System

The SH-2G(A) RAWS provides a safe and effective means to alert the aircrew if the ship descends below a preset safe altitude. The aircrew has the ability to set a variable altitude for the RAWS, while retaining a non-modifiable minimum altitude at which an alarm will always be raised. The combination of tones and visual alerts depends on the state of the landing gear (up or down) and was defined in the original aircraft specification that was agreed by Defence.

In March 2001, an Engineering Change was raised to change the RAWS implementation as a result of a Human Engineering Working Group recommendation to avoid the possibility of an unsafe situation arising during a landing approach (i.e. potential for aircrew to make a landing approach without lowering the landing gear). This change to the RAWS was implemented as agreed into the software delivered to Defence as part of Provisional Acceptance.

Subsequently in May 2003, Defence operators determined that a change was required to the March 2001 RAWS implementation, and a second Engineering Change was requested for additional changes to the alert function. The change requirements were approved by NASPO in September 2003. Software changes were implemented in 2004, and flight test was performed in 2005. NASPO accepted the revised software by letter dated 2 June 2005. However, between June 2005 and the end of the program in 2008, NASPO did not see a necessity to field this software revision in the delivered ITH aircraft.

The latter change would have been an enhancement to an otherwise safe functionality. This RAWS software version has been retained in the final version of the ITAS software and has been operated in the Prime Contractor's test and development aircraft since software acceptance in 2005.

Tie-Bar Strength

The SH-2G(A) helicopter meets or exceeds all appropriate requirements for structural integrity. In all cases these requirements are based on military specifications or standards that are consistent with the intended usage of the helicopter and in all cases structural substantiation testing or analysis has been performed to confirm structural adequacy. Since most of the SH-2G(A)'s primary, critical structure is identical to the parent U.S. Navy SH-2G, the structural adequacy has also been confirmed by many years of safe and successful operation in the U.S. Navy. The Tie Bar, discussed herein, is such a critical part.

Defence expressed concern about this part in the SH-2G(A) application and they ultimately performed testing to resolve these concerns²³² and this testing showed the part to be more than adequate, however, for reasons unknown the Report at paragraph 8.3 does not acknowledge the outcome of these tests. As part of the SH-2G(A) Engineering program the Prime Contractor was obligated to provide extensive documentation showing Defence how legacy structural parts and features were substantiated. This documentation was delivered as required and, in most cases Defence's technical experts deemed it to be entirely satisfactory. In a few cases, however, Defence was unable to make this determination either because they believed the data was incomplete or they did not agree that the data provided was sufficient for structural substantiation. In those few cases, and the Tie-Bar was one of those cases, Defence either asked the Prime Contractor for additional data or analysis or they took it upon themselves to do what they deemed necessary to satisfy their concerns.

²³² Tie-Bar strength was carried as Issue Paper 35 in Defence Airworthiness Issues list and it appears this was left open in spite of successful strength testing. Success of this testing and Defence's intention to close this Issue Paper is noted in NASPO letter serial NASPOIOUT/2006/4733 dated 13 November 2006.

The Tie-Bar is a small but critically important part that attaches the Main Rotor Blade to the Main Rotor Hub. It experiences high loading and must possess a very high static strength. The Tie-Bar is a legacy part of the SH-2G(A) and it is unchanged from the SH-2G/F application, having been used in its present form on all SH-2G and SH-2F models. On the SH-2G(A) it is subjected to very slightly increased loading due to the use of the CMRB but comprehensive substantiating analyses were performed, first for the U.S. Navy, who accepted the result, then for Defence, who expressed concern, that showed the part to have more than adequate strength for the SH-2G(A) application. Ultimately this concern was resolved when Defence performed a static strength test of the part which showed more than adequate strength for the SH-2G(A) application, as had been asserted by the Prime Contractor.

Although Defence may have had needed additional data in these few cases, neither Defence nor the Prime Contractor had serious reservations about structural adequacy, rather the concern was with the comprehensiveness of the substantiation.

Wheel Brake Overheating

The SH-2G(A) helicopter has high capacity brakes on both main wheels that are activated either singly or coincidentally through the flight crew's directional control pedals. These brakes are optimized for the small deck landing mission that requires high static holding capacity to help hold the aircraft on the moving deck. These brakes are also capable of effectively slowing and stopping the aircraft in the case of a run-on landing. However the brake disks are relatively small, with a low heat dissipation capability and consequently the Flight Manual advises against performing multiple severe brake applications in quick succession, as might be attempted in run on landing training. This does not, of course, preclude using the full capability of the brakes in an aggressive manner, when warranted by the need to perform an emergency run-on landing and where this has occurred there have been no reported instances of brake failure.

The wheel brakes are a legacy feature of the SH-2G(A) and they have provided many years of safe, reliable, low maintenance service on U.S. Navy SH-2G/F helicopters. These brakes continue to be used on Arab Republic of Egypt SH-2G(E) helicopters, Polish Navy SH-2G helicopters and, most notably, on RNZN SH-2G(NZ) helicopters and none of these users has noted any discrepancies.

Wheel Brake overheating is mentioned in the Report at paragraph 8.3, and documented in Airworthiness IP 23 which notes that the intended closing action was to add an additional Caution in the Flight Manual.²³³ IP 23 lay dormant for years with the aforementioned intended closing action. It remained open at the end of the program. As with several other IP's, it was shown as awaiting Prime Contractor action for closure when, in fact, the intended closing action was entirely Defence's responsibility.

Navigation System Drift Rate

The Prime Contractor continues to operate its test and evaluation aircraft in the U.S. without observing the condition reported by Defence. Defence was never able to substantiate its claims by providing data to the Prime Contractor. The reported condition was not repeatable even by the

crews who experienced it. The Prime Contractor concludes that this is not an issue. Seasprite navigation is managed by redundant LN-100G inertial navigation system with embedded GPS. The embedded GPS receiver updates the inertial navigation solution every one second. The LN-100G is a mature navigation system in use in over 70 U.S. and foreign aircraft extending from UAV/UUV's, fighter jets, transport aircraft, and helicopters.

²³³ This is shown in NASPO letter serial NASPOIOUT/2006/4733 dated 13 November 2006.

Navigation drift rate refers to the calculated difference between the GPS position and the inertial navigation solution over time. Because the LN-100G positional information (Le. the latitude and longitude of the aircraft) is routinely updated by the GPS, any calculated drift rate is not realized as aircraft positional error. The system routinely calculates the drift rate, however, and the operator can display the result on the Smart Display Unit in the aircraft center console. The OEM's advertised drift rate for the LN-100G inertial system is 0.8 nautical miles per hour, which is consistent with what is usually observed in the SH-2G(A) aircraft after the inertial alignment procedure is completed.

Defence operators reported several instances of high drift rates on both LN-100G's. In one case the calculated drift exceeded 60 nautical miles per hour. However, the condition was not repeatable by the aircrew reporting it. Nor was the Prime Contractor able to reproduce the situation in a properly initialized navigation system.

After extensive testing onboard the test and development aircraft in the U.S., the Prime Contractor concluded that the most probable cause of high drift rate was improper initialization of the navigation system involving an error in the input of initial aircraft position during the preflight navigation alignment procedure. Defence operators maintained, however, that their initial position input and LN-100G alignment procedure had been performed as required, and continued to attribute the drift to an unknown deficiency in the navigation system. The Prime Contractor was prepared to investigate any further observations, and solicited quantitative data from Defence aircrew but the condition was not found again prior to the Project cancellation.

In January 2007, at the request of Defence's Head Aerospace Systems Division, the Prime Contractor provided source data for the test and qualification of the LN-100G navigation system on board the SH-2G(A) aircraft. Although the Prime Contractor is aware that Defence continued to hold an IP on Navigational Drift, no further correspondence was received on this matter. The Report itself concludes (paragraph 64 [Paragraph 65], page 32) that Defence was never able to provide the requisite data to the Prime Contractor.

Cyclic Latching

Paragraph 7.32 [Paragraph 7.35] of the Report discusses a large and sometimes unpredictable cyclic displacement occurring during take-off - "cyclic latching" in a late 2004 report prepared by AMAFTU based on testing conducted during the Special Flight Permit period. This cyclic latching was due to an AFCS engagement condition, wherein, if the system was engaged on a slope, the system would continue to maintain this engagement position thus causing the cyclic displacement after take-off.

A software change was made to the AFCS in mid 2004 (trouble report 470) to eliminate this cyclic displacement and further flight testing confirmed this was no longer an issue.

ANAO Comment

As noted in paragraph 5 of the Summary, the success of the Project was dependant on the performance of Defence, the Defence Materiel Organisation (DMO) and the Prime Contractor. The ANAO's focus in conducting this audit was on Defence's and DMO's administration of the Project, including DMO's key responsibility of managing contractor performance and ensuring the interests of the Commonwealth were appropriately protected when the Project encountered difficulties.

It is clear from the Prime Contractor's response that there are points of difference between the company and Defence/DMO in their views on a range of issues relating to the Super Seasprites. These include ITAS development, AFCS development, the RAST interface, the capacity of the aircraft to undertake flight in instrumented meteorological conditions and the aircraft's crashworthiness. Analysis of ITAS issues are included in Chapters 2, 3 and 4. AFCS issues are documented in Chapter 7 and those relating to the RAST interface in Chapter 8. The ANAO has reflected in the report Defence's concerns, based on Defence documentation and analysis, surrounding the capacity of the aircraft to undertake flight in instrumented meteorological

conditions and the crashworthiness of the aircraft. Relevant excerpts of the Prime Contractor's comments on these matters have also been reflected to provide balance.

Paragraph 7 of the Summary acknowledges the differing views of the Prime Contractor and DMO. The fact that Defence/DMO and the Prime Contractor hold such differing views on these important issues is significant to understanding why the Project encountered so much difficulty over its long life and was, ultimately, cancelled. The parties' differing views are reflected in the analysis of issues in the report, particularly in Chapter 4 for the ITAS, Chapter 7 for the AFCS, Chapter 8 for other issues with the aircraft and Chapter 10 for Project cancellation.

Appendix 5: Responses from other parties with special interest in the report

CSC Australia Pty. Limited

CSC Australia Pty. Limited were provided with an extract from the proposed Section 19 report and provided the following comment.

Comment

I refer to your letter dated 14 April 2009 in which you sought CSC's input on the draft performance audit report of the Department of Defence's Super Seasprite project. Thank you for the opportunity to comment on the report before it is tabled in Parliament.

In CSC's view, the draft report appropriately explores many of the factors that contributed to performance issues in this complex Defence project. Overall, CSC agrees with the general thrust of the report and its recommendations.

CSC does, however, have a concern about the adverse implications that could be drawn against CSC as a result of the report's failure to distinguish between the performance of the various sub-contractors, of whom CSC was the only sub-contractor whose engagement with the project was conducted completely by their Australian subsidiary. We appreciate that the ANAO may have consciously sought not to apportion responsibility as between Kaman and the three subcontractors, as this was perhaps outside the scope of the terms of reference. However in our view the lack of delineation between the subcontractors has the consequence of damaging CSC's reputation in circumstances where we were not at fault.

Given that CSC is the most locally recognizable of the three subcontractors, the grouping together of these companies will possibly lead some within the Australian Government and the broader community to assume, wrongly, that CSC was the subcontractor largely responsible for the project failures. To minimise the risk of such reputational damage to CSC, we request that you amend the report to distinguish between the local and offshore subcontractors in this respect.

There are further insights that CSC could offer, from a sub-contractor perspective, into the project management and technical issues that affected the project. CSC's project team leads and I would be pleased to meet with you to discuss these issues, should that be of assistance.

ANAO Comment

CSC is correct in saying that the ANAO consciously sought not to apportion responsibility as between Kaman and the three subcontractors, as this was outside the scope of the audit. When a Defence project such as the Super Seasprite is cancelled there are implications for other parties that have an ongoing interest in the Project, such as sub-contractors to the Prime Contractor. These implications can be both financial and reputational. In conducting this performance audit, the ANAO focused on the activities of Defence and DMO in managing the Super Seasprite project, including their interactions with the Prime Contractor, and only focused on the activities of sub-contractors where their activities directly impacted on the Project. Accordingly, readers of this report should exercise care in drawing any inferences about the performance of sub-contractors.

The Hon. Brendan Nelson MP, Minister for Defence 2006-2007

The Hon. Brendan Nelson MP was provided with the complete proposed Section 19 report and provided the following comment.

Comment

I am writing in response to your letter of 14 April 2009 in which you invite me to consider the draft of the ANAO performance audit of the Defence Department's Super Seasprite project.

I appreciate very much the opportunity to read the draft report and specifically comment on it. I have read the report carefully and in particular the period of 2006 and 2007 when I was Minister for Defence.

The only comment that I would make is that following the hard-over of the Automatic Flight Control System (AFCS) I convened a meeting with the CEO of the DMO, Chief of Navy, Chief of Air Force and other relevant senior personnel to discuss the future of the Seasprite project. I made it clear to them that three alternatives needed to be actively considered and that I would expect a comprehensive report on each of them.

The first option was to continue with the project. What would that cost, what would a reasonable timeframe look like and what technical outcomes might be expected?

The second option I requested was modification of the aircraft to a lesser capability than originally envisaged. Again, what would that cost, what capability could be delivered and in what timeframe?

The third option I wanted examined in detail was not continuing with the project, the cost to the Commonwealth of not doing so and alternatives for the development of this capability.

I received a preliminary report several months later in 2006 with which I was not satisfied. I then sought much more detailed information and it was not then until early 2007 that I was ready to take a submission to the National Security Committee.

Thank you for the opportunity to read and comment on the report and I look forward to its publication.

ANAO Comment

Dr Nelson's comments have been incorporated into Chapter 10.

Scientific Management Associates (Victoria) Pty Ltd – Sub-contractor to Prime Contractor

Scientific Management Associates (Victoria) Pty Ltd were provided with an extract from proposed Section 19 Report.

Introduction

Vide reference A a draft Audit Office Report extract under s.19 of the Auditor-General Act 1997 on the Super Seasprite Project was referred to Scientific Management Associates (Victoria) Pty Ltd (SMA) for comments on a no obligation basis.

SMA was one of four Australian, New Zealand companies that entered into a Teaming Arrangement with Kaman Aerospace International Corporation (Kaman) to support a tender bid and subsequent acquisition and in-service support of the Kaman SH-2G(A) Super Seasprite helicopter offered in response to Project Sea 1411.

Background

SMA's role in the teaming arrangement was to provide a total Integrated Logistic Support (ILS) solution for the expected 25 year plus life of the helicopters. During negotiations with Kaman SMA also agreed to finance, design, develop, construct and commission a through life support centre (KAISC) including offices for administration, engineering, software development, logistics, training as well as a full motion simulation suite provided by others and an on site spares storage and handling facility.

After delivery and acceptance by Kaman, this facility was leased on an exclusive basis to Kaman with funding provided by the Commonwealth under the project in-service support (ISS) contract.

The SMA capital investment in this significant facility was not funded in any way by either Kaman or the Commonwealth with the only method of cost recovery occurring over an extended lease period including two intended ISS option periods that gave the Commonwealth rights to take over the lease arrangements at any time in the future if so needed.

During the acquisition phase and transition into ISS, SMA completed an extensive ILS program that included the development of all new technical documentation, the upgrade and validation of Kaman legacy data, development and delivery of aircrew and maintenance personnel training, preparation of all maintenance procedures, support and test equipment definition, spares analysis and assistance with provisioning, spare part storage and material management as well as technical support for design changes and configuration.

Over the extended period of the merging contracts SMA provided in house trained personnel including fully qualified pilots and tactical instructors.

During 2007 the then Government decided to continue the Super Seasprite program with SMA receiving direction from Kaman to "fully man" the In Service Support team. In the months leading up to that decision SMA had taken the view that, given the question marks around the future of the project, only critical positions should be re-staffed if serving personnel resigned from the company.

At the time the project was cancelled, SMA had implemented a fully validated support program that was capable of supporting the Super Seasprite aircraft through all test/trials and operational periods.

The flow down termination notice to SMA was implemented by Kaman without any form of consultation or termination negotiations. Notwithstanding, SMA supported the run down of the KAISC including the processing of all material returns (including spare parts and the motion simulator) to the USA through October 2008.

SMA remains in dispute with Kaman over termination costs and Intellectual Property (IP) rights that could prevent the on selling of aircraft and associated support to a third party or parties if not

satisfactorily resolved. At SMA cost, a core team of maintenance and training personnel have been retained to meet both marketing initiatives and potential longer term ISS for a foreign defence force.

Audit Objectives

The audit objectives as listed in the paper are:

- identify those factors that contributed to the on-going poor performance of the project;
- outline measures taken by Defence and DMO in seeking to overcome issues encountered by the Project and key issues encountered arising from this project for the benefit of major acquisitions projects generally; and
- determine the capability and cost implications of a project that failed to perform.

The following comments on these audit objectives are made, not only on the basis of SMA contractual involvement through the tendering phase to project termination in March 2008 but also on our own assessments made to substantiate our initial decision to join the Kaman team, involving an independent evaluation of Kaman's tender compliance and win strategy within a framework of medium to high risk technology development.

Whilst Defence specifications sought offers of proven platform airworthiness the Super Seasprite avionics suite and combatant capability, including the firing and guidance of a Penguin missile, involved leading edge technology not then in international service on a suitable platform for the RAN.

The Kaman team solution to offer a well proven fully remanufactured aircraft with a state of the art avionics update was seen at the time, by most stake holders, as an attractive solution with a containable project risk.

However similar experience on other developmental projects such as the Oberon SWUP project and the Collins Class Submarines has highlighted the type of program issues and technical risks that can lead to potential schedule and cost overruns in developmental projects of this nature. The US Marines encountered similar development issues in the combat solution for the Bell AH-1Z Cobra helicopters which was also implemented by Litton Guidance and Control Systems under much more flexible US Government contractual and funding arrangements.

The lesson that should be learned from the failure of this project is not necessarily to avoid serious technology development but rather to undertake more rigorous risk mitigation analysis with a contractual strategy that properly recognises potential technical risk and makes both cost and schedule overrun provisions as a project contingency – US DOD contracting policy would not allow such fixed price contracting for a developmental project equivalent to the Super Seasprite.

The poor alternative in the future is to always accept less capable but more proven in service solutions that may not offer a combatant competitive edge for the Australian Defence Forces. It would be an unfortunate and retrograde step to blindly follow this option.

Given that there is substantial evidence to support the original source selection and subsequent contractual award to Kaman it is nevertheless appropriate to evaluate how well the various parties performed as the project evolved.

Whilst this analysis cannot be made without access to internal files and performance evaluation criteria throughout the project it is clear that Kaman was in serious default due to the shortfalls of the principal avionics subcontractor Litton Guidance and Control Systems who was terminated in 2001. Under the original strong Kaman corporate management led by the company founder Charlie Kaman the company addressed technical and program issues responsibly as they were identified.

During the corresponding initial stage of the project the Commonwealth team led by Captain Brian Rowe RAN (who had relevant prior experience on the Sea Hawk Project) also focused on

identifying emerging technical problems and working closely with Kaman and subcontractors to resolve these issues.

As the project developed and more serious technical issues were identified, including schedule overruns the then DMO and the head of DMO's Aerospace division both became more personally involved in the project with much more emphasis being placed on tougher contractual compliance. An approach that may have precipitated an irretrievable breakdown of trust and cooperation between customer and contractor. In the end the customer (and the Australian Taxpayer) has been by far the biggest loser with a defaulting contractor let "off the hook" and given potential to recover all previous losses if a successful aircraft sale is negotiated with another customer as a result of the Deed of Settlement.

By this time Kaman was feeling financial pressure from internal corporate sources and changing management which implemented cost containment measures. From this time on the success of the ultimate SH-2G (A) project was in question. This position was foreign to Kaman who had survived over fifty years dealing with a more understanding and less cost variation adverse customer in the US Navy.

The Defence decision in the early 2000's to provisionally accept the Super Seasprites in an interim capability was a positive initiative leading to a contract amendment in early 2003 to provisionally accept nine aircraft in an interim configuration.

Flight operations were supported by SMA aircrew training, between 2003 and 2006 with limitations relating to the aircrafts Automatic Flight Control System (AFCS) leading to flying operations being suspended and the Australian Military Type Certificate for the aircraft being withdrawn in May 2006 preventing any further operation or flight testing by Navy.

Whilst the AFCS issue was short lived, the previous year's Sea King tragedy in Indonesia may well have been another factor in restricting further flying.

However, this decision must surely now be subject to critical examination, not only on its immediate impact on this project but also on the commitment made thereafter by all stakeholders to drive the project to a successful conclusion. Faced with a similar dilemma in the future would departmental management and capability sponsors again abrogate their obligation to fulfil the objectives of the original project, particularly one that offered so much to the future capability of the Australian Defence Forces? Abrogation may seem a harsh observation on decisions taken in good faith and with personnel safety in mind, but at the end of the day Australia is a nation committed to peace time preparation for the future protection of our country against any hostile act. Is it fair to ask how far away ultimate project success was when the Super Seasprite project was terminated? What image do we project as a nation to our allies and adversaries when we proclaim a defence project failure and then try to sell off the delinquent product to another customer even when processed through the original defaulting prime contractor?

At the time the Government terminated the project the SMA Pilot Training Instructor (then the only qualified SH-2G(A) pilot) confirmed to SMA Management that he was confident of night flying in the current aircraft configuration even in full cloud. This Qualified Helicopter Instructor pilot remains available to attest to this commitment. His experience and operational standing was considered by SMA a fundamental requirement in any future promotion or aircraft sale to an international third party. Notwithstanding Kaman proceeded to terminate all of SMA's operational and maintenance capability from the end of March 2008.

SMA recognises that Defence was genuinely concerned with the impact that project termination would have on all Australian/New Zealand subcontractors but particularly because of SMA's capital investment in the KAISC and IP rights associated with operational and maintenance documentation and the sophisticated training package, in the event of a third party purchase. Defence dialogue with Kaman sought a "soft termination landing" for SMA but in the end this request has had little or no effect on Kaman.

Force Multiplier for ANZAC Ships and Off Shore Patrol Vessels (OPV)

Other Defence correspondents criticisms relating to the wisdom of embarking on an all- new avionics and sensor suite to allow the aircraft to be flown by a two man crew rather than the normal three man crew have little merit given the genuine effort made by the RAN and various contractors to design an optimum operational solution.

This decision was certainly a calculated challenge but not an unreasonable risk. Indeed the reconfiguration and update of aircraft avionics packages remains an essential element of both our Defence and in country industry capability.

The ultimate failure should not become a “lessons learned” to avoid future like challenges but rather the need for full project commitment, adequate technical/system engineering oversight and a more realistic contractual and funding frame work. Australia cannot expect to maintain a sophisticated naval aviation capability using the same approach to purchasing off the shelf defence products.

There has also been much speculation that if the Joint OPV Project with Malaysia had been cancelled before contract award to Kaman it may have been prudent to accept a less capable variant of the S-70B2 Seahawk anti-submarine helicopter and retain commonality with the FFG-7 Class Guided Missile Frigates. The ANZAC ship flight deck had been designed to handle the heavier S-70B2 with identical landing capability.

As it happens the availability of surplus RAN S-70B2 helicopters, which came about by convenience in the paying off of two FFG-7s, HMAS Ship Adelaide and Canberra, has provided a low cost interim solution for the Super Seasprite aircraft replacement.

SMA was also responsible for the delivery of the complete ILS package for the ANZAC Ship Project and defined the helicopter interfaces needed for either type of aircraft.

The significance of losing the capability and force effective multiplier of the Kongsberg Penguin MK2 Mod7 anti-ship missile capability with the demise of the Super Seasprite has been largely ignored (at least in the public domain) leaving the RAN without a capability to engage an enemy ship operating out of a protected port/harbour situation. One assumes that this situation has been properly recognised and documented in project papers available to ANAO.

Whilst the new government would naturally be anxious to put this project behind them after formal contract termination some decisions taken at that time can not be supported – particularly the decision to breakdown the motion simulation (by then in a full operational condition) and return it boxed to Connecticut, USA.

This simulator offered follow on work opportunities for Australian industry and was seen by SMA Pilot and Tacho instructors as an essential marketing tool for any future sales promotion. It is unlikely this simulator which requires a purpose built facility similar to the KASIC, will ever be effectively re-commissioned. Retention at the KAISC at least in the near term would have preserved some dignity for Australia and allowed both SMA and CSC to recover their significant investment in the project.

Government lack of consultation with Australian subcontractors prior to the termination decision was particularly disappointing reflecting little appreciation given to their project understanding and commitment over a difficult decade which involved many unfunded project delays/work extensions.

Review of Draft Audit Documentation

Summary – Introduction paragraphs 1 – 7

Paragraph 1 - identifies the operational tasks intended to be performed by the Super Seasprites but these do not express the views held by Naval staff in the mid 1990's on the significant level of improved operational capability that would be realised with the new aircraft including a Kongsberg Penguin Mk2 Mod 7 launch capability. This was a highly offensive aircraft capability

that had not existed in the RAN since the de-commissioning of HMAS Melbourne in the early 1980's.

Paragraph 2 - notes that the contracts signed on 26 June 1997 included an ISS contract. This contract was mostly developed and costed by SMA and CSC for submission by Kaman on a fixed price basis. Many briefings were given to Kaman on our interpretations of what the RAN expected to be delivered under this arrangement. From other readings it is apparent that the Audit office is not fully aware that the initial Seasprite ISS contract covered only ISS management, engineering, logistic/training material storage/management, configuration/change control software updates and operation and maintenance of the motion simulator with limited technical support of aircraft operations.

The ISS contract did not cover any physical maintenance of the aircraft related to the intended rate of effort. This was a separate requirement including deeper level maintenance that would be the subject of later considerations. In the near term 805 squadron had been trained to provide full maintenance support for routine flight operations which occurred between 2003 and 2006. Kaman was separately funded for repair of subassemblies/repairable items on a case-by-case basis.

Paragraph 3 [Paragraph 5]- Clearly one of the most serious short falls of Defence management of major projects in recent years is the lack of attention given to the roles played by principal subcontractors particularly those providing complex supplies and services. It is simply not good enough to rely on the Prime Contractor to fulfil this management obligation when the performance of these key subcontractors is so critical. In the case of Litton when it defaulted on its fixed-price subcontract to develop the sophisticated ITAS most of the funds had been spent. Kaman then had to renegotiate with CSC Australia and Northrop Grumman to take over this element of the Project. The ANAO report presumable addresses the DMO oversight (and recognition of value for money of various progress payments made to Litton) in chapter 4 of the report (not available to SMA).

Paragraph 4 - No comment

Paragraph 5 - No comment

Paragraph 6 - The Deed of Settlement referenced has apparently been subject to a confidentiality agreement but may include arrangements under which the Commonwealth will support the on-going sale of the ex-Australian Seasprites to another foreign navy (including withholding of adverse comment on the performance of the SH-2G(A) variant). It is indeed a concern that this confidentiality provision has been invoked, since it has influenced the way Kaman has treated subcontractors from the time of termination. SMA will seek release of this document under the discovery process prior to implementing legal action against Kaman. The Audit office should ensure that subsequent release of this Deed will not embarrass Australia when made public.

Paragraph 7 [Paragraph 8]- SMA is particularly sceptical about the value of any lessons learned resulting from Defence project reviews and is surprised to read that DMO has already incorporated them into the 2008 Defence Procurement and Sustainment Review.

Audit Objective Paragraph 8 [Paragraph 9]- SMA is not privy to the sections of the ANAO report that may summarise the apportionment of blame against the audit objective to "identify those factors that contributed to the on-going poor performance of the project."

It is expected that at least the following will be considered:

- Kaman's qualification (in light of their previous mode of business with US DOD on projects involving significant ITAS/Weapons variations) to undertake all elements of this project.
- Failure and eventual termination of Litton's subcontract for ITAS design and development.

- The Defence monitoring of this subcontractors performance and milestone payments made against value for money analysis.
- Kaman's/DMO arrangements to put in place suitable alternative arrangements for Litton's replacement and whether the cost and schedule impacts were properly assessed at that time.
- The suitability of "fixed priced" contracts and subcontracts for complex development and software intensive military systems. Fixed priced incentive (70:30 or 60:40 share line on cost savings/overruns) and cost plus incentive fee contracts have been effectively used by the US DOD for at least the past 40 years.
- Kaman's overall failure to meet its full contractual obligations during the SH-2G(A) Super Seasprite acquisition contract.
- Defence and DMO ability and determination to recognise the consequences and cost impacts of emerging issues and the potential benefits that an additional injection of \$50-100 million, of directed software/system engineering effort at the right time, could have had on preventing the ultimate failure of a \$one billion project.
- Whether all Commonwealth stake holders were totally committed to project success and were not swayed by their own personal views on easier options.
- Other contributing factors.

Paragraph 9 -28 - Not available to SMA

Aircraft sustainment (Chapter 5)

Paragraph 29 [Paragraph 30]- As stated previously it is believed that the Audit Office is mistaken about the precise nature of the ISS contract. The transition from acquisition to ISS was undertaken in an orderly and timely manner with the build up of staff occurring not only to retain experienced personnel but also after acquisition tasks were accepted and signed off. Many of the acquisition logistic functions (with the notable exceptions of the material (spares) handling were continued under the ISS contract on a regular basis). From the commencement of ISS to project termination thousands of field changes (minor mods) were implemented to engineering drawings and technical manuals as an ongoing configuration management effort. Training aids and materials were refined as well as training staff continuing their own development as the motion simulator was brought into service. The Australian subcontractors all had to make allowances for program delays and extensions as well as retraining their own staff when staff losses occurred. Under these difficult circumstances value for money continued by ensuring that the integrity of the total support package was kept at a high level.

Paragraph 30 [Paragraph 31]- The originally intended requirement of 14 aircrafts to support 8 Anzac ships was sound. On an ongoing basis only 11 aircrafts would present difficulties in maintaining six flights at sea. However it was certainly sufficient to meet normal fleet operations. The report as written gives the wrong impression with an inference that it was illogical to continue with only 11 aircraft and no defined attrition plan. To the contrary the Seasprites were expected to perform better than any other military aircraft currently in-service.

Paragraph 31 [Paragraph 32]- The first sentence is superfluous/misleading and should be deleted.

Paragraph 32 [Paragraph 33]- This paragraph is also misleading since the transition to ISS occurred in an orderly manner. It is true that a revised milestone schedule with payments adjusted to reflect the non achievement of milestones under the Prime Contractor was adopted. SMAs subcontract was extended by two years to September 2012 without any increase in labour costs. Sadly DMO seems to have also not fully understood the need for orderly transition and retention of a highly skilled capability to maintain a viable ISS capability whilst the acquisition issues were resolved.

Paragraph 33 [Paragraph 34]- This paragraph should also be aligned with previous comments particularly since the rate of aircraft effort was not directly related to the tasks performed or time spent by ISS staff on real work.

Paragraph 34 [Paragraph 35]- In the context of the three listed Audit objectives this paragraph is largely irrelevant. The fact that \$58.94 million has been spent on spare parts from sustainment funding rather than project funds must surely have been approved by competent authority. All the spares ordered were the subject of intensive analysis by SMA technical staff then reviewed and agreed by DMO delegates before procurement by Kaman went ahead.

The term “three years worth of spare parts” is not well understood since this includes both three years of fleet usage of common maintenance items (mostly consumables) as well as the high cost insurance items that are required to support the aircraft on an infrequent basis through life. \$58.94 million is a conservative spend well below the normal project cost of 10% of project funds or more. However SMA staff feel that the total cost of spares purchased exceeded this amount and the Audit office should confirm the total spend from all funding sources.

Paragraph 35 - This comment attempts to make something out of the routine process of technical manual preparation and validation. During the program SMA prepared, updated and validated over 100 manuals representing 19,018 pages including all the Kaman legacy documentation that was supplied by Kaman in various formats but certainly not validated against the latest configuration. Navy staff reviewed all documentation deliverables with updates implemented as requested before acceptance.

The paragraph is again misleading and adds little to the objective of the report.

1. Introduction

Paragraphs 1.2 – 1.5 - The only comment is that the surface warfare definition (maritime strike) does not accurately reflect the level of operational capability that was intended with the introduction of the SH-2G(A) Super Seasprites. The loss of this capability means a lot more than just finding a replacement helicopter of current capability.

Project Phases

Paragraph 1.7 - With the exception of the helicopters and employment of the Penguin air to surface missile all the other support requirements were delivered in a validated form. The comprehensive support package was delivered in conjunction with an operational support centre (KAISC) totally funded by SMA at no cost (other than modest monthly rental) by the Commonwealth. This centre remains empty and a costly liability to SMA.

Paragraph 1.8 - Nothing has been said about the eventual disposal of the seven helicopters procured under Phase 2.

Table 1.1 Key Project Dates

1998 – Navy adopted the tri-service ADF airworthiness arrangements – was the impact of this decision on the Kaman contract evaluated at this time or did this only come to light in the mid 2000's ?

Sep 1999 – ISS Centre opened – Delivered on schedule with less than 12 months for construction and acceptance after council approvals were given.

Contractual Arrangements

Paragraph 1.9 - No comment

Paragraph 1.10 - The term unique variant does not adequately convey the significance of the RAN requirements that drove the complete redesign of the aircraft ITAS and weapon fit. This included a new glass cockpit fit out suitable for a two man crew also involving extensive software development.

Paragraphs 1.11 - 1.12 - To the best of our knowledge the costs involved for the two year extension were absorbed totally or mostly within the Kaman team.

Squadron Commissioned to operate the aircraft

Paragraphs 1.13 – 1.15 - The cost of \$181.87²³⁴ million for a squadron operation from 2001 to 2008 equates to \$520,000 per person (assuming an average of 50 personnel for seven years). Even including infrastructure and staff overhead costs this is a high number.

Procurement reform process

Paragraphs 1.16 – 1.23 - There is little in these paragraphs to suggest that the reform process has had any real impact on improved management of the Super Seasprite project that is consistent with the intention of the audit objectives.

Audit approach

Paragraphs 1.24 – 1.26 - No comment

Audit Methodology

Paragraph 1.27 - The audit methodology in subparagraphs (a) to (f) are very broad in nature and do not address the validity of the contracting methodology or the powers, experience and commitment of the defence management team to administer, monitor and direct the total output of the prime contractor and each principal subcontractor. Whether this has been done effectively is not evident in the report sections available to SMA.

Paragraphs 1.28 - 1.31 [Paragraph 1.32]- No comment

Report Structure

Paragraph 1.32 [Paragraph 1.32] - Chapter headings 2-10 do not appear to address areas of specific deficiency or related lessons learned.

Chapter 5 – Aircraft Sustainment

Paragraph 5.1 - No comment

Figure 5.1 - The important areas of crew training and engineering functions to ensure continued airworthiness and configuration management appear to be overlooked.

Capacity to address aircraft attrition

Paragraphs 5.2 – 5.6 - The logic included in paragraphs 5.2 and 5.3 incorrectly infers that the specified aircraft capability of flying at least 10,000 hours over a 25 year period would mean that the eleven aircraft would fly collectively in the order of 110,000 hours.

At a squadron fly rate between 1,000 and 2,000 hours per year the total flying hours over 25 years would be less than half the 110,000 hours quoted. In this time the attrition of one or two aircraft out of the total of 11 would not be unrealistic. To avoid unnecessary speculation on the credibility of the program with only 11 aircraft it is suggested that the reference to 110,000 flying hours be removed.

Management of the ISS Contract

Paragraph 5.7 - 5.8 - The long term supportability of the Super Seasprites was further enhanced in the early 2000's with the USN transferring the complete stock of related spare parts to Kaman for life of type management and distribution to all world wide users.

²³⁴ The figure of \$181.27 million was provided by Defence to the ANAO and had been incorrectly calculated by Defence. Defence subsequently amended this figure to \$46.9 million.

In 5.8 the reference to aircraft maintenance services does not include the industrial work associated with deeper level of maintenance and repair of the air frames and ITAS. Therefore the comparison with the lead-in fighter is not considered valid or appropriate to include in this audit report.

Paragraph 5.9 - In reality the KAISC operation did commence in 2000 with a controlled transition from acquisition funding to ISS funding. Whilst the tasks performed were not directly related to aircraft rate of effort they were essential to maintain the integrity of the total ILS package. By the time of project termination the KAISC remained fully operational and effective.

1999 Internal Audit of ISS arrangements

Paragraphs 5.10 - 5.13 including Table 5.1 - In the context of the current audit objectives this information has little or no relevance, in particular Table 5.1 is incomplete and misleading. The scope of each ISS contract is vastly different – reference to liquidated damages has no parallel under the Super Seasprite arrangement. Options to extend the Super Seasprite ISS arrangements and lease of the KAISC included potential 15 year and 10 year periods. The Commonwealth also had rights to takeover the KAISC if needed.

It is strongly recommended that this section be completely removed.

Aircraft rate of effort

Paragraph 5.14 – 5.15 including Figure 5.2 - Again the relevance of this data is questionable. In particular the response from the Head of Aerospace System Division on Seasprite availability in 2006 may only have applied to a few non-recurring events.

Payments commenced prior to aircraft acceptance

Paragraph 5.16 - 5.24 including Table 5.2 - In the main the costs shown in the table relate to KAISC rental and ongoing support as well as labour costs for contractor and subcontractor personnel operating within the KAISC on real tasks. Payments made for deeper level maintenance and other services may well relate to various aircraft modifications and repair/refurbishment of spares/equipment handled by Kaman. The increase in these activities in 2005/6 should be explained by DMO.

The establishment of the ISS capability was undertaken in an orderly manner with expenditure consistent with real work performed to maintain the support system until the aircraft could be brought on line. Economies were made which allowed Kaman to extend the contracted ISS period by 2 years. Retention of the ISS in an operational state was necessary until the decision was made to terminate the project.

Conclusions

The initial decision to proceed with the acquisition of the proven Super Seasprites with a new avionics and missile launch capability designated as the SH-2G(A) was soundly based and effectively managed until the shortcoming of Kaman's principal avionics subcontractor were confirmed. Thereafter contractual administration became increasingly difficult and the recovery of funds already paid to Litton near impossible. A situation that Kaman had not previously encountered, with the level of USN control over combat system engineering for their own projects. Kaman was not able to come to terms with the significant cost overrun exposure. Under these circumstances strict adherence to contractual obligations was unlikely to succeed. Coupled with a declining commitment on behalf of many Commonwealth stakeholders the project progressively floundered resulting in eventual project termination by which time most of the Aircraft technical issues had been resolved and a fully operational ISS capability established.

The general public will forever consider this project as a Defence acquisition failure when in fact many valued milestones were met and eventually project success would have been achieved. The ANAO report should carefully explain that the option to terminate was well balanced against the emerging options to use surplus Seahawk aircraft and a near term replacement opportunity that would provide greater efficiencies over the life of the ANZAC Ships.

Recommendations

Given that Defence needs to retain an effective management and systems engineering capability to support future military aircraft acquisition, upgrades and cost effective in-service support it also needs to understand and accept the risks that are inherently involved in acquiring state-of-the-art technology needed to maintain combatant superiority. With this goes the need to implement more flexible contractual arrangements with appropriate schedule and funding contingencies. It is recommended that the Government/DMO and ANAO consider the benefits of using the Australian Super Sea Sprite experience to re-evaluate defence contracting policy in conjunction with high level discussions with US Government counterparts who encounter similar issues with many of their complex defence projects.

Implementation of more complex contract management/administration controls within DMO may sound impressive but will not suit all situations or prevent future contractor defaults.

In the end mutual trust and co-operation to work around issues will always be needed to achieve successful contract completion.

ANAO Comment

SMA were provided with further extracts subsequent to these comments being received with the following response provided.

SMA Second response

The additional extracts of the ANAO Super Seasprite proposed audit report have been reviewed with comments provided in the attachment.

Scientific Management Associates (SMA) sees very little evidence in these sections of the report that would provide justification for the termination of the project in 2008.

As you are aware Kaman Aerospace recently announced the successful completion of all testing of its Integrated Tactical Avionics System (ITAS) software following the return and transfer of the eleven Australian SH-2G(A) Seasprite helicopters back to Kaman.

Kaman claim that this milestone significantly enhances the company's efforts to sell the multi-mission helicopter to international navies in a new configuration designated the SH-2G(I). This configuration maintains the two man crew concept of the Australian variant but with many reduced features. Kaman claim that this recent test program completes all elements of testing to ensure the SH-2G(I) fully meets design objectives. This variant will now presumably be certified for unrestricted flight by US authorities.

The decision taken in March 2006 to suspend flying operations has been a major factor in the demise of this project. By this time most of the logistic issues including the validation of the entire suite of technical manuals were well under control.

Some of the reduced confidence in the aircraft resulted from concerns precipitated by the Sea King Board of Inquiry and subsequent Airworthiness Authority reviews.

This in turn led to an unwillingness to continue the due process of working through maintenance and potential safety issues in an orderly manner.

Given the conflict between project objectives and heightened airworthiness concerns it may well have been prudent to establish a strict Test and Evaluation program outside the Squadron control to work through the types of issues that the introduction of any new aircraft would present. Indeed the concept of a lead aircraft program to fully test and evaluate the SH-2G(A) variant may have eliminated many of the problems long before fleet introduction of follow aircraft.

At no stage did SMA flight training crew have any reservation to continue with the flight training program from March 2004 onwards.

By 2008 SMA was convinced that the total logistic support package was of the highest international standard offering a much better baseline than that available for other military aircraft operating in Australia today.

SMA is willing to support the audit office in finalising the Super Seasprite report in any way possible.

THE SUPER SEASPRITE – SUBMISSION EXTRA BY SCIENTIFIC MANAGEMENT ASSOCIATES

New section released to SMA

Conclusion

Paragraph 9 [Paragraph 10] – The introduction of a new aircraft variant is always going to present issues and conflicts between the various requirements of the project office and ADF airworthiness. Is the ANAO suggesting that Defence was not ready to manage this complex task or that there was not a proper meeting of the minds amongst all stake holders? No mention is made in the report to any Introduction into Service Plan that addressed these issues as well as providing a positive way forward to bring the aircraft capability into service.

Paragraph 9 • points [Paragraph 10]

First • point – not a valid statement – The current SH-2G variant was a proven aircraft then in service with the Egyptian Forces and US Coast Guard – What was offered was a fully remanufactured aircraft with zero hours service. The SH 2G(A) variant was tailor made for Australia with an advanced ITAS and new weapons capability – It is quite incorrect to refer to the rebuild using an existing airframe (solely for cost saving purposes) as a second hand platform. No mention has been made of the success of the New Zealand SH-2G variant.²³⁵

Second • point – This is also an incorrect statement – The incorporation of the advanced ITAS capability into the SH-2G (A) variant was no greater a risk than a similar fit into a larger aircraft such as the S-70B2 Seahawk. The ANZAC Ship has a design capability equally suitable to the Seasprite or Seahawk helicopters.²³⁶

Third • point – This is also an unfair statement – The RAN Officers of the day were well aware of the project challenges prior to and through the contract negotiation process – They did, as did everyone else, not recognise the shortfalls of the ITAS subcontractor. The basic issue was to maintain the drive needed to implement a successful project when this sub contractor fell over.²³⁷

Fourth • point – It is not an uncommon practice for Defence to underestimate project costs particularly when there is a significant element of technology and capability gain. What is not addressed is why the project was allowed to proceed with a funding shortfall resulting in a reduction of helicopters acquired and the use of funds from outside the project budget – This surely created added pressure on the Project Office.²³⁸

²³⁵ This dot point was removed.

²³⁶ Now first dot point. The capability enhancements were not only ITAS, but the RAST, additional weapons station, the penguin missile, modification to the cockpit and design changes intended to improve crashworthiness among others. All these issues are covered in the audit report. Some in sections not provided to SMA for comment.

²³⁷ Now second dot point. The understanding of the risks associated with the ITAS are set out in Chapter 2. Both Defence and the Prime Contractor acknowledge issues in this area. SMA were not provided Chapter 2.

²³⁸ Now third dot point. See Recommendation 1 which was not provided to SMA.

Fifth • point – What is meant by financial leverage available through the Prime Contract? – Indeed funds were expended on the ITAS subcontractor without good effect before cancellation of his services. At the time most stakeholders would have supported the recovery actions taken. From past experience this is the time that the customer must consider all the options including a contribution of funds, or risk sharing, to achieve a better outcome.²³⁹

Sixth • point – The Seasprite Project Office commenced the project with the most experienced Air engineer in the RAN at the helm. His early departure would have certainly inhibited Defence's capacity to manage this complex project. Other staff movements should have been effectively managed.²⁴⁰

Seventh • point – Indeed software and system development activities undertaken by subcontractors to the Prime Contractor were most critical to project success – The comment that DMO had limited contractual capacity to resolve risks as they emerged can not be accepted as valid. This is a fundamental responsibility which was not necessarily fulfilled.²⁴¹

Eighth • point – Agreed the decision to provisionally accept the Super Seasprite in an interim configuration did not deliver the desired outcomes – The decision was valid at the time but failure occurred when various stakeholders passively withdrew their support and commitment to drive the project to success. The subsequent decision to terminate flying operations must surely be questioned – it effectively doomed the project to ultimate failure. Analysis of the program plans put in place at the time is necessary to see if proper provision was made to catalogue operational, materiel and maintenance issues into critical and non critical status and to work through these issues in a timely manner. This would be a fundamental "due process" for any complex project with a similar level of new development. How well this was done is not known but it may well be the most critical aspect of DMO management and/or ineffectiveness.²⁴²

Ninth • point – Failure to effectively address the disparity between contractual and ADF certification requirements certainly contributed to the demise of the project and prolongation of the scheduled introduction into service. Defence needs to seriously address this failure as it casts a shadow on the capability/willingness of the ADF to make these hard decisions in the future.²⁴³

²³⁹ Now fourth dot point. Financial leverage refers to the payment of Earned Value Method Payment examined in Chapter 2 including arrangements surrounding the sub-contractors, and the management and payment of critical milestones (see Recommendation 2). Chapter 2 was not provided to SMA for comment.

²⁴⁰ Now fifth dot point. This issue is examined in both Chapter 1 and 6 (see Lesson 1). Chapter 1 was provided to SMA, Chapter 6 was not.

²⁴¹ Now sixth dot point. There is some discussion of payment arrangements for sub-contractors in Chapter 3, the issues surrounding ITAS and sub-contractor arrangements is examined in Chapter 4. Chapter 4 was not provided to SMA.

²⁴² Now seventh dot point. A key issue in the management of the Projects was the contractual renegotiations and provisional acceptance arrangements implemented following the replacement of Litton. Recommendation 4 and Lesson No. 3, 4 and 5 address the implementation of these arrangements. These were not provided to SMA.

²⁴³ Now eighth dot point. See Recommendation 5 and Lesson 7. These were not provided to SMA.

Tenth • point – Generalisations such as, “poor contract management practices within Defence and DMO over the life of the project”, add little to the report. If they can't be identified they should be deleted.²⁴⁴

Paragraph 10 [Paragraph 11] – Reference to a total expenditure exceeding \$1.4 billion is misleading unless all elements of cost over the project budget of \$953 million are identified including the provision of escalation and exchange rate variations. Since this figure also covers various ISS costs funded outside the project, ten years on from the contracted base date, the 61 per cent increase against budget may not be so significant.²⁴⁵

Paragraph 11 [Paragraph 12] – This is a most valid introduction to the risks and issues that major defence projects present. They should be well known by all senior defence authorities and taken account of when seeking government approval. In the case of the Seasprite project, failure can also be attributed to other factors including both a lack of determination to achieve success and an escape option that looks forward to a future solution.

Paragraph 12 [Paragraph 13] – The termination of a project that offered so much to the defence capability of the Australian Defence Forces should not be dismissed so readily particularly when success was so near at hand. The audit rightly acknowledges that the DMO investment in resources and the steps taken to improve management skills are essential. Defence and DMO must also recognise that failure is not an acceptable option when public funds of this magnitude are at stake particularly when an achievable solution is near at hand.

General Comment – No conclusion is given on the logic or value for money offered by the Deed of Settlement entered into with Kaman. SMA views on this approach were provided in the previous submission.²⁴⁶

Payments continued after flying suspended in 2006

Paragraphs 2.25 to 3.27 – Again we stress that the management fees payable under the ISS were consistent with the work done to maintain the integrity of the support package and the associated KAISC facilities.

A real reduction in fees was made by extending the period of performance by two years at no cost (certainly SMA had to extend these costs by a corresponding reduction over the period of extension).

Availability of Spare Parts

Paragraph 5.28 to 5.30 – No comment.

Paragraph 5.31 – The contractor's need to borrow parts from DMO in order to facilitate provisional acceptance of the aircraft in March 2004 would not have been uncommon since Kaman was not then required to hold spares in reserve. Subsequently Kaman took over the entire stock of Super Seasprite spares from the USN.

Paragraph 5.32 – No comment.

Paragraph 5.33 – SMA earlier comments against paragraph 34 of the summary are invalid. However this paragraph 34 is misleading as it only refers to spares valued at \$58.94 million from sustainment funding. In the summary it would be better to refer to the total expenditure on

²⁴⁴ Now ninth dot point. Issues surrounding Contract Management are set out in Chapters 3, 4, 5, 6 and ten SMA were only provided with Chapter 5 of these Chapters. Recommendations, 2, 3, 4, 5, 6 and 7; and Lessons 3, 4, 5, 6, 7 and 9 included issues relevant to contract management.

²⁴⁵ The components of this figure are set out in footnote 3 and Chapter 10.

²⁴⁶ The Deed of Settlement arrangements are set out in Chapter 10.

spares i.e. \$165.36 million plus \$58.94 million. This total amount is a healthy allocation of funds for spare parts.²⁴⁷

Paragraphs 5.34 to 5.39 – This comment is in the detail and hardly relevant to the audit objectives. These minor spares problems would have been resolved over time as shortcomings in the 3 year allocation of spares were adjusted.²⁴⁸

Paragraphs 5.40 and 5.41 – No mention is made of the intended disposal of the seven airframes.²⁴⁹

Capacity to undertake testing

Paragraphs 5.42 to 5.44 – No comment.

Issues with materiel and maintenance manuals

Paragraph 5.45 and 5.46 – These paragraphs do not relate to maintenance manuals.²⁵⁰

Reduced confidence in the aircraft

Paragraph 5.47 and 5.48 – The information provided to support the reduced confidence levels is not convincing. Was this opinion held by a few or did it represent wide spread concern? What does ongoing concern surrounding Original Equipment Manufacture data mean? These comments are too thin to be included.²⁵¹

Paragraph 5.49 – What evidence exists to support this claim? During the period from late 2003 to mid 2004, SMA was under pressure to finish validation of the suite of technical manuals including nine sets (4 manuals each) of key legacy manuals (airframe, engines, transmissions, landing gear, rotors, APU, hydraulics, flight control and fuel systems). Over 100 manuals representing 19,018 pages were developed or rewritten by SMA. The process of validation (contract responsibility) was slowed due to limited access to aircraft. Rework of legacy manuals was not expected to be such a drama as the equipments involved were not subject to significant technical modification. The majority of this work was completed by mid 2004. On 16 June 2004 SMA wrote to the Head Industry Division (DMO) rejecting claims relating to SMAs performance. This letter is attached.

The process of accepting technical manuals is well structured with the Customer being required to undertake a verification process during actual operations and maintenance. The commonwealth is often reluctant to accept this responsibility. Many of the issues raised during the SH-2G(A) verification process were enhancements rather than identification of an error or omission. SMA went through all items raised incorporating necessary amendments and refuting others. During this period SMA also reviewed a massive 6000 drawing changes to finalise the manuals. By 2006 the state of the manuals was at a high level and by the time the project was

²⁴⁷ The figures cannot be added as the acquisitions under the Prime Contract also included combines spares and support acquisitions.

²⁴⁸ The acquisition of spares under recurrent funding was due in part to insufficient spare being acquired under the Prime Contract.

²⁴⁹ This is covered in Chapter 10 which deals with Project cancellation.

²⁵⁰ The Defence evidence ANAO relied upon indicates that there were issues with maintenance manuals.

²⁵¹ The evidence of loss of confidence in the Aircraft included statements to the 2005 Airworthiness Board and other documentation.

cancelled the configuration status of the total manuals package had been verified against all changes incorporated over the period.²⁵²

Paragraphs 5.50 and 5.51 – These paragraphs reflect both a scheduled ongoing process and a commonwealth failure to accept responsibility for manuals verification and the raising of related PIRRS.

Critical Maintenance Operations

Paragraphs 5.52 to 5.54 – These paragraphs related primarily to Independent Maintenance Inspections not mandated in the contracted maintenance manuals but subsequently incorporated under the ISS contract. As written there is an inference that critical maintenance operations may have been at risk - this is not accepted.²⁵³

Related Air Safety Occurrence Reports

Paragraph 5.55 to 5.58 – SMA was not directly involved in what appears to be a routine but important ongoing process.

Submission to the Airworthiness Board by Directorate of Flying Safety

Paragraph 5.59 to 5.61 – No comments.

Maintenance Reinvigoration Program

Paragraphs 5.62 and 5.63 – No doubt a very valid exercise but is it relevant to the Seasprite audit?²⁵⁴

ANAO comment

SMA were provided with a limited extract of the proposed Section 19 report relevant to the company's involvement in the ISS arrangements as a sub-contractor to the ISS Contractor (Kaman). SMA has sought to provide comment more broadly on the Project. The majority of issues raised by SMA are covered in other parts of the audit.

The ANAO acknowledges the importance of establishing appropriate sustainment arrangements as part of the process of establishing a new capability. However, recognising that the acquisition contract was encountering significant difficulties, and the Project was ultimately cancelled, the ANAO sought to understand the relationship between the Prime Contract and the ISS Contract. This analysis indicated that the ISS Contract was not regarded as better practice within Defence for this type of contract in 1999 and that linkages between the ISS Contract and the Prime Contract were unsatisfactory. In developing its views on sustainment, included in Chapter 5, the ANAO did not limit analysis to the ISS Contract, taking into account other factors that impacted on the aircraft's availability. The arrangements entered into in 2008, following the cancellation of the Project, encompassed the termination of the ISS Contract. The costs of these termination arrangements, and previous expenditure on sustainment activities, are significant components in determining the full cost of a failed Project to the Commonwealth. Costs to other parties are beyond the scope of this audit.

²⁵² The issues surrounding the verification of the Manuals was raised as an issue by the 2005 Airworthiness Board. The Prime Contractor acknowledged that the verification process was modified to facilitate the provisional acceptance of the aircraft. The report acknowledges that most of the outstanding issues with the manual had been addressed by the time the Project was cancelled.

²⁵³ The report identifies that there were Air Safety Occurrence Reports raised following incidents which were attributed to issues with the maintenance manuals.

²⁵⁴ The Maintenance Reinvigoration Program encompassed 805 Squadron which operated the Super Seasprite. The 2005 Airworthiness Board was informed that an incident surrounding maintenance conducted on AFCS on a Super Seasprite was one of the factors taken into consideration in deciding to undertake the review.

Ian S. Harrison, CPEng – Navy Aviation Project Office July 1998 to early 2002

Mr Harrison was provided with an extract from the proposed Section 19 report and provided the following comment.

Comment

On reviewing the extracts provided under Reference A, I have identified the following errors and provide several observations:

- a) Page 25, para 41 [Paragraph 42] the last sentence should start *"In May 2000, three years after the contract was signed...."* And not *"... 2001, four..."*. This then matches page 48 which states mid 2000. From my own recollection and records this contract was signed just before we conducted a series of safety workshops in the USA during Jun 2000 using the ESPs from that contract.
- b) Page 25, Para 42 (also section 7.6 on page 46 is related) second last para state *"... a lack of correlation with internationally recognised standards..."*. Albeit DGTA may have had this opinion, the development was proceeding to an internationally recognised standard (MIL-STD-882C) that was acceptable to the regulator at the time of contract signature and widely used for military systems. Although DGTA had a preferred standard (RTCA DO-178B) they were never willing to consider other standards like the widely accepted MIL-STD-882C.²⁵⁵
- c) Page 27, [Paragraph 1.2-1.6] Introduction. Why is there no reference to the Offshore Patrol Combatant (OPC) which impacted on the requirements at tender. The OPC impose significant constraints of helicopter size and weight, and is therefore relevant to the tender process. Although I was not involved in the tender process I was involved in the preliminary design process of the OPC and aware of the shared tender process to provide a common helicopter for Anzac and OPC and the constraints OPC applied due to its smaller size.²⁵⁶

The extracts of the report provide a very one sided report focusing on DGTA (as technical regulator) concerns and DGTA directions provided to the project with nothing about the projects ability to accommodate to these requests. The SEA1411 project and contract were formed under the Navy Airworthiness regulatory system and operated under that system for its first year. Further the project office came from a different acquisition management organisation (NavMat) than projects DGTA usually worked with. Specific issues include:

- a) The technical regulator change occurred about 12 months after the contract was signed. The new regulator then proceeded to request many technical changes (from that acceptable to the previous regulator) that would have required significant contractual changes. These changes would have lead to significant scope and cost increase to the project, both in the prime contract and additional support. As the project management in the first few years was heavily focused on cost control that meant any change that imposed significant cost increase was not acceptable. These constraints and regulatory changes are not mentioned in the report.²⁵⁷

²⁵⁵ DGTA's concerns surrounding MIL-STD-882C are set out in Paragraph 7.7 of this report.

²⁵⁶ The implications of the OPC for this Project are set out in Paragraphs 2.2 to 2.8.

²⁵⁷ The changes to the regulatory system and the implications for the project are included at Paragraphs 6.19 to 6.29. Examples relating to different design standards being applied to those set out in the Prime Contract are set out in Paragraphs 7.5 to 7.9 for the AFCS and Paragraphs 8.57 and 8.76 for crashworthiness.

- b) The staffing resources available to the project were also limited as was the projects ability to engage ESPs [External Service Providers]. DGTA compared NAPO's ability to undertake certification activities with several other RAAF projects but much greater resources were available to those RAAF projects for a similar (or less) technical complexity system than the Super Seasprite. A later change on project directorship started to ease these limitations, but staffing level limits and limited ability to engage ESP left this project much less resourced than similar RAAF project. From mid 2001 onwards this was further aggravated by the move of NAPO from Canberra to Nowra with several key staff not moving and recruitment of suitable senior engineers difficult in the Nowra area.²⁵⁸

The above response is limited to my period with NAPO which was from July 1998 to early 2002.

ANAO Comment

Mr Harrison was only provided with a limited extract of the proposed report relevant to his involvement in the Project. The report encompasses discussion of the areas of concern identified by Mr Harrison. Other comments by Mr Harrison have been incorporated into the report.

²⁵⁸ See Paragraphs 1.16 to 1.22. which sets out the implications of the transfer of the Project Office to Nowra.

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