Raytheon Australia

SUBMISSION TO THE SENATE ECONOMICS REFERENCES COMMITTEE INQUIRY INTO THE FUTURE OF AUSTRALIA'S NAVAL SHIPBUILDING INDUSTRY

1 December 2014

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Date: December 2014

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1 INTRODUCTION

This submission addresses the importance of systems engineering skills to the successful execution of future naval shipbuilding projects and outlines the national sovereignty justifications for maintaining defence industry skills in combat systems integration and sustainment.

Raytheon Australia's pedigree as a mission systems integrator is detailed together with a consideration of the Future Submarine and Future Frigate projects.

Raytheon Australia is a major participant in the Australian naval shipbuilding industry as one of the three members of the Air Warfare Destroyer Alliance, where the company is the mission systems integrator for the destroyer project, and through its systems integration pedigree on the Collins Class Submarine.

1.1 AIR WARFARE DESTROYER

By way of background, Raytheon Australia was first engaged as the Combat System Systems Engineer on the Air Warfare Destroyer project in 2005, with its role on the project confirmed at Second Pass in 2007.

As the mission systems integrator on the project it has been the role of Raytheon Australia to:

- Develop the design of the complete combat system with the Commonwealth, the United States Navy and its agent;
- Procure and integrate the non Aegis weapon system elements of the combat system; and
- Develop project management and systems engineering structures for the project.

Supporting its AWD activities, Raytheon Australia currently employs a total of around 350 people including at the AWD Systems Centre at Techport in Osborne, South Australia and at the company's Macquarie Park facility in Sydney, which operates as a node of the AWD System Centre.

Since being selected as the AWD combat system systems engineer Raytheon has completed the vast majority of its scope of work. This has been achieved with a cost and schedule performance of 100 per cent.

At the broader level of the AWD Alliance, Raytheon Australia devotes considerable corporate capability including significant business tools and processes as well as project management expertise and the regular involvement of Raytheon Australia corporate management. This is supplemented by the resources and oversight of the senior leadership of the company's US parent.

1.2 COLLINS CLASS SUBMARINE

Raytheon Australia's systems integration pedigree was originally established through its association with the Collins Class Submarine combat system. For more than a decade the company has applied its engineering resources to a range of tasks including:

- working with the previous incumbent to help stabilise the legacy combat system and later assuming responsibility to complete the original combat system contract;
- contributing to the Combat System Augmentation program; and
- being selected for the Collins Replacement Combat System and supporting the ongoing Replacement Combat System Technical Insert program.

Having successfully integrated and delivered the Replacement Combat System the company continues to provide in-service support for the mission system. As is the case for company's role on the AWD program, the success of Raytheon's efforts have centred on its experienced engineering resources, program management expertise, robust processes and linkages to the resources of its US parent.

2 THE IMPORTANCE OF SYSTEMS INTEGRATION SKILLS

While the focus of the current inquiry into naval shipbuilding by the Senate Committee has been on the likely future domestic demand for shipbuilding production skills, there is a substantial contribution to be made by the application of systems integration skills.

Public attention on shipbuilding production productivity issues on the AWD program has masked the success to date of the systems integration activity on the destroyer project. For example, the Australian National Audit Office report into the AWD program of March 2014 detailed the projected cost overruns in production then stated: "However combat system development is progressing more satisfactorily. By September 2013 Raytheon had expended 69 per cent of its budget for the DDG's Combat System engineering work, with the Earned Value Management System showing its cost efficiency at 1.0 or 100 per cent, and schedule performance at 0.99 or 99 per cent."[1]

Such a finding is consistent with a proposition that progress on AWD combat system architecture, procurement and integration has been good to date. This is supported by evidence of the Chief Executive Officer of the Defence Materiel Organisation, Mr Warren King, who told a Senate Estimates Committee hearing on 22 October 2014 "…the system integration, to all intents and purposes, is going fine. In fact, the balance of the program has no cost overrun of any significance..."[2]

The importance of a systems integration workforce to the success of naval projects was highlighted by the Future Submarine Industry Skills Plan (FSISP), published by the Department of Defence in 2013. The report made a number of relevant observations, one of which related to the timely selection of a systems integrator. At page 74 it was stated: "As can be seen from the Air Warfare Destroyer case study, one of the critical success factors for systems development is the early engagement of industry, which allowed enough time for a comprehensive systems engineering process".

The FSISP report identified that the skills applied to the AWD combat system integration task in 2005 was the same core team that had worked on the Collins replacement combat system and concluded "the benefit of having an established proven team is much greater than generating a new team of experienced people. The team comes with people who know each other – teamwork and proven tools and processes."[3]

The report found that retaining experienced engineers in this area is able to drive productivity improvements in a systems workforce leading to cost savings and the avoidance of cost blowouts.[4] In the context of transitioning the proven team from the Collins replacement combat systems project to the AWD the report stated "what this experience shows was the speed and efficiency of a proven team. If the task had been undertaken by a newly formed team, it would have required more time and budget because of low productivity and time spent by the team working out roles and dependencies"[5]

The report summarised this argument by stating "the key to systems development for the Future Submarine is to retain this workforce, preserve established teams (tools, processes and facilities) and engage the mission systems integrator early to help define requirements and create the systems architecture."[6]

[1] Australian National Audit Office Report No.22 2013-14. Air Warfare Destroyer Program, page 260.
[2] Senate Foreign Affairs, Defence and Trade Legislation Committee, Estimates Hansard, 22 October 2014, page 90.
[3] Future Submarine Industry Skills Plan, Department of Defence, 2013, page 74.
[4] Id. p75 and p77.
[5] Id. P77.
[6] Ibid.

As to the depth of skills necessary to undertake the Future Submarine project, a RAND Corporation 2011 report found that although Australia did not possess the necessary design capabilities to undertake such a project it did, however, possess the necessary combat system engineering skills. The FSISP agreed with this finding.

3 DEFENCE INDUSTRY AS A KEY COMPONENT OF DEFENCE CAPABILITY

Beyond industrial capability and capacity arguments there are particular foreign relations and national sovereignty reasons for maintaining skills in the area of combat systems integration. It is in this context that it is important to consider that the indigenous defence industry, and the systems integration segment of the industry in particular, has become a key component of national defence capability.

This means that defence industry is no longer just an arms length provider of commodity goods and services but rather one of the fundamental elements of the national security infrastructure.

It is also important to appreciate that the industry capabilities required to deliver against modern warfighting requirements take considerable time and investment to establish and develop, just as they deteriorate quickly and require a consistent throughput of work to maintain.

What this means is that a strategic view and commitment is required of certain, but not all, defence industry capabilities.

For its part, defence industry should not succumb to the rent seeking approaches apparent in some other sectors, nor should it expect any free ride. After all, defence industry exists to support the nation's defence requirements and not the other way around. However, the characteristics of a highly capable indigenous defence industry and the need to sustain it in the national interest should be a consideration in any strategic decision about Defence posture, capability and expenditure.

In making such decisions it is necessary to distinguish those projects and those defence industry capabilities which genuinely add to the industrial self-reliance required for our national security from those that don't.

For example, it can be argued that Australia needs to have sovereign capabilities in the integration and sustainment of submarine and major surface combatant combat systems which are incredibly valuable to the nation. Such an industrial capability adds to our industrial self reliance, particularly during times of conflict, and its retention is therefore a matter of national sovereignty. Further, as an issue relevant to our foreign relations, the protection of the intellectual property of US supplied defence technologies such as naval combat systems is a matter the United States reasonably expects of Australia and this requires a certain level of industrial capability to be maintained.

This places a high value upon maintaining an Australian industrial capability in combat system integration and sustainment.

By contrast, there are other projects and other industry capabilities to which no such national sovereignty or foreign relations arguments can be ascribed.

Indeed, there is a strong case that certain classes of vessel can and should be built where it makes the most economic sense to do so because a sovereignty argument can less likely attach to associated industrial capabilities. That the Australian Government has chosen to source the RAN's new replenishment ships from overseas reflects the fact that there is nothing particular in the nature of the vessels or the systems contained thereon that requires the involvement of a 'safe hands' Australian industrial partner.

What follows is that the debate in this area should not focus on the protection of particular industrial interests but on the protection of particular intellectual property associated with the nation's most valuable defence technologies. The latter is the reason for undertaking certain tasks in Australia irrespective of whether it could be argued that it may be more economically efficient to carry out those roles elsewhere.

That is the principal reason why there is a strong national interest associated with integrating the mission systems of major surface combatants and submarines in Australia, not merely because it creates local jobs.

The fact that foreign relations considerations have become an important influence on defence procurement is a matter of public record. In the context of the Future Submarine, the CEO of the DMO recently identified a range of factors that would influence source selection decisions, telling a Senate Estimates Committee "…there are all sorts of matters that come into play in selecting who is going to ultimately design, build and work with us on our submarine. They go beyond price and they go beyond their assessed ability to deliver; they go on to strategic relationships, interoperability and on and on."[7]

In a situation where the protection of sensitive military systems demands that systems integration activities for submarine and surface combatants are required to take place in Australia there are also consequential impacts for local ship production. In relation to these platforms, although it is not essential for systems integration purposes that module construction takes place in Australia it is likely to be the case that local combat system installation will necessitate that ship consolidation activities may also be required to occur locally.

This will anchor a considerable volume of work in Australia that may otherwise be undertaken overseas. In addition to guaranteeing Australian based systems integration, hull consolidation and sustainment activities it also necessitates that Australian firms will benefit from the need for a substantial domestic supply chain.

4 FUTURE SURFACE COMBATANTS

The considerable discussion around the impending 'valley of death' for the naval shipbuilding sector has centred on follow-on work from the current three ship build program for the AWD and the two ship build program of the Landing Helicopter Docks (LHD).

The Government has proposed that the Future Frigate is central to a long-term naval shipbuilding enterprise in Australia. To this end, the Defence Minister has expressed a desire to build eight Future Frigates in Australia and has quite rightly indicated that continued Australian industry involvement in the program is dependent on its ability to deliver value for money. Specifically, industry will be required to demonstrate that it can meet an acceptable benchmark for shipbuilding productivity.

The Government has made $78 million available this financial year to bring forward preliminary design work for the SEA5000 program to ensure local defence industry can maintain the necessary capabilities to carry out the important Future Frigate program in Australia. In June the Minister announced that this work would focus on an examination of continued production of the current AWD [F100] hull and utilisation of other Australian defence capabilities.

It was in this context that the Minister announced in August that the Government was examining whether some of the SEA5000 blocks might be constructed early to ensure no break in production beyond the launch of the third AWD. The Minister has also said that further decisions on the Future Frigate program will be taken in the context of the 2015 Defence White Paper when the Government would concurrently announce detail of its Naval Shipbuilding Plan.

[7] Senate Foreign Affairs, Defence and Trade Legislation Committee, Estimates Hansard, 22 October 2014, page 91.

Raytheon Australia welcomes the consideration of whether it is appropriate to reuse the F100 hull for the purpose of its Future Frigate program and will make necessary business related decisions based on whatever the Government determines at the end of this process.

It is clear, however, that should the Government choose not to advance the Future Frigate program then alternative proposals should be considered if the 'valley of death' for naval shipbuilding and systems integration skills is to be avoided.

For example, it is open to the Government to pursue the acquisition of one or more additional AWDs. It should be noted that the option of a fourth AWD is not new and has existed since the Second Pass of the AWD program was achieved in 2007. In the absence of advancing the Future Frigate program there could be strong reasons to proceed with an incremental evolution of the AWD design.

Putting aside any workforce considerations, as is appropriate, additional AWD's would ensure that Australia could, with a higher degree of confidence, provide its lightly armed LHD's and other Afloat Support assets with the protection they require in contested environments. Such an evolved AWD design could also undertake an appropriate role in ballistic missile defence should the Australian Government choose to adopt such a requirement in its forthcoming Defence White Paper.

Irrespective of whether or not it is resolved to re-use the F100 hull in the Future Frigate program, Raytheon Australia is strongly of the opinion that there are considerable cost and schedule benefits associated with re-using the architecture of the AWD mission system for SEA5000. The AWD mission system architecture was developed to facilitate long term capability growth, evolution and avoidance of obsolescence. It can therefore provide a solid foundation for achieving the capability needs of the Future Frigate.

In the interests of drawing upon the considerable investment already made by the Commonwealth in the mission system's design, integration and test, establishing a common mission system architecture across the AWD and Future Frigate programs (that only considers changes that are required to implement different capability needs) has the potential to considerably reduce total non-recurring engineering costs, reduce integration risk as well as reduce through life engineering support, maintenance and training costs by maximising commonality of equipment across the surface combatant fleet.

If it is subsequently decided to proceed with the F100 hull for the Future Frigate then taking full advantage of the opportunities associated with the hull's re-use will depend upon a proper consideration of the harmonisation of the AWD platform and mission system.

The Capability Development Group of the Department of Defence released its 'Top Level Requirement' for the Future Frigate at the Maritime Environment Working Group on 31 August 2014. The capability requirements envision a 'multi-purpose surface combatant capable of operating across the full spectrum of maritime operations, from low level constabulary operations to high end war-fighting, with an emphasis on Anti-Submarine Warfare (ASW)'.

This requirement includes capabilities far in excess of that embodied in today's ANZAC class ships as would be expected in order to counter the future threats over the thirty year life of the platform. In particular, high end war fighting capabilities that will shape the mission system performance requirements for the Future Frigate combat system include:

- Embarked Commander Task Group facilities for Anti-Air Warfare, Anti-Surface Warfare (ASuW) and ASW command and control enabled by current and future tactical data links and extensive voice communications and information systems;
- A comprehensive organic ASW capability including an integrated sensor suite including a long range active/passive towed array and hull mounted sonar, torpedo decoys and surface launched torpedos;

- Aviation facilities for two Seahawk 'Romeo' helicopters providing stand-off ASW and ASuW capabilities;
- A stand-off strike capability fully integrated into a Joint Fires network; and
- Significant Task Force Air Defence and Task Group Anti-Ship Missile Defence capabilities which will drive the requirement for long range surface to air missiles, enhanced short range surface to air missiles and the Cooperative Engagement Capability.

In addition to these capabilities identified by the Department it would also be feasible for the Future Frigate to have a ballistic missile defence capability should the Government determine such a requirement.

Consistent with the Defence Minister's announcement of June this year, the mission system architecture of the Future Frigate will also be required to incorporate the leading edge, indigenously developed, radar technology proven by CEA Technologies in the ANZAC ASMD upgrade as well as incorporate a further evolution of the radar suite for longer range surveillance and for fire control support of the Standard Missile family of weapons.

The system performance requirements and the insertion of national capabilities such as the CEA radar are all requirements that can be satisfied with low risk and in a cost effective way by re-using the AWD mission systems architecture.

As alluded to above, a common systems architecture across the AWD and Future Frigate programs would have a range of benefits including the re-use of many existing supplier relationships, the reduction of sustainment costs though reducing the potential range of equipment needed to be supported and the reduction of the training burden on the Navy by providing a commonality across the fleet.

There will also be the obvious industry workforce benefits of utilising existing AWD resources. Immediately available will be the experienced and established program management and systems engineering resources of the AWD program to be applied to the Future Frigate project.

5 FUTURE SUBMARINE

Raytheon Australia has made an important contribution to the discussion on the Future Submarine program in the form of a company produced white paper entitled 'SEA 1000 – A Hybrid Build Precis'. This document is reproduced in full as an attachment to this submission. The Committee is invited to consider the content of this document as part of its deliberations.

It is apparent that the Government has yet to make a decision on the acquisition strategy for the Future Submarine. In this respect, until the Government makes such a decision, all options remain on the table.

One of the important considerations articulated by the Defence Minister is the need to avoid a capability gap once the Collins class submarines begin to be retired from service in the latter half of the next decade. This has consequences for the type of acquisition strategy to be adopted for the project but it also emphasises the need for the Government to make timely decisions to accelerate the procurement.

The Raytheon Australia white paper confirms that if the first Future Submarine is to be in the water by 2026 an acquisition strategy needs to be settled now.

It is clear that Australia does not have the design capabilities to go it alone on the Future Submarine program and it is now nearly two decades years since the country commenced the build of the last Collins submarine. This means that Australia will need to work with an international partner to successfully undertake this venture.

Raytheon Australia is of the view that the Government should move as soon as practicable to establish a long term collaborative partnership on the design and build of the future submarine.

From an Australian industry perspective such a collaborative approach would provide a great many new, long-term local jobs.

It has been lost on many people involved in this debate that the Government has made it clear that the integration of the US sourced combat system for the Future Submarine will be required to take place in Australia. For example, the attached white paper makes reference to public remarks by the Industry Minister to this effect. What follows from the requirement that systems fit out occur in Australia is that hull consolidation will also be required to be undertaken in this country.

This means that the likely roles for Australians under a collaborative approach will necessarily include mission system design – working closely with an offshore designer - as well as mission system fit out, hull consolidation, test and activation and the substantial task of sustaining the submarine throughout its 30 year operational life. These roles will also necessitate a substantial Australian supply chain.

Australian industry has every reason to welcome the opportunities presented by the Future Submarine. Through a collaborative approach with an international partner Australia has the potential to acquire the most capable conventional submarine in the world, optimised for our needs.

However, to achieve such an outcome without any capability gap requires Government action to be taken as swiftly as possible in regard to the selection of an acquisition strategy to establish the way forward and ensure a capability gap is avoided in 2026.

The attached document points to the need for the early establishment of a “core team” consisting of the Commonwealth, an Australian Combat System Systems Engineer (CSSE) and an Australian platform sustainment partner to inject the necessary key disciplines of engineering management and complex program management into the project.

As an essential member of the core team, the CSSE would have an important role during the preliminary design phase to:

- Conduct trade studies on mission system equipment and Australian unique requirements (combat system, communications suite, etc.);
- Conduct the overall mission system architectural design, including integration with wider ADF systems, networks and collaboration;
- Collaborate with the overseas designer to ensure systems, electrical requirements and platform impacts are suitably addressed in the design (i.e. accommodation of Australian unique requirements);
- “Australianise” the operational and environmentally specific requirements;
- Address systems engineering and architecture considerations to ensure systems can be adequately sold-off;
- Consider the total cost of ownership, life of type management and undertake sustainment planning; and
- Cost and plan for future phases.

To effectively undertake its role the CSSE should have a strong and successful ‘landed’ capability; be suitably experienced with extensive corporate capability in systems integration, complex program management and Australian submarine capabilities; and have the necessary experience in handling sensitive US technologies.

Consideration of the Future Submarine project is now at a critical point. The correct decisions made in a timely fashion can ensure not only value for money for the Commonwealth over the long term and the introduction into service of the most capable conventional submarine in the world optimised for operations in Australia's area of interest but the re-establishment of a complementary and modern naval submarine industry capability, focused on achieving international benchmarks for production, efficiency and the support of the Future Submarine through life.

6 CONCLUSION

Raytheon Australia has considerable confidence in the future of the Australian naval shipbuilding industry. By focussing squarely on the production and sustainment of submarines and naval surface combatants the defence industry will be presented with a wealth of opportunities that will not only contribute to Australia's national defence but enhance our industrial sovereignty.

It is in this context that Raytheon is grateful for the opportunity to contribute to the Committee's deliberations.

ATTACHMENT A

SEA 1000

A Hybrid Build Précis

I N T R O

International involvement in the Future Submarine project has the potential to renew one of Australia's most vital defence capabilities and sustain an industrial capability essential to our national sovereignty. Australia cannot undertake such an enormous venture on its own and there are many reasons why a long term collaborative arrangement with an international partner can achieve desired capability outcomes whilst minimising risk to the ADF and the taxpayer. However, for the most effective strategic outcome to be achieved and to de-risk the complex requirement to design, build and provide through-life sustainment for the Future Submarine, an equipment acquisition strategy needs to be determined immediately. This paper outlines the characteristics of an optimal acquisition strategy for SEA 1000. The decision to embark upon a collaborative approach and a hybrid build of the Future Submarine has the potential to develop and sustain critical Australian submarine capabilities and provide increased work for Australian industry for the long term.

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SEA 1000 – A HYBRID BUILD PRÉCIS

Date: November 2014

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1 INTRODUCTION

International involvement in the SEA 1000 Future Submarine project has the potential to renew one of Australia's most vital defence capabilities and sustain an industrial capability essential to our national sovereignty. Such involvement will build on existing in-country capabilities and leverage the approximately $1 billion already devoted to the COLLINS enterprise each year. SEA 1000 presents a rare opportunity for the Commonwealth to achieve value for money in acquisition and sustainment costs, while shaping and supporting Australia's critical submarine industry capabilities for the foreseeable future.

This paper is written on the premise that the Australian Government has yet to make a decision on the acquisition strategy for SEA 1000. In this respect, until the Government makes such a decision, all options remain on the table.

However, one of the important considerations that has been articulated by the Defence Minister, Senator David Johnston, is the need to avoid a capability gap once the COLLINS class submarines begin to be retired from service in the latter half of the next decade.

This has consequences for the type of acquisition strategy to be adopted but it also emphasises the need for the Government to take the necessary steps to ensure that timely decisions can be made to accelerate the procurement.

There is considerable public debate about investigating the potential for Japanese involvement in the development of Australia's Future Submarine beyond the consideration of German and French alternatives. These investigations are all logical activities because Australia has neither a submarine design capability nor the production engineering skills to design and build submarines on its own.

It is now 19 years since Australia commenced the build of the last of the COLLINS class submarines (HMAS RANKIN). As has been highlighted in recent third party studies into Australia's submarine design capabilities, if all Australian draftsmen and engineers with submarine design experience were available, they would constitute less than 52% of the peak demand requirements of a local submarine design and build. This fact alone suggests that Australia should seek a collaborative approach to Australia's Future Submarine, combining international capacity and capabilities that cannot be effectively and practically sourced from Australia, with our existing national submarine capabilities.

While it is clear that Australia cannot undertake the enormous venture of Future Submarine on its own, there are many reasons why a collaborative approach, encompassing Australia's sovereign capabilities in submarines and the sovereign capabilities of a partner nation with experience, capability and capacity in large conventional submarines, would be sensible, practical and feasible.

Such an approach would leverage the submarine design capabilities of an international partner; a US combat system and weapons (based upon 'spiral development' of the COLLINS class combat system); Australian industry's extant naval integration capabilities; and the submarine sustainment capability resident in-country. It would also facilitate the inclusion of leading edge international and Australian technologies, build on Australia's sovereign submarine capabilities, and provide considerable work for Australian industry. Overall, it would result in the lowest cost/risk approach to the provision and sustainment of a new submarine capability for Australia.

It is proposed that the Government should move, as soon as practicable, to establish a long term collaborative partnership with an international partner on the design and build of the replacement to the COLLINS class. Such a move would deliver this vital strategic capability and ensure maximum value for money is achieved for the Australian taxpayer over the life of the project.

2 PURPOSE

The purpose of this paper is to outline how a SEA 1000 Future Submarine program might be conducted through a long term collaborative partnership with an international partner; building on Australia's sovereign submarine capabilities and leveraging the partner's submarine design capabilities to provide the lowest cost/risk approach to the provision of a new submarine capability for Australia.

While the primary design alternatives for Australia's Future Submarine include French, German and Japanese options, the collaborative approach necessary to support such a project would be similar regardless of which partner was selected.

This paper focuses on what a collaborative approach might entail, using the Japanese option as a vehicle for the discussion. The proposed approach could be tailored and applied just as effectively to each of the other design alternatives.

3 THE REQUIREMENT

3.1 CAPABILITY

The operational requirements for SEA 1000 are currently being developed; they are expected to be endorsed by the Defence White Paper 2015. The foundation requirement for SEA 1000 is to introduce a regionally superior submarine capability matched to Australia's unique circumstances, which include our geographic location and the extended transit distances to potential areas of operations. Specific capabilities are expected to include:

- Interoperability with the United Stated Navy (USN).
- Anti-submarine warfare.
- Anti-surface warfare.
- Intelligence collection.
- Surveillance and reconnaissance.
- Electronic warfare.
- Mine warfare.
- Support to both Special Forces and advance force operations.
- Land Attack/Strike (conditional on Government endorsement of this capability and the acquisition of a suitable sub-surface launched strike weapon).

Project success will be determined by how well Australia develops an adaptive acquisition strategy for a selected submarine design, incorporating the combat system and weapons needed to deliver the required capabilities over the life of the submarines.

4 CONSIDERATIONS

4.1 TIMING

Government and Defence have stated the intention to avoid any capability gap between the retirement of the COLLINS class and introduction of the SEA 1000 capability. As the first of the COLLINS submarines (HMAS COLLINS) will achieve 30 years operational service in 2026, SEA 1000 will need to advance quickly to ensure capability maintenance.

The proposed schedule to retire the COLLINS class and deliver the SEA 1000 capability, displayed in Figure 1, shows a timeframe from the commencement of the preliminary design phase (Phase 1) to completion of the operational evaluation for the first SEA 1000 submarine of approximately 10 years. The achievement of such a schedule is predicated on the early selection of the preferred designer/builder and concurrent establishment of an Australian CORE Team (discussed further at Section 5.2) as an integral part of a joint Japanese/Australian industry team. As can be seen, the phase-in of SEA 1000 and the phase-out of COLLINS submarines in the late 2020s/early 2030s is predicated on maintaining a schedule which has the first SEA 1000 submarine completing its operational evaluation by year 10 after commencement of preliminary design.

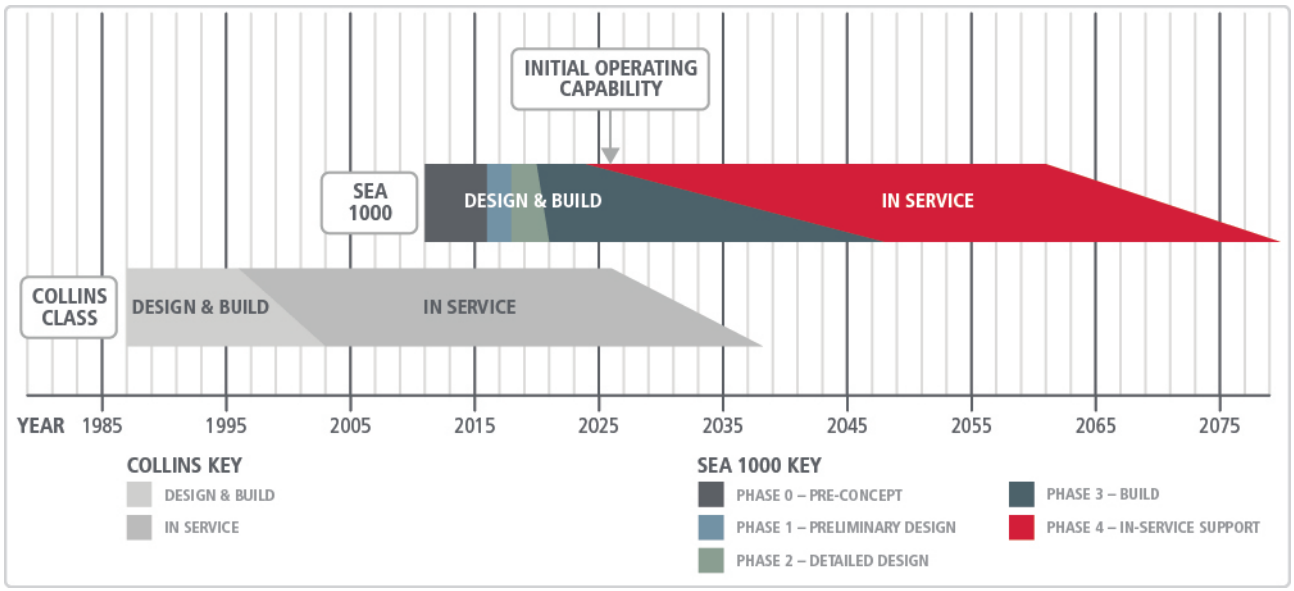

Figure 1 - Phasing of COLLINS and SEA 1000 Capabilities

4.2 US TECHNOLOGY

A major consideration for SEA 1000 is the pedigree of the combat system and weapons for the new submarines. Australia has established an extensive relationship with the USN in the areas of submarine operations and support, covering the combat system (AN/BYG-1) and weapon (Mk 48 ADCAP torpedo), as well as the provision of extensive submarine operations and intelligence support. The SEA 1000 submarine will be more capable than COLLINS and will potentially require additional capabilities, such as an Unmanned Underwater Vehicle (UUV) and a Land Attack Missile[1]. The weapons mix will be a key factor in the selection of the submarine combat system because most of the candidate US submarine weapons can only be integrated into a US-compatible system. The export, transfer, integration and sustainment of any US technologies will be subject to US Department of State International Traffic in Arms Regulations (ITAR) thereby restricting the technology recipient list to US Government approved foreign entities and contractors.

[1] To be confirmed by DWP 2015.

Further considerations for the respective SEA 1000 combat system and weapons selections include the requirement for Australia to retain full interoperability with the US and maintain the very close relationship it has developed with the USN. This includes providing the necessary security safeguards required for the highly classified intelligence and data provided by the US in support of submarine operations. The COLLINS program demonstrated that integrating US combat and weapons systems with third-country submarines designs – which have been built for another country's national systems and weapons – will be a highly complex and risk laden endeavour. Although the US is likely to release the combat system and weapons for incorporation into a foreign or indigenous design, it will require strict safeguards to protect the classified and sensitive information and equipment that is approved for release. Such safeguards are likely to include engagement of trusted companies to install, integrate and maintain the respective combat system and weapons throughout their life.

The likely suite of US technologies incorporated within SEA 1000 are not, in themselves, sufficient to meet the demanding capability requirements of the platform. In addition to the combat system and US weapons inventory, many other local and international technologies will be required. Aside from major communications systems, periscope technologies, sonar and safety systems, Australian and international industry will need to provide a comprehensive suite of technologies and tools for both the build and sustainment phases of the program through to life of type. The mission system architecture of SEA 1000 needs to take into account these disparate system origins to maximise their effectiveness, minimise obsolescence and ensure the system is designed for support within the submarine enterprise framework.

4.3 SUPPORTING AND SUSTAINING THE CAPABILITY

Given that SEA 1000 will deliver submarines with a service life of at least 30 years, the selection of the hull design, combat system and weapons will be critical. Implicit in the SEA 1000 selection is the requirement for the submarines to be capable of regular upgrades and modifications, in order to retain operational and technological superiority in a rapidly changing warfare and threat environment. To achieve this, Australia will require full access and control of the SEA 1000 Intellectual Property (IP). The configuration management organisation (across the full architecture of the submarines) must therefore be established as soon as possible.

The combat system and weapons will also need to be fully supported throughout the life of the submarine; a requirement that limits the range of possible candidates systems available as few countries other than the United States have the requirement, industrial base or resources to support and sustain respective systems throughout the life of the submarines.

4.4 POLITICAL

The Coalition's Defence policy released prior to the 2013 election outlines the Government's stated position on providing for an effective submarine force. In relation to any substantial acquisition decision in this area, the policy states that "*we will make the decisions necessary to ensure that Australia has no submarine capability gap within 18 months of the election*." Contrary to suggestions that the Government committed itself to a complete Australian build of the future submarine, the policy is silent on the matter other than to state "*we will ensure that work on the replacement of the current submarine fleet will centre around the South Australian shipyards*."

This is a position that has been consistently maintained since the election. On numerous occasions in recent months, the Prime Minister has outlined the considerations that will influence the Government's decisions in this area. For example, in an address to the South Australian Liberal Party on 23 August 2014, Prime Minister Abbott said:

"*Defence acquisitions have to be made on the basis of defence logic; not industry policy, not regional policy, but on the basis of sound defence policy. I have to stress, we have not yet made a final decision on the design and build of the next generation of Australian submarines. But there will be more of them. The bulk of the Australian work will be done here in Adelaide and that means more jobs for South Australia."*

The Government's position provides it with considerable flexibility regarding SEA 1000 design and construction arrangements. The notion of 'sound defence policy' is also sufficiently broad to allow the Government to take account of wider security interests in making such decisions. For example, it is open for the Government to consider its defence co-operation arrangements with its allies. The opportunity for Australia to strengthen its defence relationship with Japan, particularly in light of Japan's relaxation of its long-held restriction on defence exports, offers potential benefits in terms of defence industrial co-operation between the two countries. In a practical sense, of course, this is unlikely to occur without the concurrence and encouragement of the United States.

An example of the American attitude was reported in the Australian Financial Review of 3 October 2014, when former US assistant secretary for East Asia and the Pacific, Christopher Hill, said that an Australian choice of a Japanese Soryu class submarine would be part of a "natural deepening of the security relationship" with Japan.

The Australian Government's preparedness to allow defence procurement practice to be influenced by foreign policy rather than industry policy considerations is a significant development.

It is difficult to justify a solely Australian build of the future submarine as a matter of industry policy. We must remember that the last submarine (HMAS RANKIN) was delivered to the RAN over ten years ago. Re-establishing submarine construction in Australia would therefore be an expensive and high risk activity because there is minimal submarine design and construction capability remaining in Australia.

Irrespective of what build option is adopted for SEA 1000, it seems certain that Australian industry will be required to support the future submarines throughout their operational lives; a period in excess of forty years from the acceptance of the first boat to the ultimate disposal of the last boat. This will be a significant source of jobs for Australian industry.

Applying the political methodology articulated by the Abbott Government to this procurement suggests that a co-operative agreement with Japan to utilise Soryu based technology to develop Australia's future submarine could meet threshold foreign and defence policy considerations. A subsequent hybrid build would serve to protect important US sourced IP and ensure that the Adelaide shipyards could be used for Australian based work in consolidation, integration and subsequent sustainment. Such an outcome would be consistent with the Government's undertakings in this area.

In support of this, the Government recently confirmed that the systems integration role on the future submarine will be undertaken in Australia. In an interview on ABC Radio National on 15 October 2014, the Industry Minister, Ian Macfarlane, said "*wherever it is built it will have to have the final electronics fitted in Australia. There is absolutely no option on that*."

4.5 INDUSTRY

Irrespective of the build location or acquisition strategy ultimately selected, Australian industry will have a fundamental and critical role in delivering the SEA 1000 capability and sustaining it over the life of type. The options for local involvement in the hybrid build vary from a complete build in Australia, with hull sections fabricated and consolidated by Australian industry; to combat system installation post hull construction in Japan. Although both of these extremes are highly unlikely due to cost and risk, several options in the middle ground provide for varying levels of involvement by Australian industry, with commensurate levels of investment by local, State and Federal governments. A 'balanced build' is one where Australian industry benefits from technology and capability transfer of industry best practice, and where the resultant risk profile is acceptable to the Commonwealth. The balance of risk versus local content should drive the ratio of Australian to overseas content, and ultimately determine the acquisition strategy.

While constructing hull sections overseas for consolidation in Australia might be an appropriate approach to deliver the capability, the submarines are unlikely to be sustained from overseas because of practical difficulties arising from long transit distances; the need to guarantee certainty of supply and commercial arrangements; and for national security reasons. It therefore seems clear that a modern, capable and efficient sovereign industry sustainment capability will be essential for SEA 1000 throughout the program (40 years+), irrespective of the acquisition and/or build strategy.

Such a capability cannot be established quickly. Submarine construction, systems and support through life are unique and not easily transferrable from surface platform sustainment programs. As a result, the skills and experience required for proficient submarine sustainment can require significant investment and many years to establish.

Fortunately, Australia already has a proficient and substantial submarine sustainment industry base, developed through the COLLINS program, which can grow and progressively adapt to deliver the sovereign capability required for the upkeep and upgrade of the SEA 1000 boats through life, as well as for the COLLINS boats while they remain in service. This commonality of sustainment effort will deliver efficiencies and facilitate a successful transition of submarine sustainment expertise from the COLLINS class to the Future Submarine. To effectively achieve this Australian industry will require an enduring knowledge of the design, including: safety; seaworthiness; signatures; information security; mechanical and electrical systems (including power and propulsion); naval architecture; fluid mechanics; ship control systems; and mission systems.

Work for Australian industry could include consolidation of the SEA 1000 hull and fit-out, production of the cabling and piping, platform system equipment and integration and platform system test and evaluation. Similarly, for the SEA 1000 combat system and weapons, Australian industry could supply the sensors, the cabinet and console hardware and cabling, conduct the install and integration of the combat system, weapons and components and undertake the respective test and evaluation.

Contrary to the current expectations in the community, it is clear that all possible acquisition strategies available to the Government will provide Australian industry with considerable work in systems integration, hull consolidation and long term sustainment. This will also necessitate a substantial Australian supply chain.

5 THE APPROACH

5.1 OVERVIEW

Given the unique nature of the Australian requirement, it seems highly unlikely the solution for SEA 1000 would be either an 'off the shelf' purchase from an offshore supplier or an onshore design and build activity. Any existing designs would need to be customised with a US combat system and weapons, and an appropriate indigenous design would obviously have significant cost, risk and time implications. As Dr Andrew Davis and Dr Mark Thomson pointed out when referring to a previous ASPI conference "*…pursuing an entirely new design will be risky. Conference presenters drove home the message that Australia currently lacks two key prerequisites for success: ongoing collective experience and a highly-trained design, engineering and submarine-specific building workforce*."[2]

Instead, the optimum acquisition strategy for SEA 1000 is likely to fall somewhere between these two approaches as part of a 'hybrid' design and build process. This position is again reinforced by commentary from the Australian Strategic Policy Institute in September 2014 where Dr Andrew Davies stated "*I think what we're likely to see is a submarine where the hulls and many of the propulsion systems are built in Japan, then it comes to Australia for the final assembly and inclusion of things like the weapons systems and combat systems*"[3].

In order to understand how to build a hybrid Japanese/Australian submarine, several key factors about approach, capability and risk need to be considered.

5.2 CORE TEAM

A central initiative of the approach proposed in this paper is the establishment of a 'product agnostic' Australian CORE Team to inject the necessary key disciplines of engineering management and complex project management. Participants would be the Commonwealth, an Australian Combat System Systems Engineer (CSSE), and the Australian platform sustainment partner (to inform 'design for support' activities). Such a CORE Team would be inherently responsive throughout the acquisition to reduce program execution risk and assist the smooth progress of the design and build activities.

The CORE Team would be established as early as possible in the acquisition cycle to advance initial program planning, including initial design; Japanese engagement strategies; mandated equipment selection; Australian regulatory compliance; an initial trade study "way forward" and organisation; as well as ITAR/Export controlled information procedures. As discussed further below, it is envisaged that elements of the CORE Team would be established in both Japan and Australia.

The proposed CORE Team has a markedly different role to the SEA 1000 IPT (established in 2012), which has the key role of working "above the line" as the Commonwealth agent responsible for the products of Pre-Concept (Phase 0). On completion of Phase 0, it is envisaged that the IPT would merge with the SEA 1000 Program Office/SPO and continue to use its experience and capabilities to drive the outcomes sought by the Commonwealth, while supporting the Program Office/SPO to address DMO internal business processes, assurances and the business cases for First, Intermediate and Second Passes.

[2] "How to buy a submarine – part 2' dated 25 Jun 2014.

[3] Submarine policy: Industry calls for clarity amid reports fleet will be bought from Japan, not built in SA. ABC AM Political reporter Louise Yaxley, Tue 9 Sep 2014, 7:55am.

5.2.1 JAPAN

In order to enable the discussion of a build strategy it is assumed the decision is taken to pursue a joint development of the Japanese Soryu design. Thereafter an element of the Australian CORE Team would need to be collocated and integrated with the Japanese design team in Japan. The element's role would be to provide the management interface for the preferred Australian elements of the design of the submarine and Australian support system, which might include weapons handling and discharge, sonar systems, combat management system, electronic warfare systems, communications, intelligence and information systems.

This Japan-based element would effectively become the guardian of the Australian requirement and design intent and would provide the necessary technical data, including agreed FMS data, and 'on the spot' interpretation of prevailing Australian regulatory constraints at each stage of the design process.

Additionally, the element of the CORE Team would need to include representatives of Australian industry who could ensure the submarine is designed for efficient Australian production (to the extent that such consolidation occurs locally) in accordance with the agreed build strategy, as well as logisticians to ensure the support system is coherently designed for efficient in-country support. A complementary Japanese team would need to be established in Australia, with similar roles to the Australian team in Japan, in order to provide the vital interface between Japan and Australia.

The teams in both Australia and Japan would share a single collaborative networked environment, appropriately compartmentalised to comply with national export and import security requirements. The constitution of the team and the balance of the locations would be likely to change over time to reflect the particular stages of maturity in the design and build process.

5.2.2 AUSTRALIA

The inclusion of mandated systems and sensors into the design suggests that the early appointment of a CORE Team is essential to insulate SEA 1000 from risks that would otherwise be apparent with post design inclusion of warfighting systems. The establishment of the Australian CORE Team would be a suitable way to provide a single point of truth for foundation data, ensure sovereign capability of key systems, and provide the necessary partition between Australian ITAR/export controlled data and the Japanese designer/builder. To this end, it is appropriate for CORE Team participants to be drawn from the Commonwealth, a CSSE, and the platform sustainment partner (to inform 'design for support' activities). Selection should be based on an assessment of established in country capability and capacity to support SEA 1000, as well as relevant current experience and performance.

As the CSSE would be a key participant in the CORE Team, ensuring that the CSSE possesses the right capabilities will be fundamental to its success. Such capabilities include significant systems engineering and architecture capability; the ability to perform a 'safe hands' role (i.e. experience, capability, and pedigree in managing ITAR and classified data, etc.); the ability to demonstrate an Australian "landed" presence; COLLINS combat system capability/experience (to minimise ramp up times and costs, etc.); and the capacity/capability and commercial qualities consistent with a long-term partner.

CSSE tasks during preliminary phases would include:

- The conduct of trade studies on mission system equipment and Australian unique requirements (combat system, communications suite, etc.).
- Overall mission system architectural design, including integration with wider ADF systems, networks and collaboration.
- Collaboration with the Japanese designer to ensure systems, electrical requirements and platform impacts are suitably addressed in the design (i.e. accommodation of Australian unique requirements). This would also entail sanitising, declassifying or removing ITAR content from platform design input data and managing sensitive OEM and US design discussions.
- "Australianisation" of operational and environmentally specific requirements.
- Addressing systems engineering and architecture considerations to ensure systems can be adequately sold-off.
- Consideration of the total cost of ownership, life of type management and sustainment planning.
- Costing and planning for future phases.

To effectively undertake its role as a critical member of the CORE Team, the CSSE should be a single commercial entity which:

- Has a strong and successful "landed" capability with a broad base from which to draw capability as required.
- Is suitably experienced with extensive corporate capability in systems integration, complex program management and Australian submarine capabilities.
- Has a proven track record in the effective delivery of performance based support solutions.
- Is provided with long-term program incentives.
- Has the experience and proven capability to manage US technologies, data and information throughout.

The other key member of the CORE team would be the platform sustainment partner. Effective and efficient sustainment of the SEA 1000 submarines throughout their lives will be a fundamental determinant of overall operational performance. As the through life cost of a complex naval platform is approximately three to five times that of the acquisition cost, establishing and implementing the optimum support solution will be a critical undertaking. During the design phase, trade-offs are continually made to achieve a balanced design, and the input of the sustainment partner will be fundamental to ensuring that through life cost benefits are realised. An important observation is that approximately 60% to 70% of the through life costs are "baked" into the design by the completion of the design phases, so correctly establishing the "design for support" strategy from program commencement is therefore critical. Specifically, the sustainment partner will bring a depth of knowledge and understanding to the design including:

- Maintenance/Availability Strategies.
- Training.
- Technical Publications.
- Support Facilities.
- Human Factors.
- Packaging, Handling, Storage & Transport.
- Australian Technical Compliance regulations and requirements.
- Australian Supply Chain capabilities and support.

To effectively undertake its role, the sustainment partner should be a single commercial entity which:

- Has a strong corporate capability with the experience and proven capability to effectively and efficiently sustain submarines in Australia through life.
- Has extensive knowledge of Australian industry, manufacturers and the related submarine supply chain.
- Has a strong and successful “landed” capability with a broad base from which to draw capability as required.
- Is provided with long-term program incentives.
- Is well versed in “design for support” of submarines.
- Has a proven track record in the effective delivery of performance based support solutions.

5.3 LEVERAGE COLLINS

The least risk transition to a dominant SEA 1000 capability will be realised if the investment already made in the COLLINS class submarine is drawn upon to its greatest possible advantage. The existing investment is a quantifiable sovereign capability which could act as a capability bridge to reduce the risk inherent in building, assembling and/or supporting the new submarine, regardless of the design and build option selected. It is only in the utilisation of the COLLINS enterprise that the path to SEA 1000 represents acceptable risk to the Commonwealth.

SEA 1000 will produce an enduring and regionally dominant future submarine capability that is interoperable with the USN and which capitalises on Australia’s existing submarine enterprise. Having the USN as the parent Navy for the combat and weapons system core entrenches life-long capital and capability investment in the respective systems, while ensuring preparedness of the COLLINS technologies for seamless transition to SEA 1000.

The US combat and weapons system core, which is regularly updated to counter a potential adversary’s advances in warfare systems and weapons, will be a critical element in achieving interoperability with the USN and regional superiority over the life of a submarine. The COLLINS Class has achieved this by establishing and maintaining a strong relationship with the USN for operations and support, including the combat system (AN/BYG-1) and weapon (Mk 48 ADCAP torpedo), as well the provision of extensive submarine operations and intelligence support.

An Armament Cooperative Program (ACP) for submarine combat system development, which included the Replacement Combat System and its design, installation and ongoing upgrade under a Technology Insertion Program (TIP), was established with the USN in 2007. Similarly, Australia has combined with the USN in a joint development program for the MK48 ADCAP Mod 7 (CBASS) torpedo, which is the primary weapon for the COLLINS Class.

The ongoing technical insertion program ensures the updated ANBYG-1 can be ported across to the SEA 1000 program, delivering significant program efficiencies and savings in training and logistic support, while enabling crew flexibility between the two classes of submarines.

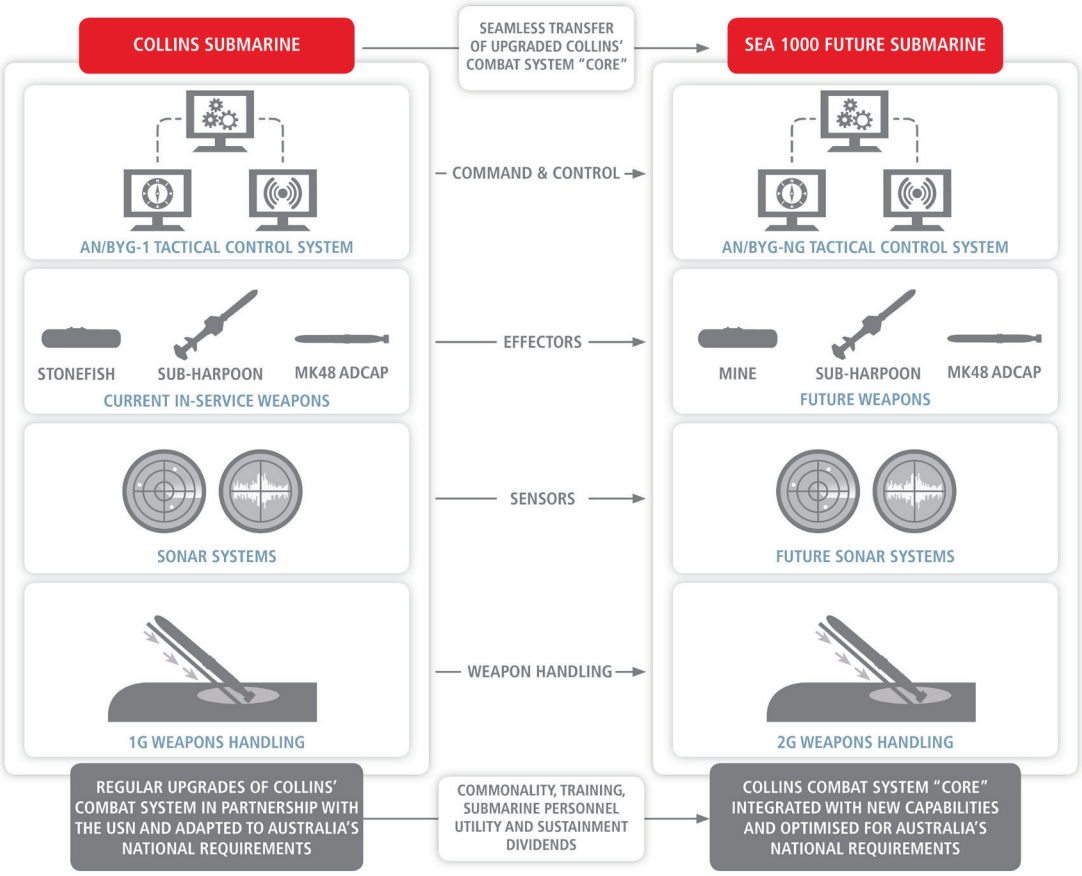

Figure 2 - COLLINS Technology Crossover

Other technologies, including communications and sonars, are upgraded as required under specific projects, and the combat system architecture is amended to reflect these upgrades. Figure 2 shows the potential opportunity to seamlessly transfer the unique and regularly updated COLLINS combat system technologies to SEA 1000.

SEA 1000 will deliver new submarines into service as COLLINS submarines are progressively retired. Consequently, there will be several years where Australia will operate and support two different submarine classes, with three concurrent and critical submarine activities undertaken simultaneously, namely: building SEA 1000 submarines; supporting operational SEA 1000 submarines; and supporting operational COLLINS submarines.

COLLINS submarines will be progressively retired as the new SEA 1000 boats are commissioned into service, and respective crew numbers are expected to be similar between classes. Because SEA 1000 and COLLINS will have a common combat system and weapons "core", the conversion training burden will be significantly reduced. This will provide a high degree of personnel posting flexibility. The automation of systems since the COLLINS boats were commissioned will probably reduce the personnel numbers slightly but, due to operational tempo crew considerations driven by the new mission profiles and capabilities of the upgraded SEA 1000 platform, the crew requirements are likely to stay relatively consistent between classes.

While the number of RAN submariners will need to increase to operate an increased number of platforms, the RAN has sufficient time to recruit and train to ensure the SEA 1000 crews are in the training pipeline and fully qualified prior to the requirement.

The two submarine enterprises will also need to undertake the three activities concurrently. While the COLLINS class sustainment enterprise exists today, it will need to be re-designed and carefully prepared to ensure a smooth transition to SEA 1000, while maintaining the existing in-service boats. Failure to manage this activity effectively will exacerbate the peaks and troughs evident in other programs, such as LHD or AWD, where the individual capability is rapidly built then diminished, rather than progressively invested in and maintained at an optimum level. To achieve the appropriate outcome, the SEA 1000 enterprise will need to realise the sovereign investment in local capability already made in COLLINS.

Although it is intended that each enterprise will consist of dedicated teams responsible to the respective Systems Program Offices (SPO), the investment in COLLINS must be allowed to transition to SEA 1000 as the capability balance shifts from COLLINS to the new submarine. While the functions of force development and capability management remain the remit of the RAN and CDG respectively, several subordinate functions, such as the SPO and CORE team/combat systems partners, will need to be established as a shared resource for both classes. This is the fundamental reason for establishing the CORE team and thereby extending the submarine combat systems and maintenance expertise across both enterprises. The same is true for the platform sustainment partner and the supply chain elements of both enterprises, where resources shared across both classes represent the greatest potential efficiency gain for the Commonwealth.

5.4 BUILD

Proposed phases for a hybrid build are discussed in Section 6. Given that major naval acquisition and sustainment programs have proven to be complex undertakings of extended duration, with the potential for significant cost and schedule overruns, it is worth reflecting on key lessons learned from previous comparable naval acquisition programs, which might guide the development of the SEA 1000 acquisition strategy:

- A tight coupling between the selected designer and builder should be maintained. Effective management of the relationship between the designer and the builder for a hybrid-build will require contractual tentacles to extend to both the Australian and Japanese builder, while a collegiate approach to issues management such as technical data packages and design alterations should be adopted.
- Sovereign control of IP is critical to program success for both build and sustainment of the capability. While collaboration between Australia and Japan is vital to success on the program, so is the need to protect Australia's ability to own and operate the submarine through life of type.
- There is considerable value in confirming combat system and primary weapons selection early and in conducting trade studies for the remaining systems/capabilities to lay the foundation for the conceptual and detailed designs.
- There is a need to impose strict design discipline during production and to avoid unnecessary changes which would otherwise impact upon cost and schedule.
- It is important to 'design for support' to optimise the design for sustainment over the life of the capability.
- There is merit in building in batches, or flights, to address obsolescence during extended production programs. This would allow for incorporation of design and compliance changes throughout the build phase, without the expense of schedule impact of baseline redesign.
- As two platform classes will be in service together, there is a need to optimise commonality, where feasible to reduce support costs, including the training burden, and increase personnel utility between classes.

- ITAR restricted and classified equipment and information require a multi-level security regime to be established and managed throughout the life of the program.
- It is important to assign an in-country CSSE to manage the combat system design and integration role (including integration into the wider ADF), as well as the final verification activities and to support the introduction into service of the capability. This is likely to facilitate a local industrial capability for the longer-term through life support activities.
  The additional benefit of an in-country CSSE is that it significantly reduces the risk in managing the ITAR and sensitive data.

6 PROGRAM PHASES

6.1 OVERVIEW

While there are many alternatives and options to be considered, it is imperative that Australia adopt a low-risk phased approach for a Japanese/Australian hybrid design and build. The proposed phases recognise the importance of incorporating Australian, US and Japanese technologies into the SEA 1000 design, while optimising sovereign capability. For the purposes of this paper, the program has been structured into five phases, with appropriate off-ramps identified to ensure a low risk, value for money outcome for the taxpayer.

The proposed phased approach has been drawn from best-practice examples of complex military build programs over the past 20 years requiring international collaboration across many design and technical challenges. Designed as a foundation skeletal framework, the phases can be adjusted to meet the specific demands of the program and respective government interests. Figure 3 and the following paragraphs outline the proposed phases.

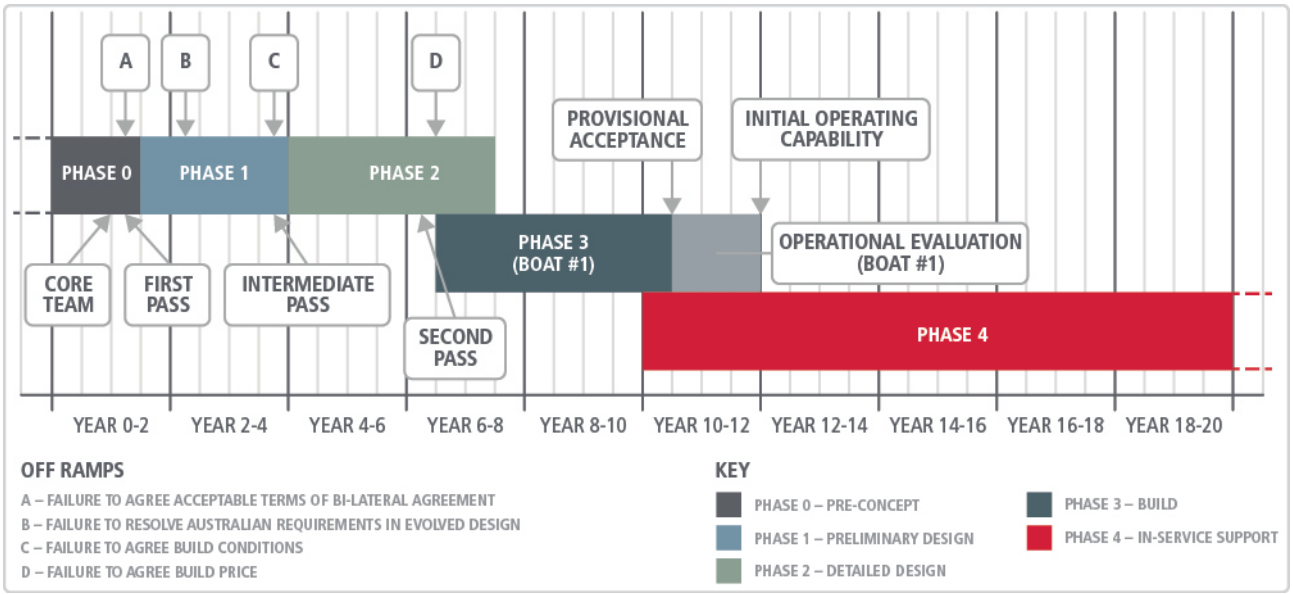

Figure 3 - SEA 1000 Phases and Project Decision "Off Ramps"

6.2 PHASE 0 (PRE-CONCEPT)

Location: Australia.

This is the current phase of SEA 1000 which seeks to understand the Australian Future Submarine trade space and develop the artefacts and inputs required for subsequent phases, including the top level requirements (TLR), operational concept document (OCD), functional performance specifications (FPS), identified critical technologies and preferred systems (e.g. evolved from the COLLINS class). An additional activity is the development of the hybrid build strategy to assist the Government to expeditiously move SEA 1000 forward.

Critical initiatives during this phase include:

- The establishment of the bi-lateral agreement between Australia and Japan to collaboratively co-develop Australia's Future Submarine[4]. The agreement would need to:
  - Address technology transfer; intellectual property rights for acquisition and support; work share; cost/risk sharing; Australian/Japanese content; design; production; security of supply (for sustainment of Japanese technologies); in-service sustainment; training; access to information, including sensitive and classified design technologies; and the details of the proposed build strategy.
  - Consider exit provisions and off-ramps for the relationship, such as failure to agree on the joint requirement (assuming co-development); failure to achieve a satisfactory preliminary design (2nd Pass); failure to agree on cost of design; failure to agree on cost of production; failure to agree full access to all required intellectual property for the life of the submarines; and/or poor performance remedies.
  - Address the maintenance of competitive pricing as a core tenet, given that the establishment of the bi-lateral agreement in effect eliminates competition and any benefits of competitive tension.
- Establishment of the Australian CORE Team for the reasons outlined in para 5.2 (CORE Team) above.
- Establishment of the required bi-lateral technical assistance arrangements and agreements with the United States for the information, systems and assistance required for SEA 1000.
- Successful completion of First Pass.

6.3 PHASE 1 (PRELIMINARY DESIGN)

Location: Australia

This is the Preliminary Design phase, which will take the program from First Pass through to Intermediate Pass and will address:

- The finalisation of the build strategy, which will be determined by evaluation of a number of factors, including economic analysis, relative risk, respective industry experience, efficiency, productivity and the management of obsolescence through build. A critical consideration for the build strategy will be how to achieve compliance with mandated security and protection requirements for selected systems and foreign technologies. In outline, the build strategy is expected to confirm the manufacture of pre-fabricated submarine sections in Japan for subsequent consolidation in Australia. The installation of the combat system by the CSSE would also occur in Australia.
- The preliminary design, which, for the hybrid build, will be the co-development of the submarine requirements as mapped to the OCD and FPS with the Japanese designer and other equipment/systems suppliers. The outputs of this phase are the Intermediate Pass paperwork for Government consideration and the agreed fundamental design basis for the detailed design.

[4] Minister for Defence and Minister for Foreign Affairs – Joint Press Conference – 2+2 Foreign and Defence Ministers, 11 June 2014.

6.4 PHASE 2 (DETAILED DESIGN)

Location: Japan and Australia.

Upon achievement of Intermediate Pass, the design will be detailed with final installation data provided by equipment manufacturers, as modified to comply with mandated engineering and regulatory standards to define a complete physical representation of the submarine for production.

During this phase the Australian CORE Team and the Japanese designer will work together to iterate the design (making trade study decisions on technologies and products with reference to the base design). This phase may be conducted with the bulk of the submarine design team in Japan and the majority of the CSSE team in Adelaide, with substantial cross pollination and skills transfer between respective parties.

When the design phase is all but complete, the project will proceed to Second Pass and the Australian “builder/consolidator” will be selected (approximately six months out from commencement of the build phase).

6.5 PHASE 3 (BUILD)

Location: Japan and Australia.

This phase initiates the construction of the submarine to the selected design and build strategy and is followed by approximately two years of testing, trials and operational evaluation.

Although there are many variables and options which will need to be considered for this critical phase, the following elements provide the basis to meet the political and economic imperatives of the program:

- Construction of submarine sections in Japan (with a level of pre-outfitting completed as part of this construction) by the Japanese builder.
- Shipping of the pre-fabricated sections to Australia for final ‘fit-out’ prior to consolidation.
- Integration of the combat system into the hull sections by the CSSE and Australian builder/consolidator.
- Consolidation of the hull sections by the Australian builder under the supervision of the Japanese builder. This approach ensures that the risk/ownership of the boat performance rests with the Japanese, while the necessary skills are transferred to Australia for subsequent consolidation and support activities.
- Test and Trials conducted in Australia by a combination of the Japanese designer/builder, CSSE and DMO to achieve Provisional Acceptance (PA).
- Passing of the submarine to the RAN for commissioning and operational evaluation.

This approach delivers sufficient Australian content for the sustainment of high-end skills necessary for the support of the submarines in Australia. DMO risk is minimised, with the design/build responsibility remaining with the Japanese design/build partner and mission systems responsibility remaining with the CSSE. This approach also ensures adequate technology control and compliance with ITAR and security requirements for classified and sensitive technologies and equipment.

6.6 PHASE 4 (IN-SERVICE SUPPORT)

Location: Australia.

This phase provides for timely and effective logistic support to the Future Submarine from Provisional Acceptance (PA), concluding with the disposal of the submarines in the second half of the 21st century. The ISS phase, which would be closely coupled with the continuing support for COLLINS, would rely heavily on the existing enterprise to support both classes of submarine simultaneously.

7 AUSTRALIAN INDUSTRY OPPORTUNITIES

To provide some perspective to this discussion, it is worth noting that when the Defence and industry components of the COLLINS class submarine enterprise are combined, the program spend exceeds $1 billion a year, which will continue for many years into the future. Additionally, while adopting a hybrid build strategy might attract unwarranted criticism for not maximising the number of blue collar production jobs in Australia, such comments neglect to account for the substantial numbers of jobs created to carry out the consolidation and integration of the SEA 1000 submarines in Australia. Moreover, such criticisms ignore the significant workforce required to sustain both COLLINS and SEA 1000 submarines through life, estimated to be approximately three to five times the cost of the initial build.

If the Government's preference is to adopt a hybrid design and build strategy, supported by appropriate Defence advice, then this would lead to a significant undertaking by industry, involving a great many Australian jobs.

Significantly, in addition to providing many shipbuilding jobs, this approach would create hundreds of jobs in combat system design, development and integration roles; skills that are required to be retained for the industrial self-reliance necessary for Australia's national security. Facilitating such an arrangement would satisfy the condition set by the Prime Minister that a decision be based on securing "*the best and most capable submarines at a reasonable price to the Australian taxpayer…. Not on the basis of industry policy*"[5].

It is important to commence the collaboration with an international partner as soon as possible. It would then be advantageous to follow this decision with the early selection of the combat system, weapons and CSSE to de-risk the integration task. This threshold decision would allow the joint development of Australia's Future Submarine to begin in earnest, together with the extended period of design that will be required.

The number of individual system, sub-system and component level suppliers for SEA 1000 is likely to exceed 1000. A successful strategy to ensure supply chain effectiveness would see the designer and builder commence the adaption of the Australian supply chain early in the design and build process, so as to include the timely and smooth transition of any IP required for selected suppliers. This might well open up parallel opportunities for Australian Industry to be included in the designer/builder's global supply chain, which could increase export opportunities for Australian industry and reduce overall support costs through expanded production and economies of scale.

[5] Reported in the Advertiser 9 September 2014.

8 SUMMARY

The political, strategic and industrial opportunities that follow from a decision to pursue the SEA 1000 capability are significant with an enduring effect on the ADF and Australian industry. Conversely, there is little time available if a submarine capability gap is to be avoided in the late 2020's timeframe. Should the Government pursue a hybrid design and build acquisition strategy for the Future Submarine, and join in a co-development activity of the Soryu design with the Japanese, the potential benefits could include:

- The introduction into service of the most capable conventional submarine in the world, optimised for operations in Australia's area of interest.
- The re-establishment of a complementary and modern naval submarine industry capability, focused on achieving international benchmarks for production and efficiency and supporting the submarines through life.
- Achievement of maximum value for money for the Australia taxpayer by de-risking SEA 1000 design and production activities, while achieving significant work-share and investment in Australia.
- Ensuring full compliance with ITAR and security requirements for classified and sensitive information and technologies.
- Retention of sovereign capabilities (for both acquisition and sustainment) and the provision of appropriate safeguards for the United States with respect to technology transfer.
- Commonality of the combat system between COLLINS and Future Submarine (as both will be running an evolved COLLINS combat system and using US weapons), which will significantly assist operational readiness, sustainability, supportability and training.

The purpose of this paper was to outline how a SEA 1000 Future Submarine program might be conducted through a long term collaborative partnership with an international partner, and define the requisite steps to achieve the outcome while minimising risk to the ADF and taxpayer. In order to achieve the most effective strategic outcome and to de-risk the complex requirement to design, build, deliver and sustain the future submarine, the equipment acquisition strategy needs to be proposed, agreed and directed immediately.

It is stressed that the Australian Government has yet to make a decision on an acquisition strategy for SEA 1000 and until it does so, all options remain on the table. In this context, the decision to build a hybrid Japanese Australian submarine develops and sustains critical Australian Industry submarine capabilities while delivering increased work for Australian industry. When combined with Japan's proven submarine design capabilities and the integration of US weapons and combat system, the hybrid build provides the lowest cost/risk approach to the provision of a new SEA 1000 submarine capability for Australia.

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