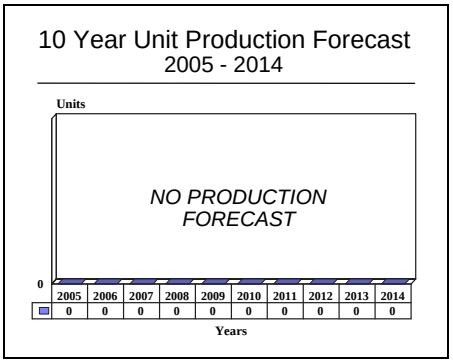
Collins Class - Archived 12/2006

Outlook

- Program essentially completed
- Remaining work involves upgrades and rectifying defects
- Rumors of two additional hulls now appear discounted
- No replacements until at least 2025



Orientation

Description. Diesel-electric-powered patrol submarine (SSK).

Sponsor

Australian Department of Defence
Navy Office
Queen Victoria Terrace
PO Box E33
Canberra, ACT 2600
Australia
Tel: + 61 6 265 9111
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Status. In production and limited operational service. Full operational service is not now expected before 2007.

Total Produced. Six submarines are in limited service.

Pennant List

Number & Name	Builder	Launch Date	Commission Date
S73 *Collins*	ASC	8/1993	7/1996
S74 *Farncomb*	ASC	12/1995	1/1998
S75 *Waller*	ASC	3/1997	7/1999
S76 *Dechaineux*	ASC	3/1998	2/2001
S77 *Sheean*	ASC	3/1999	2/2001
S78 *Rankin*	ASC	11/2001	3/2003

Mission. The Collins class submarine is designed to replace the Royal Australian Navy's six Oberon class submarines. Its missions will include anti-surface warfare (ASW), anti-surface ship warfare (ASuW), and intelligence gathering and surveillance. It can also be used for covert operations in hostile environments and as a deterrent against aggressors.

Price Range. The whole program is said to cost AUD5 billion ($3.9 billion). The estimated cost per submarine would thus be about $650 million.

Contractors

Australian Submarine Corporation Pty Ltd, http://www.subcorp.com.au, GPO Box 2472, Adelaide, 5001 SA, Australia, Tel: + 61 8 83 48 70 00, Fax: + 61 8 83 48 70 01, Prime

Kockums AB Karlskronavarvet, http://www.karlskronavarvet.se, 82 Karlskrona, S-371 Sweden, Tel: + 46 455 68 30 00, Fax: + 46 455 179 34, Email: information@kockums.se, Consortium Member

Boeing Military Aircraft and Missile Systems, Morton, PA United States, Consortium Member

Hale Hamilton Valves UK Ltd, Cowley Road, Uxbridge, UB8 2AF Middlesex, United Kingdom, Consortium Member

Inspec Foams Inc, Suite 201, 101 East Park Blvd, Plano, TX 75074 United States, Tel: + 1 (972) 516-0702, Fax: + 1 (972) 516-0624, Email: dan.trahan@degussa.com, Consortium Member

Kongsberg Simrad AS, http://www.simrad.com, Strandpromenaden 50, PO Box 111, Horten, 3191 Norway, Consortium Member

L-3 Communications - Ocean Systems, http://www.L-3Com.com/os, 15825 Roxford Street, Sylmar, CA 91342-3597 United States, Tel: + 1 (818) 367-0111, Fax: + 1 (818) 367-6999, Email: Cam.Mcdonald@L-3Com.com, Consortium Member

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Thales Optronics (Glasgow) Ltd, http://www.thalesgroup-optronics.com, 1 Linthouse Rd, Glasgow, G51 4BZ United Kingdom, Tel: + 44 0 141 440 4000, Fax: + 44 0 141 440 4001, Consortium Member

Thales Underwater Systems, HQ, http://www.thales-naval.com, 525 Route Des Dolines, BP 157, Sophia Antipolis, 06903 France, Tel: + 33 4 92 96 30 00, Fax: + 33 4 92 96 39 50, Email: TUS@thales-underwater.com, Consortium Member

Technical Data

	Metric	U.S.
Dimensions		
Length	78 m	255 ft
Beam	7.8 m	25.6 ft
Draft	6.8 m	22.3 ft
Displacement		
Surfaced		3,051 tons
Dived		3,353 tons
Performance		
Speed, surfaced or snorkeling	18 kmph	10 kt
Speed, submerged	36+ kmph	20+ kt
Diving depth	300 m	984 ft
Operating range (snorkeling)	16,600 km at 18 kmph	9,000 nm at 10 kt
(surfaced)	21,300 km at 18 kmph	11,500 nm at 10 kt
(dived)	740 km at 7.5 kmph	400 nm at 4 kt
Crew	6 officers, 36 enlisted; 5 trainees	

	Type	Quantity
Electronics		
Radar	Kelvin Hughes Type 1007	1
Navigation		
Echo sounder	AlliedSignal ELAC Nautic	1
Navigation system	EDO Model 3040 Doppler	1
Inertial navigation systems	Litton SINS	2
GPS	Rockwell Collins	1
Electronic Warfare		
ESM	EDO AR-740 (radar warning)	1

	Type	Quantity
Electronics (continued)		
Sonars		
Bow/flank arrays	Thales Underwater Systems Scylla	1
Towed array	Kariwara (73 & 74) or Namara	1
Command and Control	Singer Librascope SCCS Mk 2 fcs.	
Degaussing	Marconi SDG-1802	
Periscopes		
Search	Thales Optronics CK043	1
Attack	Thales Optronics CH093	1
Armament		
Torpedo tubes	21 in (533 mm), with air turbine discharge	6
Torpedoes	Gould Mk 48 Mod 4 heavyweight	16 (est., total load-out mix 22 including missiles)
Missiles	UGM-84B Sub-Harpoon	6 (est.)
Power Systems		
Diesel propulsion	Hedemora/Garden Island V-18B/14	3x2,006 shp
Electric propulsion motor	Jeumont-Schneider DC shunt, water-cooled	1x7,344 shp
Electric generators	Jeumont-Schneider 440 V DC	3x1.4 MW
Emergency motor	MacTaggart Scott DM 43006 retractable hydraulic motor	1
Propeller	Back-skewed; special stealthy alloy	1

Design Features. The Collins class is a diesel-electric submarine designed to engage both submarines and surface combatants. The control surfaces for steering and depth are arranged in an X form, as opposed to the cross form used by many submarines. The X shape provides better three-dimensional control compared with a cruciform configuration. Each plane has its own control processor and individual shafting, allowing continued use in case of power loss or damage to any of the four planes. The Royal Australian Navy (RAN) believes that either upper or lower pairs of control planes alone will be effective for operations.

The Collins class's internal equipment is constructed on two decks external to the hull, then inserted into the hull sections prior to final assembly of the submarine. This is done to allow work to be performed by as many companies as possible scattered throughout Australia. This setup also helps satisfy the Australian government's requirement that local content in the program be at least 70 percent.

The main propulsion for surface or snorkeling operations is provided by an axially mounted direct-current (DC) motor with a liquid cooling labyrinth in its stator. Power for the electric motor is derived from a diesel-driven generator that charges the lead-acid storage batteries. The engines are three Hedemora 18-cylinder turbocharged diesel generators. High-capacity lead-acid batteries powering a double armature motor provide submerged propulsion. There is one skew-bladed propeller.

The primary weapon system of the class consists of the Mk 48 Mod 4 torpedo, which has a range of 21 nautical miles at 55 knots and 27 nautical miles at 40 knots, and the submarine-launched Harpoon cruise missile with a 70-nautical-mile range. Singer Librascope will produce the combat system.

Operational Characteristics. The Collins class is designed specifically to meet Australian operational requirements, including an operating range of up to 11,500 nautical miles. This entails that the submarines be able to traverse 2,500 nautical miles each way to and from their designated patrol areas and spend a specified time on patrol while there. The submarines are based at Cockburn Sound in Western Australia.

Rotational cycles using two crews are viewed as a partial answer to crew fatigue. The two-crew concept has already been successfully tested on one of the Oberon class submarines. The benefit of using two crews that man the ship in shifts is the greater operational availability of the ship itself. The only problem is engaging a sufficient number of trained personnel. Only 12 trainees can be on board at a time, and even though the on-land training is said to be in high gear, it is a time-consuming process. The Navy, however, supports the use of dual crews, using the concept as an argument for further procurement of

submarines as well, since it makes more effective use of the platforms.

The RAN ruled in 1996 that women would not serve on submarines. In a major survey conducted to find if the crew shortages could be alleviated by admitting female crew members aboard submarines, respondents indicated that female sailors should not be admitted. Thus, no modifications were to be made for the accommodation of women sailors. However, training of the first female submariners began in January 1998, easing the Royal Australian Navy's recruitment problems.

The hull-mounted sonar system is the Thomson-Sintra Scylla. This is a series of bow and flank arrays that is an outgrowth of Thomson-Sintra's TSM-2272 Eledone bow-mounted array. Versions of the Eledone sonar are used by the Royal Navy as the Type 2040 Argonaute, by the French Navy as the DSUV-22, and by the Royal Netherlands Navy as the Octopus. The submarines also will receive a towed array, either the locally developed Kariwara or the Thales Namara.

Collins Class Submarine

Source: Australian Navy

Variants/Upgrades

A-19 Gotland Class. The Collins class is an upscaled derivative of the Swedish A-19 Gotland class, of which the Royal Swedish Navy has four in service. The Gotlands have a 200-foot-long hull and a 20-foot beam; their total displacement is 1,240 tons surfaced and 1,490 tons dived. The A-19 in itself was a scaled version of its predecessor, the A-17 class.

AIP. The options available for retrofitting an air-independent propulsion (AIP) system in the Collins class were the Stirling cycle engine or the oxygen/hydrogen fuel cell. (Both systems are being evaluated by Germany, Sweden, Japan, and other countries operating diesel-electric submarines.) In either case, an AIP retrofit would have required installing an extra hull section, increasing the displacement by about 10 percent. The more logical choice between the two technologies would have been the Swedish Stirling system, as it would have been easier and less expensive to retrofit in this particular submarine.

Nevertheless, the RAN stated in 1996 that retrofitting the boats with AIP would not be cost-effective and was unnecessary. Tests had been carried out on the Stirling AIP technology using a shore rig.

Anechoic Tiles. All hulls but the first-of-class were fitted with anechoic tiles during their construction. The *Collins* will receive them as a retrofit.

External Mine Belts. These were considered either an option or a retrofit possibility at one point of the program, but such plans have since been abandoned.

New Torpedoes. The torpedoes on the Collins class were to have been upgraded under Project SEA 1429. The torpedoes being considered for evaluation were Raytheon Systems' Mk 48 ADCAP, Bofors' Torpedo 2000, GEC-Marconi's Spearfish, and STN-Atlas Elektronik's DM2A3 and DM2A4 Seehecht Mod 1. This program has now been abandoned.

Program Review

Background. The RAN stipulated a requirement in the early 1980s for a replacement for its six Oberon class submarines. The Oberons had then been in service from five to 15 years. In 1984, seven companies responded to the RAN's invitation to undertake project definition studies. VSEL offered the Type 2400 Upholder design; France's DTCN responded with the Agosta B1; Italy offered the Type 1107, a modified Nazario Sauro; and the Netherlands offered the Walrus. The two German entrants were the Type 2000 from Howaldstwerke Deutsche Werft and the TR-1700A from Thyssen Nordseewerke. Sweden offered the Kockums Collins class.

The RAN called for a submarine with a low indiscretion rate, deep diving capability, long patrol endurance, high burst speed, low noise, low detectability, and long range (in excess of 10,000 nautical miles) at a relatively high speed. Another vital factor was the ability to operate with the RAN's Mk 48 Mod 4 torpedoes and Sub-Harpoon missiles. This factor immediately eliminated the French designs, which can only operate using indigenous weapons systems. Another major factor was the ability to be fitted with an air-independent propulsion system.

The Royal Navy and Vickers heavily promoted the Type 2400, exploiting the close ties between the British and Australian navies, but by mid-1984 the Type 2400 and most of the other contenders had been eliminated from consideration. In late 1984, the IKL Type 2000 and the Kockums Collins class were chosen as the finalists. The two companies were subsequently granted funds for full-scale project design efforts. The RAN required each company to form a team with an Australian company, which would handle all construction and program management.

The Collins class was found to have a higher battery capacity, better acoustic characteristics and indiscretion ratios, and more space. The Collins class was reported to be able to hold a 4-knot speed for 120 hours, compared with the Type 2000's 84 hours. At 21 knots, the battery capacity of the Collins class was 1.58 hours, compared with 1.35 hours for the Type 2000. IKL had extensive experience with overseas shipbuilding, and had worked out licensing agreements with other navies for its earlier Type 209 design. Kockums had no prior experience in those areas. The Type 2000 also was expected to be simpler to construct, a major consideration given Australia's high labor costs.

On June 2, 1987, the RAN signed a contract with the Australian Submarine Corporation Ltd for the supply of six Collins class submarines. The RAN report claimed that the IKL 2000 had an inadequate range, fuel, and battery storage capability. It also found problems with the weapon discharge and handling system, the acoustic emissions, and the overall quality of the program package. The evaluation team assessed the Swedish design to be quieter and to run with greater underwater endurance than its competitor. The X-form rudder configuration offered enhanced maneuverability. The RAN was also impressed by the weapons-handling system of the Collins class.

The final agreement called for Australian Submarine Corp to build all six submarines under Kockums' supervision. The front and rear halves of the first two submarines were to be built in Sweden, and 70 percent of each submarine's equipment was to be built in Australia. The major systems built outside Australia were the diesel generators, main motors and propellers, pumps and compressors, masts, weapons, sensors, and control gear. Kockums' partners included Wormald, an Australian diversified engineering group, with 25 percent of the program; Australian Industry Development Corp, a government-owned development bank, with 25 percent; and BI Constructors, a subsidiary of Chicago Bridge and Iron, with 20 percent.

Fabrication of the systems for the first submarine began in June 1989 with construction of the bow and stern sections in Sweden. In 1990, Strachan & Henshaw delivered the first section of the torpedo tubes. The first submarine of this class was launched in 1993.

With the first of the Collins class boats in the water, ASC started to explore the possibility of exporting submarines to other countries. The designs on offer included the Collins class and the Swedish A-19 Gotland class (for customers requiring a smaller design). The ASEAN countries were considered the primary customers, with Malaysia and Singapore the immediate prospects. In September 1993, Indonesia started to hold a series of meetings with ASC aimed at exploring the possibility of acquiring submarines based on the A-19 design.

In February 1994, software problems were identified with the command system installed on HMAS *Collins*. They were serious enough to delay the commencement of sea trials by up to six months. The problems were restricted to the final software package, which had already been identified as representing the greatest risk. These problems had been resolved by September, and the submarine commenced its basin trials shortly afterward. Initial sea trials were then set for early 1995. These trials took longer than expected due to recurring problems with the command system, but the submarine was eventually commissioned into the Royal Australian Navy in March 1996. (Or so it seemed.)

In September 1994, the Singaporean Navy approached Germany with the goal of purchasing four ex-German Navy Type 206 submarines. These would be used to train crews and establish a shore infrastructure and base support system while new submarines were being built. This plan later mutated into the direct purchase of a single Swedish submarine for training while the construction of full-service boats was opened to bids. Later, the plan to buy any new boats was abandoned in favor of transferring a total of four Sjöormen class boats from Sweden. A fifth boat was acquired for spare parts.

In parallel with these negotiations, South Korea initiated studies to explore the possibility of a submarine purchase from Australia. At this time, the possibility of acquiring two more Collins class submarines for the Australian Navy was re-opened. Australian Navy sources suggested that a major driver behind the debate was the need to preserve the ASC capability for impending export orders. This question was addressed in full in the 1995 Australian Defence White Paper. It concluded that, while there were strong economic and industrial reasons for building two additional Collins class boats, the modernization of the surface fleet had a higher priority.

Taiwan requested details on the Collins class in early 1996, with an interest in procuring two to eight units. However, the Australian government elected to rebuff this approach. Concurrently, the Australian Navy investigated the possibility of deploying Tomahawk cruise missiles on the Collins class. While this was physically possible, computer overload was found to cause additional command system problems.

Debate over whether to exercise the option of the original contract for two additional submarines continued through 1996, with no conclusion in sight. By mid-1997, the option had lapsed, making it most unlikely that any further boats of this series would be built. A fleet of eight would have allowed splitting the total into two squadrons, one on the East Coast and one on the West Coast.

Another sign of fiscal prudence was RAN's decision to forgo the option of refitting the submarines with the AIP engine. The manufacturer had been hoping for additional business worth an estimated $79 million in retrofit work. The Navy eventually decided, however, that a retrofit was not really needed, as it would simply not have any cost benefit over the existing propulsion source.

In June 1998, the RAN conducted the first-of-class escape and rescue trials with HMAS *Collins*, being the first live escapes ever undertaken by the Navy from a submerged submarine. The exercise included the rescue vehicle *Remora* and two recompression chambers on board the mother ship MV *Seahorse Spirit*. The rescue service is contracted out to ASC on a five-year lease, based in Port Adelaide and operating on 12 hours' notice year-round.

There had been growing unease over the Collins class program since 1996. Although the first-of-class had nominally been commissioned since 1996, it was becoming apparent that all was not well with her. Rumors started to circulate throughout the naval community that her trials had revealed substantial and crippling deficiencies. These were given substance when a U.S. Naval Undersea Warfare report evaluating the Collins class was leaked to the press in the fall of 1998. Initially an attempt was made to dismiss the issues raised in this report, including the noise levels emitted by the submarine and the capabilities of its combat and weapon control software, as press exaggerations. However, as more information came to light, it became apparent that the earlier reports had been more than justified and that the problems with the Collins class were far more serious and wide-ranging than the submarines' worst critics had guessed.

Early accounts of the problems with the Collins class centered on delays in its launch and commissioning dates due to developmental bugs in its various combat, weapon control, and other software systems. Boeing Australia was delivering software for the Collins class boats in sequential issues, or "Drops," all of which were to improve the performance levels of the previous issues.

In December 1997, Drop 5 and Drop 6 were delivered. The added features offered by Drop 6 include expanded weapon control capability, facilities for automatic data trackers, and provision for data tracking and recording in general and in trials use. Allegedly, Drop 6 would give the Collins class boats the minimum capability required to defeat any submarine in regional service. According to RAN, Drop 6 brought the final combat system functionality up to about the 60 percent level, and it allowed the submarines to deploy with the Mk 48 Mod 4 torpedoes.

By mid-1998, the Australian government was in full damage control mode. An attempt was made to divert attention from the problems with the class by publicizing the adoption of the U.S. Navy SUBSAFE program to ensure the operational safety of the submarines. In addition, reports were leaked to Australian press groups that a group of Australian naval officers were under investigation, accused of spreading damaging stories about the Collins class in an attempt to shift funding to surface ships. Meanwhile, the time bomb represented by the defects in the Collins class continued to tick away. In late 1998 the Australian Navy refused to take delivery of the third of the six submarines due to the ongoing problems experienced with the first pair. The RAN stated that the submarines were noisy and badly built, and would need extensive repairs before they were fit for combat.

By March 1999, detonation of the time bomb that had been running since 1996 was imminent. That month, the Australian Navy launched a detailed review of the Collins class program headed by Malcolm McIntosh, head of the Commonwealth Scientific and Industrial Research Organization. The report was scheduled to be available by June 30. In the meantime, the Australian Navy attempted to regain some credibility for the class by staging a spectacular demonstration of a Collins class submarine torpedoing the decommissioned frigate HMAS *Torrens*. This proved that the Mk 48 torpedo worked perfectly.

The final release of the McIntosh Report proved the rumors circulating over the previous three years had, if anything, badly underestimated the problems being experienced with the submarines. Technical problems with the submarines included defective propeller shaft seals that showed leakage exceeding 300 liters per hour, some 100 times greater than that experienced with the seals on the old Oberon class; in addition, the fuel oil dewatering system was inefficient and not user friendly, causing seawater to enter the diesel engines. These deficiencies had resulted in excessive corrosion, inefficient combustion, and eventual seizures. The diesel engines themselves were unreliable and "far from robust," recording more than 750 defects in two years. These included broken pistons, broken gear trains, and seized fuel injectors. Lubricating oil consumption was excessively high, preventing the submarine from achieving its full operational range.

Noise levels, the primary area of criticism in earlier years, were confirmed as being excessive. The McIntosh Report stated that it was "astonished and appalled" at the noise level on these submarines. The alleged acoustic deficiencies of the Collins class were confirmed and shown to be the result of poor hull design and propeller cavitation. The propellers themselves were suffering not only from fatigue failure but from cavitation damage – a "potentially catastrophic" defect. In other areas, the periscopes suffered from excessive vibration and optical defects, and the communications arrays were slow, unreliable, and cumbersome, "placing the submarine in a very vulnerable position while transmitting."

The heart of the problems was the combat system, which simply did not work despite the "progress" claimed for the assorted Drops. Why this was so was the subject of a detailed exposition, but it basically distilled to a poor selection of starting point, an inappropriately early technology freeze, and contractual terms that prevented the problems from being addressed as they were encountered. The submarine combat system deficiencies were such that she couldn't fight and wouldn't know who to fight even if she could. In explaining why this situation had arisen, the McIntosh Report said, "like World War One – each of the parties [was] firmly entrenched in a bunker and repelling all approaches," concluding that the relationship between the various parties was "far more antagonistic, defensive, uncooperative and at cross-purposes than should be the case."

The four-year time bomb had exploded, and nobody came out of the blast unscathed. The McIntosh Report listed a whole series of technical fixes that were essential to rectifying the problems with the submarines. These included major changes to the diesels, the propellers, the shapes of the outer casing and fin, the communications arrays, and the periscopes. The existing command systems were considered to be beyond saving, and it was recommended that a new system be procured and installed. As an interim fix, two shipsets of U.S. Navy combat management equipment would be delivered. These would bypass the defective areas in the existing systems and allow operations until a new combat system could be procured.

The most important lessons of the McIntosh Report, however, were that the contractual arrangements for the Collins class program were fundamentally flawed in that they did not allow for flexibility in changing mission parameters and operational requirements as the program progressed; nor did they allow for the program to absorb and correct technical problems. It was these contractual shortcomings rather than lack of performance on the part of suppliers that were the primary cause of the Collins class problems.

As the dust settled from the McIntosh Report, the process of rectifying the defects on the submarines was initiated. For all the seriousness of the defects in the class, many of the problems could be (and were) easily rectified – things that most navies would have encountered and solved during the trials process. By March 2000, bids were being invited for the new

command system, and the process of getting the submarines up to an operationally deployable standard was well in hand. As the McIntosh Report had pointed out, the Collins class is a potentially effective and capable submarine. What was needed was a concerted effort to correct problems that should have been identified much earlier in the program.

In order to aid in this process, two Collins class submarines nearing completion, HMAS *Dechaineux* and HMAS *Sheean*, were designated as "fast track" ships intended to act as the prototypes for a Collins class get-well program. These two submarines were refitted with the U.S. Navy combat management system equipment, and the other modifications recommended in the McIntosh Report were made. Following completion of this work, the two submarines were commissioned on February 23, 2001. Of necessity, this meant that work on the last of the class, HMAS *Rankin*, would be delayed, until November 2001. This ship finally commissioned in March 2003.

The use of equipment supplied by the U.S. Navy was intended to be a stopgap until selection of a fully defined solution to the Command System requirement. Initially, this was opened up to public tender, with Sonartech Australia (a subsidiary of STN Atlas Elektronik) being the favored candidate. However, in mid-2001, the Royal Australian Navy reversed course and elected to eschew a commercially bid procurement in favor of a close technical and operational alliance with the U.S. Navy. The objective here apparently is to exploit the expertise of the U.S. Navy in sonar processing and data-handling systems and thereby ensure a good degree of interoperability.

At the launch ceremony for the sixth and last Collins class submarine, HMAS *Rankin*, the outgoing Australian Minister for Defence, Peter Reith, indicated that the Collins class program was running more than five years behind schedule and that the full operational capability of the class would now not be achieved before 2007. Furthermore, he revealed that the remedial work to be taken up to that time would cost between $400 million and $500 million over and above the original planned expenditure on the class. In reality, the official plans called for the completion of the submarines between 1995 and 1999, indicating a program delay comfortably exceeding the stated five years.

In January 2002, the Australian National Audit Office (ANAO) confirmed that the work required on the Collins class during the 2002 to 2007 time period was budgeted at $434 million, a sum that, together with the other emergency problem rectification programs, had resulted in the entire program running over budget by 39 percent. The ANAO also sounded a cautionary note, pointing out that the fast track work carried out on HMAS *Dechaineux* and HMAS *Sheean* had cost $137 million but had succeeded in providing only a limited increase in capability. Even this had only been achieved by deliberately shortening planning times and accelerating systems engineering processes. As a result, the improvements were only partially successful, and the Collins class rectification program still faces extensive developmental risk.

Among completed efforts, the command systems in *Dechaineux* and *Sheean* were augmented following trials in *Collins* to improve the performance of the excising command system. However, the remaining boats will not receive this upgrade. In parallel, significant improvements to noise signature have been achieved through the installation of platform improvements (involving modifications to propellers and casing sections and improvements to the hydraulics system and engine). These improvements were added to the *Dechaineux* and *Sheean* as retrofits and were installed aboard *Rankin* during build. *Collins, Waller* and *Farncomb* will eventually be refitted to this standard.

In October 2002, the Australian Navy selected the Raytheon CCS Mk 2 combat system coupled to the Atlas Elektronik CSU-90 sonar processing system to replace the existing Collins class combat system. The Thales Underwater Systems Scylla sonars would be retained. Current plans call for the CCS Mk 2 to be fitted in *Collins* by 2006 and in the other boats by 2010.

Unfortunately, just as the tide of problems surrounding the Collins class appeared to be receding, more problems struck the class. HMAS *Dechaineux* suffered a hose rupture while deployed, partially flooding the submarine and forcing her to surface. An independent review threw little light on this incident and it appeared to be a normal example of the risks inherent in running a submarine fleet. However, an examination of the other five submarines for similar defects revealed cracks in the welding of two pressure hull sections in HMAS *Collins*. These were repaired during a refit. Similar cracks were not detected in the other Collins class submarines.

Funding

Although no specific information has been released on funding of this program, the Australian defense budget has supported the program on a steady basis, allowing the procurement of six submarines. The program's total cost has been pegged at about AUD5 billion for the first six boats, depending on the extent of the contract's coverage. In April 1998, it was stated that the program has stayed within its original budget, even including the engineering development necessary throughout the course of the project. In October 1996, when the option for ordering two more boats was nearing its deadline, the cost of those two additional units would have been about AUD1 billion ($800 million). Of that sum, the costs for the 1996/97 fiscal year would have been about AUD45 million, rising eventually to an annual peak of AUD170 million. The contractual agreements called for 70 percent of all equipment expenditure to be placed in-country, with domestic suppliers. It appears that this goal is not only being met but exceeded; i.e., the rate of local content is higher than anticipated.

A budget exceeding $500 million has been made available for rectifying the problems with the existing submarines.

Recent Contracts

Contractor	Award ($ millions)	Date/Description
Australian Submarine Corp	1.12	Feb 1997 – Australian DoD contract to RAN for acoustic windows.
Thomson-Marconi Sonar	0.973	Feb 1997 – Australian DoD contract to RAN for Sonar Raw Data Replay Units.
Boeing Australia	5.2	Jan 1998 – Support of combat systems, including routine services and scheduled maintenance by ASC, RAN teams.
Comptek Federal Systems	N/A	Mar 1998 – Flight Line Advanced Multiple Environment Simulator (FLAMES) for test, evaluation, and training (including Collins class).
ASC	500.0	Oct 2001 – Refit and maintenance work.
BAE Systems	5.0	Oct 2002 – Periscope support.
Raytheon	400.0	Oct 2002 – Replacement combat system.
Thales Underwater Systems	23.0	Oct 2003 – Sonar upgrade and modernization contract.
ASC	3,500.0	Dec 2003 – 25 year upgrade, modernization, refit and repair contract for the Collins class.

Timetable

Month	Year	Major Development
	1984	Royal Australian Navy releases RFP
	1986	RAN releases shortlist of two competitors
Jun	1987	RAN signs contract with Australian Submarine Corp
Feb	1990	First keel laid down
Aug	1993	First-of-class launched
Jun	1996	Plans to retrofit AIP abandoned for cost reasons
Jul	1996	HMAS *Collins* commissioned
Jun	1998	Escape and rescue trials carried out by HMAS *Collins*
Oct	1998	U.S. report slams submarines' acoustic signature and command and weapon system capabilities
Apr	1999	Revised launch date for fifth boat

Month	Year	Major Development
Jul	1999	Progress report issued, listing technical problems, failures, management oversights
Feb	2001	Fast-track submarines commissioned as testbeds for fault rectification programs
Nov	2001	Sixth and last submarine of class launched
Mar	2003	Sixth and last submarine completed
	2007	Full operational capability to be achieved

Worldwide Distribution

Australia. 6

Forecast Rationale

The Collins class is now complete and no more submarines of this class will be built. Present activity consists of trying to bring the six existing submarines up to the originally planned levels of performance and correcting defects as they appear. This being the case, this report will be archived next year.

This is, therefore, a good time to look back on the Collins class program and contemplate many lessons that can be learned from it. Perhaps the most important and fundamental is that it is essential to detect and identify problems before they become so deeply entrenched that solutions becomes impossible It was the failure to observe this basic principle that led directly to the Collins class fiasco. In truth, the problems that afflicted the Collins class development program were not actually that bad. The problem was that their existence was denied and their extent covered up until they were so deeply entrenched that their solution had a severely negative impact on the program as a whole.

Another lesson is that warships designs, whether surface ship or submarine, do not easily scale up or down. It was the failure to recognize that basic fact that that has led to a number of problems with a wide variety of programs. In the Collins class case, it led to difficulties with the propulsion machinery and the piping, the latter causing a near-serious accident. The problem is that scaling a design up or down does not create a variant of an existing design at all; it results in an entirely new design that is likely to have issues all of its own. There are few, if any, savings to be made by following this route.

Closely allied with that consideration is the long-demonstrated but still neglected rule that there are no minor changes in a ship design. What may seem to be a minor change usually resonates through the design, and has surprising results in unexpected places. Submarines are particularly vulnerable to this effect since the demands of packaging everything into their pressure hull are demanding indeed. This is particularly the case if the "small changes" in the design are made after construction has started. In that case, a minor change leads to a major problem that puts the designers in a world of hurt.

The Australians have paid a heavy price for these lessons. The Collins class submarines really are exceptionally good performers once their problems have been solved. Exploiting technology a full decade more advanced than was originally specified, they will prove to be formidable opponents for the foreseeable future. Yet, for all of that, there is no chance of any export orders being placed for these submarines. Their technical difficulties have been too well publicized. If they had been resolved at an early stage, it is quite probable that ASC would have become a regional center for submarine construction with orders for at least six boats and possibly twice that number.

The Australian Plan Blue confirmed that the need for a replacement submarine will not now occur until around 2020 or 2025. There is undoubtedly some preparatory work going on to formulate the design requirements for these submarines, but in practical terms, it is unlikely that Australia will introduce a new submarine program within the forecast period. This suggests that the experience gained with the construction of the Collins class will have been lost by the time the new program starts.

Ten-Year Outlook

All six submarines planned for this class have been completed and there are no additional orders in prospect. The forecast chart has, therefore been deleted.

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