

**Joint Committee of Public Accounts and
Audit**

**Inquiry into matters contained in Auditor
General's Report No 22 (2019-20)**

Future Submarine Program

Submission to the JCPAA

by

Submarines for Australia

19 March 2020

Acknowledgements

Submarines for Australia is an entity with a website owned and operated by Gary Johnston, founder and CEO of Jaycar Electronics Pty Ltd. Mr Johnston has no commercial interest in the SEA 1000 program or Defence projects more generally. Over the last three years, Mr Johnston has supported significant research by Insight Economics and others into Australia's future submarine project. We are extremely grateful for Mr Johnston's sponsorship of this important public interest work.

Mr Johnston is also keen to acknowledge the contributions from the members of an expert reference group that has developed around this issue. These individuals include distinguished Australians with strong relevant experience who have contributed their time and expertise in the national interest.

Inter alia, this group includes:

- Dr Michael Keating AC, former Secretary of the Department of Prime Minister and Cabinet and Secretary of the Department of Finance
- Professor Hugh White AO, Emeritus Professor of Strategic Studies at the Australian National University and former Deputy Secretary of the Defence Department
- Rear Admiral RAN (Retired), Peter Briggs AO, former commanding officer of Oberon class submarines and CO of the Submarine Force, Director of Submarine Warfare and Head of the Submarine Capability Team
- Rear Admiral RN (Retired), Chris Stanford CB, former anti-submarine warfare expert and NATO squadron commander
- Commodore RAN (Retired), Paul Greenfield AM, former Engineering Officer in the Submarine Force, and a principal of the Coles Review into Collins class sustainment
- Commodore RAN (Rtrd), Terence Roach AM, former commanding officer of two Oberon class submarines, former Director Submarine Policy and Warfare, Director General Naval Warfare and Director General Maritime Development
- Dr Hans J Ohff, Visiting Research Fellow at the University of Adelaide, former Managing Director and CEO of the Australian Submarine Corporation
- Dr Andrew Davies, Senior Fellow, Australian Strategic Policy Institute
- Mr Jon Stanford, Director, Insight Economics Pty Ltd.

This Submission has been greatly enhanced by the expert views of members of this reference group, most particularly the retired senior naval officers, including three former RAN submariners. Responsibility for the material in this Submission, however, lies with *Submarines for Australia*.

Sources

We have used publicly available information on the Attack Program. Comments about evolved Collins are based on public information and the knowledge and experience of several Australians who have been involved in submarine capability and construction in Australia going as far back as the Oberon class boats. Some of those people are still actively involved in Australia's submarine enterprise. Analysis and comments on the public record from the ANAO, ASPI and the Kokoda Foundation have also been drawn upon.

Submarines for Australia also made a [Submission](#) to the ANAO inquiry, *Future Submarine Project – Transition to Design*.

Executive Summary

Australia's submarine capability came close to collapse during the transition from the Oberon class to the Collins class submarines. Getting it back up to the level required for the size of the investment in it has taken a generation and is not really complete yet. We face the risk of repeating that experience in the transition from the Collins submarines to their replacements.

This Submission by Submarines for Australia proposes mitigation strategies for the high risks facing Australia's submarine capability.

Situation

- The acquisition program for new submarines faces very high risks in all of cost, schedule and capability – the fitness of conventional submarines for purpose.
- Australian industry involvement in the build is crucial for sustainment of the submarines in service throughout their lives -- this looks to be at risk too.
- The capability relies on trained and experienced submariners and numbers must grow substantially for the numerically larger submarine force that is planned.
- Navy's capacity to produce more submariners depends on having submarines at sea – this is threatened now because the lives of the Collins class submarines must all be extended, which will be challenging and risks reducing their availability.

Proposals

This submission examines all these risks and proposes mitigations.

- A "Plan B" design study for an evolution of Collins, that would:
 - not cause any delay to existing work;
 - reintroduce competition into the acquisition program;
 - cost less than 0.2% of the current budget; and
 - potentially return many times that amount in savings.
- Bring forward the review of submarine technology planned for the end of the decade.
 - Start that review immediately; and
 - examine whether nuclear powered submarines should be acquired in the future, so that we can start to understand what would be involved.
- Urgently prioritising the life extension of the Collins submarines.

1. Background to this Submission

1.1 Australia's submarine capability is at risk

This submission argues that, in the context of Australia's rapidly changing strategic circumstances, the extent and magnitude of the risks facing Australia's submarine capability are sufficiently serious to warrant urgent review.

The Auditor-General's recent report on the SEA1000 program (*Transition to Design*) identified a number of issues. Viewed within the context of Australia's evolving strategic circumstances, and Defence projects more broadly, the reported situation with SEA1000 looks very serious, especially for such an important project at the beginning of its life. We must also keep in mind SEA1000 is the largest Commonwealth project in history, and not just the largest Defence project.

The most serious risk is of a gap in submarine capability between retirement of the Collins class and the new submarines being ready for operational service. This constitutes a serious and long-term risk to national security. The risk arises because the schedule for delivery of the new submarines means that the service lives of each of the six Collins class submarines must be extended by at least ten years. This will be a very major and complex task that will complicate the execution of SEA1000, because it will put a major call on limited project management, financial and industry resources. But planning for this work is at a very early stage, according to the ANAO report. History shows too that we should keep in mind there is a high risk that the SEA1000 schedule will not be achieved. For all these reasons the life of type extension (LOTE) of the Collins class submarines must be given the highest priority.

There are cost and capability risks as well with SEA1000, the Attack class submarine program. We argue that the cost for the capability proposed seems extreme and certainly much higher than we should be willing to pay for the submarines. Our analysis also suggests that there is a serious risk that the new submarines will not be fit for purpose in the strategic circumstances we will face even when the first of them enter service.

In response to this situation, we propose two studies be undertaken urgently. In combination, we believe these studies would help mitigate the high risks to Australia's submarine capability, to which the government has admitted publicly, and by extension to our national security.

We propose that without interrupting or occasioning any delays to the existing Attack class program with France's Naval Group, the government should commission a parallel preliminary design study for an evolution of the Swedish Collins design. This is a risk minimisation strategy to address existing cost and schedule risks. It could build on and therefore have a very close relationship with the Collins LOTE, reducing risk and cost in both activities. It is not a reversal of earlier decisions, nor do we suggest abandoning the Attack program. On the contrary, given Australia's rapidly changing strategic circumstances we believe the Attack program should be accelerated if at all possible.

The second study we propose is a review of submarine technology, which the government committed to in the 2016 Defence White Paper. We argue that this review needs to start now, not in the late 2020s as the White Paper forecast. It should also consider nuclear powered submarines.

We emphasise that this risk mitigation strategy that we are proposing is in no sense a reversal of course on the submarine project. While we understand the belief that Defence should know best, the problem with leaving it to Defence to grapple with the

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present scale and range of problems, is that the situation may well become untenable sometime in the future. This has happened before, and the Government will then find that eventually it has to step in. Examples of this include cancellation of the Super Seasprite project by Minister Combet, with no useable capability acquired despite well over \$1b being spent, and acquisition of Super Hornets by Minister Nelson as a stop gap when F-35 delays blew out. The delays before such intervention came at a high cost in preparedness and money.

1.2 Sustaining submarine availability is vital

Australia's rapidly evolving, volatile and increasingly uncertain strategic circumstances are at the heart of the issues at stake but the capability issue is being lost in the heat of debate between states about jobs. Industry capability nationally, not just in South Australia, is one of the vital elements of the capability to be sure, especially in the long term, but the current debate is fixated on spending and jobs that will only ever be a small percentage of gross State product. There needs to be recognition of the capability and national security dimension and the serious risks if we get it wrong.

The part of the current submarine picture that is getting little or no attention in the public debate, which must be done well, in which there is very little room for mistakes and compared with which problems with the new submarine program are almost irrelevant, is the plan for transition from the Collins class to the future capability, whatever it may be and whenever it arrives. Vital in this is the Collins LOTE, which it appears does not yet have an agreed scope, plan for execution or funding approval. This is cause for great concern.

Not widely known is the fact that in the transition from the Oberon to the Collins class submarines late last century, the submarine capability overall fell to two submarines in service for several years, sometimes less, while none of the newly delivered Collins class was employable. With only two Oberon submarines in commission after the other four had been scrapped, the submarine capability fell to a very low ebb and Navy struggled to grow submariners for the six new submarines.

The capability comprises the submarines and their support arrangements plus enough submariners who are both trained *and* experienced. Experience can only be gained through long service at sea in submarines. Recovery involved fixing the problems with the new submarines, getting their availability right and replenishing the submariner workforce numbers, training and experience. That has taken a quarter of a century. Progress has been good recently, but the recovery is far from finished. In any case, the submariner workforce must more than double from today's numbers to meet the new, larger fleet size of submarines larger than Collins, which in all likelihood will have a bigger crew.

The future of the submarine capability, which is often and widely described as vital, depends on having enough submariners and that cannot be achieved without submarines at sea. Keeping the Collins submarines at sea and achieving a smooth transition to the new submarines will rely on a successful Collins LOTE, which will be a challenging undertaking. We are at risk now of repeating the near total loss of submarine capability we experienced during transition from the Oberon to the Collins class submarines.

2. Analysis of the risks

In this section of the Submission, the implications of four major areas of risk to Australia's submarine capability are examined:

- The unexplained high cost (budget) and consequential, very serious opportunity cost to the Defence Integrated Investment Plan (IIP)
- The long delivery schedule for the new submarines and the need to extend the lives of Collins class submarines which together create the high risk of a capability gap in the transition between submarine classes
- The questionable relevance of the Attack class capability when the new submarines are delivered
- Australian industry involvement.

2.1 Budget risks

Among several issues apparent with SEA1000, cost is perhaps the most obvious. It has serious and broad implications. The budget breakdown has not been explained but it appears to us to be far above what we should pay for the capability sought.

Determining how much a submarine should cost is challenging because comparable and verifiable data are difficult to get. Credible analysis undertaken over several years in Australia by people closely involved in the submarine enterprise has shown that a global western benchmark conventional submarine cost is about A\$500,000 per tonne (constant 2018 \$ value, tonnage being the submarine's displacement on the surface, not when dived. This figure includes the combat system but not the weapons, which are usually costed and procured separately from the submarine). Despite all the hype and misinformation, the fact is that the Collins class average cost per submarine was just under the benchmark at the time. This was quite a remarkable achievement for submarines built by an inexperienced work force in a new shipyard established on a green field site in a country that had never built submarines before.

Using this approach to cost estimation, we could accept that the average cost of the Attack class at around 4,270 tonnes (the publicly available surfaced displacement) should be in the order of \$2.135b (i.e. 4270 x \$0.5m) per submarine. Therefore, twelve submarines should cost \$25.62b (12 x \$2.135b).

Defence has stated that the budget for SEA1000 is \$50b (constant, 2018 \$ value). Other Defence statements lead us to understand that this does not include the combat system (an additional \$6b), the cost of extending the life of the Collins class submarines or sustainment costs for the Attack class. What then is the remaining \$24.38b buying?

Design fees, project management costs, spare parts, integrated logistic support, new infrastructure including a shipyard, training and education systems such as the Naval Shipbuilding College, weapons, project contingency and other foreseeable items would all quite reasonably be a part of the \$50b total but based on estimates of what those things should cost, it's very hard to see anything like another \$24.38b being justified.

We note too that the unsuccessful German bid offered a fixed price contract for all 12 submarines at just over \$20b and while there is insufficient information available on which to make any judgement about the difference between that bid and the current SEA1000 budget, the size of the difference raises serious questions.

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In the absence of any official public breakdown of the budget for SEA1000, this analysis suggests that we are at risk of paying a great deal more for the Attack class than we should. This situation argues for more than just the scrutiny of a review. Bringing pressure to bear on the prime contractor by re-introducing competition into the project could help flush out problems that seem to be hidden at the moment. If SEA1000 is costing even a few billion dollars more than we should pay, the opportunity cost to the rest of the Defence IIP and by implication to national security are very serious indeed.

Perhaps even more important than this is the absence of any information on funding for Collins LOTE, which we estimate will require at least \$6b dollars and possibly much more. If the LOTE funding must come from the existing SEA1000 budget, what is being traded off? If it is new money, this will be an additional opportunity cost to the Defence capital budget, which there is no talk of increasing.

As an aside, being outside the main focus of this submission, we analysed the cost of the three Air Warfare Destroyers (AWD), Project SEA4000 and the Future Frigate Program. Our conclusion is that we paid more than twice the international benchmark price for the AWDs and we look like paying much more for the frigates than we should. This is a travesty after the successful Anzac Frigate program that was internationally very competitive on cost and achieved excellent value for money. We note too that the first AWD was delivered 16 years after retirement of the last of the three ships it was replacing. There were implications of that gap that were very costly, including upgrading extensively the FFG7 class frigates already in service to improve their air defence capability.

2.2 Schedule risks

The implications of the publicly available schedule for delivering the new submarines have been highlighted already. We observe too that the schedule seems generous and there is probably scope for earlier delivery at a higher rate.

Advancing delivery may be possible and we should certainly investigate doing so. But there would be consequential risks that we should guard against. Cutting corners in the design process to shorten the time to delivery would increase the risk of serious problems that might not emerge until much later, when they would be very expensive to fix. We learned that with Collins. One solution would be to build the submarines in France which would undoubtedly advance delivery, especially if the established French supply chain was used too. But we should not lose sight of the national importance of achieving the original goals around Australian sovereignty, which are discussed in more detail below.

The schedule for delivering new submarines must also take into account the absence of any apparent progress with Collins LOTE, which is no longer discretionary. As highlighted already, the implication of the current schedule is a very high risk of reduced submarine availability and capability at a strategically inopportune time.

2.3 Capability risks

There are serious questions over whether a diesel-electric submarine relying on lead-acid battery technology (at least at the beginning), will be fit for purpose in capability and survivability terms against the capabilities of potential adversaries Australia will face when it is delivered. This needs urgent and detailed examination. The decisions taken so far on such things as battery technology are not the issue. The question is more whether any conventional submarine, regardless of technology, will have sufficient utility for Australia to make the massive planned investment worthwhile.

That aside and even if Australia continues down the current path, there is no evidence of any process either in place or yet contemplated for introducing new technology into the Attack design during the decades-long build. This is a critical component for the success of a continuous build program. Without such a process, which plans for the work to be done to introduce selected new technology and capabilities, we are exposed to a risk of equipment and capability obsolescence as the build program progresses. This risk will increase over time and grow very quickly in those technologies that evolve rapidly.

The review in the late 2020s of submarine technology mentioned in the 2016 Defence White Paper should be started immediately. Such a review needs to factor in the Collins LOTE.

2.4 Australian industry involvement

Recent public statements do not give any confidence that action in hand on this front will be successful in delivering the level of industry involvement Australia seeks. Australian industry involvement is a vital component of the capability for the very long term, across the life of the submarines that goes well beyond considerations of jobs and the economy. There are major implications for Australia's ability to support the capability throughout its service life and these implications impact the total cost of ownership. We need to be realistic too. The number of Australian jobs is important but will always be relatively small in the national scheme of things, compared with other industries, and not all of these jobs will be in the high end of advanced manufacturing skills.

Government should specify the levels of Australian industry involvement required and define how achieving those levels will be measured. The objective target levels sought may not be possible from the start so the requirements should be expected to increase over time, but on a set schedule. The prime contractor should be contractually obliged to meet these targets. If this is not done, a critical strategic objective will fall prey to becoming an excuse for price escalation and schedule slippage by the prime contractor. Implications for the delivery schedule would need to be understood.

Reintroducing competitive pressure on the prime contractor, which was abandoned prematurely as a result of the novel (for Australia) competitive evaluation process, could materially assist.

2.5 Other considerations

We understand there are serious pressures on the Defence capital budget, which is heavily committed to several very high cost and high-risk programs, including the submarine and frigate acquisitions. We note that these two acquisitions alone account for 21 out of the 24 platforms that will make up Navy's future fighting capability. The size of the challenge faced by domestic industry in meeting the Continuous Naval Shipbuilding Program complicates the picture and adds to the total risk profile.

3. Risk mitigation strategy (1): Collins 2.0

We believe there is a pressing need for a strategy to reduce the risks addressed in Section 2 above. We propose two studies that should begin urgently:

- Introduce competition to the SEA1000 program by commissioning a preliminary design study of an evolved Collins class submarine, Collins 2.0
- Bring forward the review of submarine technologies flagged in the 2016 Defence White Paper so as to understand how the Navy's future submarines may be 'future proofed' so as to better ensure their effectiveness and survivability.

In combination, we believe these studies would help clarify options to mitigate the risks with the current program. The first of these proposed studies is analysed in this section of the Submission. We also need to understand, however, the importance of the Collins class life of type extension (LOTE) and the potential synergies between the LOTE and Collins 2.0.

3.1 The importance of the Collins LOTE

With the Collins class reaching the end of its design life between 2026 and 2034 and the Attack class scheduled to enter service in 2035-36, a comprehensive LOTE of the existing six submarines is essential if we are to avoid a very serious capability gap.

Defence's thinking on the Collins LOTE was laid out in limited detail in answers to questions at Senate Estimates. Replacing diesel generators, the main motor, elements of the power distribution system and periscope(s) were all mentioned. This is a very major scope of work that will be complex, costly and risky. It will involve substantial design effort and very invasive industrial activity. Industry colleagues have suggested that building the replacement components into brand new hull section(s) constructed before the submarine enters the dockyard to begin the LOTE, might make it possible to do the work with less impact on submarine availability. Conceptually, such an approach makes sense but it moves the LOTE from being largely a repair, maintenance and routine component replacement activity to one with a heavy emphasis on shipbuilding, which would require specialised infrastructure and industry skills. There would be competition for the same resources required for the Attack construction program.

Defence has experience with comprehensive upgrade programs, not all of it happy. Regardless of how thorough the preparatory work may be, unseen deterioration of the vessel and unforeseeable problems emerge once the shipyard starts pulling things apart. Some of these will be major and even if they are not, they can rarely be ignored, especially in a submarine. It will consume time and effort to rectify such things. All sorts of problems can emerge too when the shipyard starts putting it all back together and trying to make it work. The FFG Upgrade Program is a worthwhile case study in how challenging it can be.

Equally important, sensors, combat, communication and weapon systems will also need to be upgraded to maintain the submarines' relative capability compared with potential threats evolving in the region. Some of this work is scoped, funded and underway or planning is advanced but some is not yet even identified.

There is a high risk that the totality of this work will result in the submarines' availability to be at sea being constrained, which will have a flow on impact on Navy's ability to generate the increased number of qualified and experienced submariners it needs. ASC will need additional resources as well, if the Collins LOTE is to be completed during scheduled deep maintenance and docking periods.

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This is one of the main reasons that the choice of location for future Collins full cycle dockings and the LOTE is so important. Getting this right, so that availability of the submarines to be at sea is not reduced, will be critical if the risk to production of more submarines is to be minimised.

The design effort required for the major changes to the submarine mentioned above will be significant and getting that work right will be vital too. This will be especially important if the LOTE entails major changes that alter the overall weight distribution and therefore balance of the submarine, which is very likely for the scope mentioned above.

It makes sense that ASC would be the lead contractor for the LOTE and notwithstanding its very useful design capability, expertise and capacity, we believe that ASC does not have the experience to undertake such a major activity without help. While ASC is now the Design Authority for the Collins class, they did not design it and the design work they have done falls far short of the major changes outlined by Defence. Australia would be most unwise not to engage the services of an experienced design partner to assure ASC's work. ASC's capability partner, US submarine designer General Dynamics Electric Boat could provide valuable but limited assistance. The original designer, now SAAB Kockums, is the company best equipped to provide such services, having designed the submarine in the first place and having had extensive and practical experience in life extensions and comprehensive upgrades for its designs. Strict limitations on access to Collins class intellectual property also effectively restrict the choice to SAAB Kockums.

3.2 Collins 2.0 preliminary design study

Most of the risks to our future submarine capability inevitably flow from relying solely on the proposed Attack class submarine, which itself is exceptionally risky. The best way to mitigate these risks is to be able to consider a possible alternative before final decisions are made to build or, in other words, to introduce competition to the process.

We therefore propose that the government should commission a parallel preliminary design study of a Collins 2.0 option. We estimate the cost of such a study would be less than \$100m or around 0.2 per cent of the future submarine budget. This could be recovered many times over even if only by the introduction of competition. The government could then choose between the Attack class and Collins 2.0 in about 2022, a decision that it should be possible to base on fixed price tenders for the first batch of submarines, including firm proposals for delivery, local content and intellectual property rights as well. We discuss later how this might be done without interfering with the current programs.

The viability of this proposal necessarily depends on SAAB Kockums having the capacity to devote the necessary design staff to the task. Our assessment is that there is a window of opportunity now but commercial realities being as they are, it will be short-lived, especially if they win the Dutch program on which they are currently bidding.

This proposed study would also re-introduce competition that would help bring issues with the Attack program into the open. In addition, it would seek to exploit the full breadth of the nation's hard-won experience with the Collins class submarines which in our view was abandoned prematurely. It takes account of some important facts:

- The service lives of all six Collins boats must be extended by a full operating cycle of ten years, at least, to avoid a capability gap.

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- These submarines and the Australian industry supporting them are performing well after a troubled start. Australia has learned a great deal from that experience, lessons we now face learning again with a supplier with whom we have no experience apart from a rocky beginning, which does not augur well
- The Swedish designer of the Collins class, Kockums, with whom we have long experience, is now in a healthy state. It has undertaken complex life extension work, including inserting new hull extension sections into the older submarines in Sweden's own navy and is building the first of a new class of submarines for Sweden. It is also offering an evolution of the Collins design in competition with French and German bids to replace the current Dutch submarine force of four Walrus class submarines, which itself was a contender for the original Collins acquisition.
- Importantly, after a long period in German ownership, Kockums is now owned by the Swedish company SAAB, with which Australia has developed a very sound and productive long-term relationship and with which we are contractually engaged for major future naval acquisitions stretching decades into the future.

Benefits of an evolutionary approach to submarine design

Creating a new submarine design by evolving the existing, in-service platform, thereby building on the lessons learned from building, operating, sustaining, and modifying it, is the approach followed by all countries that are successful in building submarines for their own use. Overall, it is an approach that involves lower risk and cost than the alternatives. This may sound like what Australia has done with the Attack class, but it is not. The Attack class design is not an evolution of an existing design. Rather the original concept was to put diesel engines in a nuclear submarine – which is an oxymoron. So the Attack class submarine is an evolution of France's submarine design expertise, but not their experience or ours with an existing design. Furthermore, France exports but does not operate conventional submarines. The Attack class will incorporate France's lessons, not Australia's, except to the extent that Australia has specified the performance requirements and is able to influence the design as it is done.

There is evidence and analysis to suggest that a design evolved from Collins (Collins 2.0) and building on the additional experience that will be gained from the Collins LOTE would provide a comparable capability to Attack but could be delivered five years earlier, possibly more, at less cost than Attack and with much higher local content initially. There would also be significant and valuable synergies between Collins LOTE and Collins 2.0 in such things as submarine sub-systems, logistics and training systems and component commonality that would benefit both industry and Navy.

Why Collins 2.0?

Given that it was designed specifically for us, the Collins class is the only existing conventionally powered submarine design that comes close to satisfying Australia's operational requirements. Those requirements are driven mostly by geography, which explains why Collins is larger than almost all other conventional submarines of its era. Most importantly perhaps, after decades spent sorting out problems, it is now accepted that the Collins class is most assuredly not a "Dud Sub".

Early in the Future Submarine Program, Australia was encouraged by the US and others to build on the experience gained from 30 years of the Collins program. Overseas practice reflects this approach because an evolutionary program is cheaper,

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less risky and more quickly achieved than ‘starting from scratch’ as we have effectively chosen to do with SEA1000. Nations that are long-term parents of their own submarine capability run their programs in this way, evolving what came before. They utilise existing supply chains and build on their procedures for fabrication and manufacture, operations and maintenance, and testing and commissioning. With the Collins program and our unique submarine, Australia took on these parental obligations whether we knew that or not.

Undertaking a Collins 2.0 preliminary design would necessarily involve SAAB Kockums. The synergies that could be achieved with Collins LOTE as a result are significant.

As Defence Minister, Christopher Pyne stated that evolving the Collins design was considered and dismissed by Defence some years ago but this is not the whole story. Defence did study updating the Collins design but this was done prior to the competitive evaluation process (CEP) that Australia used to select between France, Germany and Japan as the designer of its new submarines. Sweden was not invited to submit a proposal during the CEP. The publicly stated reasons for this decision may have been relevant then (although arguably they were not) but there is sound and considerable evidence showing the situation is very different now.

Importantly too, agreement on intellectual property (IP) rights was negotiated with Sweden before any work started on investigating an evolved Collins design. This agreement is presumably still valid and even if it is not, it provides a very sound basis for a new agreement.

Collins 2.0 is a good Plan B, if we are to get as close as possible to meeting the capability requirement. We argue it’s the only viable alternative option to the Attack class:

- German and Japanese designs were evaluated during the CEP and rejected – there is no reason to revisit them
- Government has ruled out ‘off the shelf’ conventional submarine designs offered in the market (by France, Germany and Sweden, plus Spain and South Korea if their designs were to be available commercially) because they are much less able than Collins to meet Australia’s challenging capability requirements
- With nuclear powered submarines not being considered, there are no alternatives available from the UK or USA, neither of which build or operate conventionally powered submarines.

Other government policy objectives, such as a high level of Australian industry involvement as an enabler of greater sovereign control over the capability and control over through life costs, are of fundamental importance and underpin the analysis contained in this proposal. Building on over two decades of experience in sustaining the Collins class, with a local industry content of over 90 per cent reportedly being achieved today, Australia and the existing national supply chain brings with it a deep understanding of those submarines, as well as operating and supporting them. This knowledge is a valuable sovereign asset, the benefits of which are maximised by the approach proposed here. They should not be abandoned lightly although we are at risk of doing just that. Early experience with France is showing just how hard it will be to rebuild that comprehensive national submarine capability from a zero base with a country with whom we have no experience working on submarines.

Other considerations

There are other reasons for examining Collins 2.0. Defence has done a worthwhile body of work on it already, having engaged Kockums in 2013 to investigate Collins 2.0 through contracts valued at just under \$10m. This was in addition to work Kockums undertook evaluating extending the Collins class service life. The products and the collaboration are reported to have been good. SAAB Kockums has done a great deal of work on it too, for its bid for the Dutch replacement submarine.

The close integration that would be possible between Collins LOTE and Collins 2.0 in a single program approach with a single design partner could reasonably be expected to be simpler and therefore lower risk than the current arrangements because it would entail much less commercial complexity (and therefore risk and cost) than exists now. Cost should be lower overall and a quicker delivery schedule should be achievable. Greater Australian industry involvement would be achieved sooner and there would be greater commonality between the old and new submarines plus substantially greater opportunities to 'carry over' systems and lessons from the Collins LOTE to Collins 2.0, again reducing costs. LOTE could also be used to test systems intended for the new submarines, thereby further reducing future risk.

The current situation will inevitably create tension between two separate submarine designers and builders involved in upgrading and sustaining Collins on the one hand, and building the Attack class on the other. Both will be competing for the same pool of manpower and resources but with very little ability to 'cross-level' those resources.

In addition to the benefits we foresee, the challenges and costs for Navy that are associated with transition between classes, particularly logistics and training system requirements, would be reduced. Lower sustainment costs would also be achievable from necessarily shorter, more domestic and less complex supply chains. The longer-term result would be reduced total cost of ownership. We should not forget that acquisition cost (already an eye-watering amount) accounts for only around 30% of the total capability cost through life.

The Collins 2.0 preliminary design study we propose would put competitive pressure on Naval Group for a better outcome, in Australia's interests, whichever choice government was ultimately to make. We should have no concerns about doing so and Naval Group should have no grounds for concern either. If their submarine truly offers Australia the best capability in terms of value for money, schedule and Australian industry content they will win. But the great benefit of competition is that if Naval Group does win, it will have needed to refine its bid substantially in order to prevail. Having two contenders presenting tender-ready designs at the same time would allow the Australian government to negotiate a fixed price (with escalation provisions) for the construction of the first batch of submarines, with contractual obligations for a specified level of Australian industry content.

3.3 The proposal

This proposal is for a study at very modest cost compared with the \$80 billion (out-turned dollars in addition to the combat system) acquisition budget for SEA1000. It is a risk minimisation strategy, not a reversal of course and nor does it require abandoning any decisions already taken. The outcome of the study, with a final report in 2022 before government faces the critical decision point of committing to a construction contract on the Attack class, would be that when that decision is taken it will be on firmer grounds than will exist with the current plan. If started very soon

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an interim report could be expected sometime in 2021, potentially to coincide with the preliminary design review for the Attack class.

Under today's approach with Naval Group, government will have three options when deciding whether to proceed to a construction contract: accept the French design, modify it, or leave it. Leaving it would delay replacing the Collins boats for a long time and probably mean the end of Australia's submarine capability because even if Collins LOTE was delivered successfully and as soon as possible, in all likelihood those submarines could not be sustained cost effectively for long enough to allow another new submarine program to be executed (unless it was Collins 2.0, perhaps). Modifying Naval Group's proposal would necessarily involve more delay and possibly also cost and/or capability trade-offs. Taking it as it is at that time would be viable if it's the right overall package of cost, capability and schedule, which it may be. The study we propose provides government with another option, relatively cheaply, which would mitigate those risks.

In summary, we propose the following actions:

- Establish immediately a small team to oversee the conduct of a design study (PDS) by ASC and SAAB Kockums for a Collins 2.0 designed to meet the original CEP capability requirements. The primary objective of the PDS would be to understand the capability such a submarine would provide, when delivery could begin and at what rate, and the average price we might expect to pay per submarine based, in the first instance, on a six-boat build. Other selected Australian companies in the existing Collins supply chain should be involved, to ensure the lessons of long experience from building operating and supporting the Collins class are fed back into the design so as to keep manufacture, assembly and through life support costs down.
- ASC engage SAAB Kockums to assist with planning and executing Collins LOTE and to maximise the potential for carry over between the two activities. An additional objective would be to understand in greater detail the benefits and challenges of running Collins LOTE and a new build program of Swedish design origin in parallel.

Defence's comments at Senate Estimates suggest that they do not have the skilled workforce to run more than one design development program. In any case, we consider that the urgency and importance of this program are such that diverting resources from current Defence submarine activities or causing any delay or distraction to industry or Defence should be avoided.

We consider the proposed study needs only a small team, between 15 and 20 FTE, to set up and manage the necessary contracts. A few APS administrative support people would be required but the required specialist submarine skills could be contracted from among experienced Australians who are no longer working in Navy, CASG, Naval Group or ASC. One or two overseas experts may also be needed. This team would clearly need to be responsible to the Secretary of Defence and Chief of the Defence Force but should be separate and not draw people from any current submarine activity, in order to avoid impact on them. Evaluation of the output of the PDS and comparison with Attack leading to the choice about which path Australia should follow would also need to be managed very carefully to avoid conflict of interest and bias, conscious or unconscious.

4. Risk mitigation strategy (2): Technology

4.1 Review of submarine technology requirements

The 2016 Defence White Paper flagged a review of future submarine technologies in the late 2020s. We believe there is a pressing need to start this review now. Completing a fairly thorough review should be possible within two years so the results should be available ahead of a decision to start construction of new submarines.

Introducing new technology into platforms already in service or under construction in a continuous build program requires research and development, scoping, planning, securing funds, design, industrial activity and testing. This all takes time and can take a long time. It must be done methodically, and the system for doing so needs to be built at the start of the program otherwise the risk of successive new platforms being delivered with obsolete systems or even capabilities will grow quickly – the program will be in ‘catch up’ from the start.

Continuous evolution of the original design is a characteristic of programs in all countries which run continuous build programs for their own purposes. The design in construction is updated regularly in response to changes in the threat posed by adversaries, technology developments and the changes to missions that become possible as a consequence. Updates take place on a regular basis; frequent for those technologies that are changing rapidly, such as ICT based systems; less often for slower moving technologies, such as engines. Changes are also introduced to reduce construction and support costs and thereby the total cost of ownership.

Australia must deal with this challenge as we start our continuous build programs, not once those programs are underway. This requires planning wisely. We note here again the ANAO’s statement that the Collins LOTE is at a very early stage of development, which is very concerning in this context.

Acting now is important; things take time to do

Publicly available information gives important indications of how long things take:

- The Future Submarine Program was kicked off by Defence in late 2008
- The French bid won the CEP in 2016
- The Strategic Partnering Agreement and initial design contract with Naval Group were signed in early 2019
- Preliminary design of the Attack class should be completed in 2022
- The date for completion of the detailed and production designs appears to be early 2026
- Production, starting with fabrication of qualification hull sections, will start in 2023
- The first submarine is scheduled for delivery in 2030 and after operational test and evaluation will enter service by 2033 (although other public comments from the Commonwealth, notably the Chief of Navy, suggest it will be several years later than this)
- New submarines will be delivered at about two-year intervals.

We observe:

- Reaching agreement on the capability requirement took about 7 years (2008 to 2015)

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- After government agreed the requirement, the time to select the designer, negotiate agreements and contracts, finalise the design and start construction will be almost another 11 years (2015 to 2026) if all goes to plan.

In this case the process was probably the longest possible; starting with a contentious capability definition then selecting and contracting a designer for a completely new design of submarine, undertaking the long and complex design process through to starting construction in a new shipyard. We note too that the time it has taken Australia to get through this process is not dramatically different from other countries' experience. It could be done faster in an emergency but there is a limit; the skilled people required plus other resources, especially funds, all exist in finite supply.

Incorporating major new technology into the Attack class, such as new battery technology that would probably significantly alter the submarine's balance and stability, should take less time than this but how much less? That will depend on many factors, such as the maturity level of the new technology to be incorporated and therefore how much research and development work is needed to bring it to readiness for service. Also, the more the new technology impacts the original design, especially the overall weight balance and margins (space, weight, reserve buoyancy, power, and cooling) the longer it will take to do the necessary design work and the greater the cost and schedule implications will be.

In practical terms, and being generous, if we started preparing significant changes to the Attack design immediately, those changes would probably not be delivered in a new submarine until well into the 2030s; Attack class submarine number 3 or 4 or possibly even 5. Defence has given no indication that any such capability and design development process is underway or even yet contemplated.

The public is led to believe that the first Attack submarines will be delivered with the same lead-acid main storage battery technology as used in the Collins class. We make no comment on the basis for this decision because it has not been explained but we note that this is the same technology that has equipped submarines from the beginning; early last century. We note that battery technology has been changing dramatically in the last two decades and that new battery technology is being fitted in conventional submarines now. Anticipating that Defence will want to change battery technology at some point in the foreseeable future is reasonable, but the detailed planning for that should be underway already.

In our rapidly evolving strategic circumstances, to have to wait until almost 2040 to see technological developments appearing in Australia's submarines is not acceptable. If we wait until the late 2020s to start thinking about this issue, we will be operating obsolete technology well into the 2050s and beyond.

We must catch up with developments in submarine technology

We briefly examine the roles of Australia's submarines in following paragraphs but to provide overview and context, some of those roles are enduring; what drives them does not change. Geography, which drives where submarine missions are best undertaken, and the laws of physics, which inform why those missions make the more sense and others less, are enduring. Physics also drives the constraints on how those missions can be performed but also defines the opportunity space.

Things that change can expand or further constrain what missions a submarine can perform. For example, technology has dramatically increased the effectiveness of submarines in the intelligence collection, surveillance and reconnaissance (ISR) mission. High capacity networked and secure communications combined with

reliable long range, precision heavyweight torpedos, submarine-launched anti-ship and land attack missiles have all made the submarine a much more potent attack weapon than could have been conceived only decades ago. Advanced main storage battery technology, designs for stealthy snorking, air-independent propulsion (AIP) systems, electro-optics, uninhabited underwater vehicle technology and artificial intelligence are other areas where advances in technology either promise new capability that gives the prospect for new missions or better ways of performing current missions or they are already doing so. Some of these advances flow from the explosion of computing power the world has enjoyed in recent decades.

These developments present both opportunity and threat. They can be exploited against us by adversaries, as well in our favour by ourselves and our allies.

Submarines are offensive weapon systems. Using them in a defensive posture is to largely waste the massive investment they require. They are most effective when used to attack the adversary before he attacks us. This is the common strategy among submarine operating nations, and it applies whether they field nuclear or conventionally powered submarines. In Australia's geostrategic circumstances, an offensive strategy necessarily means attacking the adversary close to his own home. That will be a very long way from Australian territory and our submarines will have to cross an ocean to get there, regardless of who the adversary might be. Australia is the only nation operating conventionally powered submarines that sends its submarines across oceans to get to the operating area. All other nations who face that challenge operate nuclear attack submarines (SSNs).

Everywhere we look in our region, nations are investing in more sophisticated, modern military capabilities. Nowhere is this more the case than China and India but it applies to all but the poorest and smallest nations as well. The capabilities that are emerging are many and varied but they certainly include systems that will make it much harder for us safely to operate our conventional submarines close to an adversary's bases. Included in developments are such things as sea-bed acoustic arrays, sophisticated surveillance systems of all types and dramatic improvements in anti-submarine warfare capabilities. Regardless of who it is, every potential adversary we might confront by 2030 will be much better equipped to counter our submarines compared with the challenges foreseen in the 2009, 2013 and 2016 Defence White Papers; some already are. Operations 'up threat' using conventional submarines are becoming increasingly challenging and the operational effectiveness and survivability of our submarines will be diminished as a consequence.

We consider that to have to wait until 2040 to see any significant new technology incorporated in Australia's submarine force is not acceptable. Therefore, the submarine technology review planned for the late 2020s should be an urgent government priority. And, like the Collins 2.0 design study, it must not be allowed to distract from current submarine capability activity.

4.2 Australia should investigate nuclear propulsion

No nation that faces Australia's geostrategic situation uses conventionally powered submarines for the missions that make sense for RAN submarines. It is true that several regional nations in similar circumstances to ours have conventional submarines in service, but those nations also operate SSNs. For the missions that we undertake, their first choice would be to use their SSNs. Those nations with only conventional submarines all operate relatively close to home because their geography means that's all they need to do, while still executing an offensive strategy.

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Only SSNs have limitless dived endurance on patrol and can transit to the operating area at much higher sustained speed than a diesel boat. This capacity for high-speed transit without the need to charge batteries dramatically reduces the risk of detection and would translate for Australia into an ability to put more submarines on station – perhaps three times as many as with a diesel boat during a period demanding a surge in operations. Their endurance and capacity for sustained high speed also offers major advantages in survivability and operational effectiveness once on station. There is no other technology today or in prospect that can come close to delivering these performance characteristics. Exotic batteries and air independent propulsion systems cannot now and probably never will come close, either singly or in combination.

We recognise it would be difficult and expensive for Australia to acquire SSNs. There are few potential partner nations to whom we might look and who might be willing to release such sensitive technology to us. For any of them, the circumstances would need to be such that they could be convinced that doing so was not only in their interests but safe. That would not be easy. As a minimum, firm bipartisan political support and long-term, stable funding for a program that might take 15-20 years would be essential. Navy would face enormous challenges growing the necessary engineering and other skills and the nation would need to commit to building the educational, regulatory and monitoring machinery required. But we do not need a nuclear industry beyond what we already have as a prerequisite, as is often argued by those who seek only to shut down discussion.

The potential benefits to national security are worthwhile, even if considered only through the submarine capability. There are likely to be other benefits to the nation as well. Without examining the challenge to see what the risks, benefits, opportunities, cost, schedule and other implications really are, we will remain hostage to an ill-informed and emotional debate.

Examining the feasibility of acquiring SSNs should be included in the submarine technology review.

5. Defence Minister's response

The recent *Submarines for Australia* [report](#) on future submarine capability, which informed this submission, was released publicly at the National Press Club in Canberra on Wednesday 11 March 2020 by Emeritus Professor Hugh White AO. The Minister for Defence, Senator Reynolds released a public rebuttal, but we doubt that the Minister would have read the report by then, especially as the following three specific elements of her statement reflect a misapprehension of what is actually in that report.

Previous examination of an evolved Collins

“Senator Reynolds said the technical feasibility of delivering an evolved Collins class submarine was reviewed in 2013-14, but a review found it would be equivalent to a whole new design, involving similar costs and risks, without a commensurate gain in capability.”

We addressed this statement, which is essentially similar to a statement made by Christopher Pyne as Defence Minister in 2018, in section 3.2 of this submission. At least in terms of design effort, there is no dispute that an evolved Collins would be the equivalent of a whole new design. The investigation Kockums was contracted to undertake was artificially constrained (i.e. no change to the existing hull diameter and a limited number of modifications from the original Collins design) specifically to determine whether there would be less design effort than with a new design. This was to see if the design schedule could be minimised. There was no investigation beyond that, to determine the cost, risk, and schedule impacts of using the existing supply chains, technical networks and manufacturing, commissioning, operating and maintenance procedures, nor the effect on the Navy and its operating and sustainment budgets.

Once it was identified that evolving Collins with that constraint would bring no benefits compared with a new design in terms of design risk, cost, schedule or capability, the artificial constraint ceased to have any purpose and could be removed. The full story is that a constrained version of an evolved Collins was only ever partially considered because Kockums was excluded from participating in the CEP. This would have been the avenue by which to judge what gain in capability might have been on offer from an unconstrained, new design of submarine evolved from the experience both Kockums and Australia have with Collins.

Given Kockums was the only competitor with experience of designing and building a submarine for Australia's needs, excluding them from the CEP was not in our best interests.

Dismissal of our proposal on cost, schedule and risk grounds

Senator Reynolds statement said:

“This assessment by Submarines for Australia will only increase cost, delay the delivery, and put at risk our submarine capability.”

We have argued that what we propose is a risk minimisation strategy for a project that the government itself has agreed is very high risk. We accept that the study we propose will have a financial cost but that it is modest in the context of the budget; \$100m or under 0.2%. We have also laid out the benefits from potential savings, which we firmly believe would be many times that amount and why they could accrue. We have explained an approach in section 3.3 of this submission which we believe will avoid any delay in delivery of new submarines, which we have also argued should be brought forward if at all possible.

Dismissal of nuclear propulsion

“As has been the policy of successive Australian Governments, a nuclear-powered submarine is not being considered as an option for the attack class submarine,” Senator Reynolds said.”

Our proposal is not that a nuclear-powered submarine be considered as an alternative for the Attack class. Our argument is simply that the government’s review of submarine technology, planned for the late 2020s, should be started as soon as possible and should include examination of nuclear propulsion for submarines. The main reason for looking at that technology is that conventionally powered submarines look increasingly likely to be not fit for purpose for Australia in the foreseeable future. We accept that a decision could be many years in the future and should not be made without full understanding of what would be involved, including which countries might make the technology available and under what circumstances. That’s the point; today we have no such knowledge. We argue it’s time for Australia to find out and that the submarine project’s immense cost and high risk of being of limited utility make it imperative.

6. Conclusion: drawing threads together

The logic and various threads of this submission can be drawn together into a straightforward story.

The submarine program is increasingly worrying - again

- The submarine capability comprises a number of inputs, but the submarines, submariners and industry elements are the key ones
- Without enough of all three, working well and in harmony with the others, there can be no effective submarine capability
- All three are at risk in the current program. We look to be on track to have to learn again, this time with France, many of the lessons we learned from the Collins program because we have ignored much of that experience and the advice we have been given by experienced friends. We risk wasting vital time and countless billions of dollars in the process
- This time however, letting things sort themselves out doesn't look like a wise approach.

Uninterrupted availability of Collins, including during the LOTE is vital

- Navy must grow more submariners for the larger future force the government wants – education, training and experience at sea in submarines are all required to do that
- Therefore, Navy cannot afford a reduction in Collins availability because the capacity of the system to generate submariners will decline if that happens, when Navy needs it to increase
- This means that the timely completion of Collins LOTE, undertaken so as not to reduce availability of the Collins boats, is the key to successful transition to the larger future submarine force.

We should investigate Collins 2.0

- In our rapidly changing strategic circumstances, we need more submarines sooner and faster than Attack class boats are scheduled to be delivered
- It also seems clear that the published schedule for Attack is already at great risk of not being achieved in that critical early stage when we must retire the Collins class
- We should urgently put in place a Plan B to mitigate the risks in the current program
- The Plan B we propose is a parallel design study for a Collins 2.0.

We should start the technology review immediately, including investigating SSNs

- Waiting until the end of the decade to review submarine technology is too late because of the time it takes for new technology to be fielded. We need to start now
- Conventional submarines are at increasing risk of becoming unviable in Australia's context, so we should investigate acquiring SSNs
- Acquiring and becoming a proficient SSN operating nation would take time and be expensive, but it does not require that Australia first develop a more extensive nuclear industry than we already have, such as nuclear power generation plant

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- Moving to SSNs would make it even more imperative that Navy produces more submariners sooner, especially senior and experienced submariners, so that the education and training for the transition to SSNs can begin
- We cannot get to SSNs from Collins in one step because the growth in submariners required can only be achieved with more submarines than we currently have
- To get to the increased submariner workforce we would need to start a transition to SSNs we need a force of 10-12 conventional submarines that would necessarily comprise Collins LOTE and the Attack class or Collins 2.0.