SUBMISSION TO SENATE ECONOMIC REFERENCES COMMITTEE INQUIRY INTO *AUSTRALIA'S SOVEREIGN NAVAL SHIPBUILDING CAPACITY*

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by

THE ROYAL INSTITUTION OF NAVAL ARCHITECTS (AUSTRALIAN DIVISION) INC
[redacted]

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1. INTRODUCTION

1.1 WHO WE ARE

1.1.1 The Royal Institution of Naval Architects - Australia has its beginnings in the early 1950s when graduates of the naval architecture course at Sydney Technical College formed the Australian Association of Naval Architects. In early 1954 the Association became a Branch of The Royal Institution of Naval Architects (RINA) based in London, an established learned society relating to the engineering design, construction, operation and sustainment of ships as outlined in Section 1.3 of this submission. It subsequently became RINA's first Division on the Branch's 25th anniversary in 1979.

1.1.2 As the relevant learned society dealing with the science, engineering and technology of ship design, construction, operation and sustainment, the Division is concerned with the appropriate and cost-effective implementation of current engineering technologies to naval shipbuilding.

1.1.3 This submission is made in direct response to the Committee's email of 28 November 2019.

1.2 NAVAL ARCHITECTURE, NAVAL ARCHITECTS AND MARITIME ENGINEERS

1.2.1 Wikipedia defines naval architecture in the following terms:

> ***Naval architecture**, or **naval engineering**, along with automotive engineering and aerospace engineering, is an engineering discipline branch of vehicle engineering, incorporating elements of mechanical, electrical, electronic, software and safety engineering as applied to the engineering design process, shipbuilding, maintenance, and operation of marine vessels and structures. Naval architecture involves basic and applied research, design, development, design evaluation (classification) and calculations during all stages of the life of a marine vehicle. Preliminary design of the vessel, its detailed design, construction, trials, operation and maintenance, launching and dry-docking are the main activities involved. Ship design calculations are also required for ships being modified (by means of conversion, rebuilding, modernization, or repair). Naval architecture also involves formulation of safety regulations and damage-control rules and the approval and certification of ship designs to meet statutory and non-statutory requirements*.

1.2.2 Many other sources provide narrower definitions of naval architecture such as "the science of designing ships, submarines, floating docks, yachts, oil rigs for the offshore oil and gas industry and any craft for use on water."[1] This may be taken as outlining the primary competencies of a graduate naval architect, but in practice the work undertaken by professional naval architects extends to all aspects of the design, construction, maintenance and operation of marine vessels and structures as reflected in the above Wikipedia definition. Accordingly, naval architects involved in ship design and construction are responsible for the integration into the vessel of technologies from all areas of engineering including from hydrodynamics (seakeeping, stability, powering, structure, equipment, fitout, coatings, survey, certification, maintenance and

[1] Dear I C B & Kemp P, *Oxford Companion to Ships and the Sea*, Oxford University Press, Second edition 2005

so on) to ensure that the vessel performs to user requirements throughout its life. Given that we designed, built and operated ships and boats since time immemorial, it could be said that naval architects are the original multi-skilled systems engineers.

1.2.3 That being the case, naval architects are engaged internationally at all levels of the maritime industry, from preparation of design concepts, detailed designs and supervision of shipyard work through to research, including senior management of shipping and shipbuilding companies. Their work is not limited to the narrow definition mentioned in the preceding paragraph. Quite simply: it is Naval Architects that are responsible for all aspects of the design of ships.

1.2.4 From the outside, the terms "naval architect" and "naval architecture" may be misleading, for they involve the engineering of an ocean vehicle much more than its aesthetics. The term is historical as it is one of the oldest branches of Engineering covering a very broad range of sub-disciplines within the maritime industry. If the profession of naval architecture were to be invented today then it would probably be called something like: "Maritime Systems Engineer". This submission takes the terms "maritime engineer" and "maritime engineering" to be synonymous with "naval architect" and "naval architecture".

1.2.5 The engineering profession of naval architecture is closely related to the shipwright trade, such that naval architects have been referred to as "shipwrights with attitude". Accordingly, while some of the points made in this submission may be extended to the trade of shipwright which is itself an essential part of the shipbuilding industry, the views expressed in this submission cannot and should not be taken to represent that trade.

1.3 THE ROYAL INSTITUTION OF NAVAL ARCHITECTS

1.3.1 The Objects of RINA are as set out in the Charter of Incorporation 1910 - 'the improvement of ships and all that specially appertains to them, and the arrangement of periodical meetings for the purpose of discussing practical and scientific subjects bearing upon the design and construction of ships and their means of propulsion, and that relates thereto".

1.3.2 RINA's fundamental role is as the international learned society for the engineering of ships and marine structures of all kinds, setting and maintaining appropriate professional standards for its members. Notwithstanding its name, RINA covers engineers and para-engineers in all areas of maritime engineering and its membership is not restricted to those having qualifications in "naval architecture".

1.3.3 RINA is a Licensed and Nominated body of the UK Engineering Council. Accordingly, RINA members may become registered through the UKEC as Chartered Engineers, Incorporated Engineers or Engineering Technicians respectively in accordance with the provisions of the Washington, Dublin and Sydney Accords. Given this range of qualifications, naval architects may be employed at any level above tradesman. The membership and registration available from RINA is recognised by formal agreement with Engineers Australia (EA) to be mutually recognised as equivalent in membership and registration.

1.3.4 RINA has world-wide membership in excess of 10,000, the majority of whom are located outside the United Kingdom. Australia has about 7% of RINA members.

1.3.5 RINA is recognised by the International Maritime Organization as the non-governmental organisation representing naval architects world-wide.

1.4 THE AUSTRALIAN DIVISION OF RINA

1.4.1 Through the international connections outlined in section 1.1, the Division's members are kept informed on the latest national and international technical and commercial developments in the engineering of ships and marine structures by way of RINA journals, magazines and conferences. For example, in addition to members having access to RINA's international magazines and conferences, the past two months have seen the Division publish the latest issue of its quarterly journal *The Australian Naval Architect* and lead the organisation of the biennial International Maritime Conference at Pacific 2019 in Sydney.

1.4.2 The Australian Division is headed by its own Council, which supervises the operations of Sections which convene technical meetings in Queensland, New South Wales, ACT, Victoria, South Australia-Northern Territory and Western Australia. In this submission the term "RINA" generally refers to the Division, except in the case of membership and registration matters where the Institution's world-wide requirements are of course applicable.

1.4.3 Given the Institution's broad coverage of maritime engineering as outlined above, the Australian Division is the pre-eminent learned society for maritime engineers in Australia.

1.4.4 In view of the broad cross-section of maritime engineering and maritime engineers covered by RINA membership categories, additional to tertiary qualified maritime engineers many technical officers involved in the naval shipbuilding industry are RINA members, particularly in the naval shipbuilding centres of South and Western Australia.

1.4.5 As the learned society representing maritime engineers in Australia, from time to time the Division Council makes representations to the Parliament and national bodies in relation to technical professional standards and how they are applied nationally to ship acquisition and maritime safety matters. A recent example is our submission to PWC (as Skills Service Organisation supporting the Naval Shipbuilding College (NSC) Industry Reference Committee (IRC)) commenting on their "Naval Shipbuilding Strategic Workforce Discussion Paper" for Defence. Prior to that, the Division made a submission to the 2017 re-opened inquiry into the "Future of Australia's Naval Shipbuilding Industry" by the Senate Committee on Foreign Affairs, Defence and Trade. The current submission is another such representation on an area of expertise of the Division's membership.

2. ADDRESSING THE INQUIRY'S TERMS OF REFERENCE

The Senate has tasked the Committee to inquire and report on:
"Developing and delivering Australia's sovereign naval shipbuilding capability, with particular reference to (the subjects addressed in a. to j. below)".

2.a. Oversight and scrutiny of the national shipbuilding plan, to support a continuous build of vessels in Australia;

a.1. When considering 'oversight and scrutiny' of the Naval Shipbuilding Program (NSP), the following constraints of that program need to be considered:

- We note that sustainability is not included in the title of this inquiry, yet the cost of establishing the Program could easily be lost if the naval shipbuilding industry is not sustainable. The establishment costs of previous naval shipbuilding projects have largely been lost in this way through lack of longer-term planning. This submission is based on the assumption that the Program is intended to result in a sustainable as well as a "sovereign" industry;

- An efficient shipbuilding program will minimise total costs, which can result in maximising the rate of production of each vessel, as this reduces the annual cost of overheads (eg facility costs) and improve the utilisation of trades;

- Where the drumbeat of construction is constrained through competing priorities (ie the size of the fleet and rate of replacement) then this will alter certain efficiency metrics when compared to other overseas construction programs;

- The impact of batching philosophy which is justified and supported from a capability upgrade and technology insertion perspective needs to be balanced against the cost of non-recurring engineering (NRE) and the learning curve benefits derived from a continuous build of a single class with limited alterations. These aspects are highly dependent on the size of the batches and the level of change between them.

a.2. As a consequence of these points the metrics used to determine the effectiveness and efficiency of the national shipbuilding program will need to be derived and measured against the full range of objectives less they give a false indication when measured against the performance of overseas programs resulting in claims of waste of taxpayer funding. For example, the ANAO report into the Air Warfare Destroyer Program (No.22 2013–14) indicated that the root cause of the early delays to that program was largely the purchase and use of some design drawings that were subsequently amended by the designers, so the cost of any similar delays in later programs should not be held against the shipbuilder and contractors who are not responsible for the design.

2.b. Progress of the design, management and implementation of naval shipbuilding and submarine defence procurement projects in Australia;

b.1. No comment provided as the subject refers to procurement rather than the engineering of the projects, although we do have members with expertise in this

area which could be provided to the Committee upon request.

2.c. Progress of the Naval Shipbuilding College in building workforce capability, and developing the required skills and infrastructure to design, build, maintain, sustain and upgrade current and future naval fleet;

c.1. In keeping with its fundamental role as outlined in para 1.3.2, RINA Australian Division has an overview of professional education and standards and the appropriate application of the relevant skills to ships and marine structures, such as in naval shipbuilding. Accordingly, since its membership includes engineering personnel at all levels above trades level, the Division has strong interest in the provision of relevant training courses at certificate, diploma, degree and post-graduate level.

c.2. We would therefore expect to be able to assist the Naval Shipbuilding College (NSC) in ensuring that the required skills are provided through appropriate education and training courses.

c.3. However, we were not included in the NSC IRC and the Minister for Defence has advised us that she is "unable to review the membership of the IRC". Our investigations subsequent to the Minister's letter indicate that the IRC was established through the Department of Education and Training by the Australian Industry and Skills Committee (AISC). The AISC web-site states that the Committee was established by COAG to "give industry a formal role in approving vocational education and training (VET) training packages for implementation. Nonetheless, the terms of reference given to the IRC by AISC include "higher education" in addition to VET.

c.4. RINA has a particular interest in VET regarding training courses at those post-trades certificate, diploma and associate degree level courses that provide an educational basis for work as draftsmen and engineering technicians and recognition within the international engineering profession. Our examination of the relevant courses nationwide shows that there are is a distinct shortage of such courses within Australia; for example TAFESA has courses up to diploma level in a number of areas of engineering but none in shipbuilding-related areas. Not being privy to IRC discussions we are not aware of any proposed courses to cover-off this skill deficiency, but our websearch does not indicate any units available to develop appropriate maritime knowledge and skills at this level for personnel entering the naval shipbuilding industry. The Division strongly holds the view that the NSP would be better served if NSC were to promote the training of maritime engineering para-professionals who are fully familiar with preparation and interpretation of shipbuilding drawings.

c.5. From documents seen by RINA, NSC and the IRC appear to have so far concentrated on VET issues and ignored training beyond trades level.

c.6. We note that paragraph 4.50 of the NSP states:

> *The second phase of the Naval Shipbuilding College will commence around 2020–21, increasing the capacity and throughput of students in key higher education qualifications (such as naval architecture and*

engineering) through universities. It will also develop and provide bridging programs for qualified workers from allied industries (such as automotive manufacturing and resources).

c.7. Accordingly, neither "naval architect" or "maritime engineer" were included in the "jobs taxonomy" provided to us by the NSC or in the workforce list presented by the NSC Chief Executive at our recent Pacific 2019 International Maritime Conference. When questioned on this, the NSC Chief Executive indicated that naval architects were included within "designers" despite naval architects' skills being applicable to many of the specialisations included in the list and to all stages of ship design, building, maintenance and sustainment. We note that this answer was given despite a number of universities, such as the Australian Maritime College of the University of Tasmania (AMC) providing four-year degree courses in naval architecture and maritime engineering.

c.8. The Division has for several years been concerned that there are no courses in naval architecture / maritime engineering in Australia other than four-year degree courses at the AMC, post-graduate "conversion" courses by the AMC and the University of Adelaide and various TAFE certificate III and IV courses in subjects such as "marine craft construction" and "marine mechanical technology". For example, TAFESA offers "engineering" courses at certificate III, diploma and associate degree level but these do not include any units specific to the practices and terminology of maritime engineering; this is inadequate for a State to which a high proportion of the NSP has been allocated. The Division holds the view that the NSP would be better served if NSC were to promote the training of maritime engineering para-professionals who are fully familiar with preparation and interpretation of shipbuilding drawings.

c.9. RINA understands that the NSC is focussing first on the trades, and then may focus later on the professions and technical grades including maritime engineering.

c.10. We believe that the NSC should apply at least equal priority to the training of naval architects / maritime engineers and related para-professionals as to trades because:

1. It is necessary to complete design, and associated work before commencement of construction and maritime engineers and technical officers are required for this work; even where detailed construction drawings are purchased from a foreign designer, there will invariably be a need for amendments to reflect local sourcing of equipment and materials; and

2. Ignoring the time taken to establish training courses, training of a maritime engineer or technical officer takes longer than a trades person; a four-year full-time course supplemented by relevant experience compared with part-time training of an apprentice while simultaneously gaining on-the-job experience, while training of a technical officer is usually a blend of the two. - this lead time should be taken into account in the plans developed by NSC.

c.11. Over many years the graduates from the only maritime engineering courses in Australia have been fully employed by existing demand in the naval and commercial sectors, with little surplus to meet any new initiatives. RINA believes that a substantial number of additional maritime engineers and technical officers

will be required to meet the needs of the current $90bn NSP. These personnel should be trained in Australia either by adding to the capacity of existing courses or, preferably, by commencement of new courses that add to the diversity of background knowledge, experience and collective capabilities of personnel entering the naval shipbuilding industry.

c.12. In light of the above, the Division holds the view that the NSC is not making satisfactory progress in meeting this term of reference.

c.13. With respect to the term 'design' in this term of reference, there requires to be a clear understanding of the anticipated role of the Australian enterprise in the design of the future fleet. Design can be interpreted to mean many things from the initial concept design of a future vessel through to detailed design of components of systems to be fitted within the vessel. Only when it is clearly understood the extent of the anticipated design activity/involvement of the enterprise can the skill set and size of the associated workforce be determined. The Division understands that one of the long-term aims of the NSP is for the NSC to provide a full suite of skills to underpin the industry, from research through design into production. Given that research capability already exists at Defence Science and Technology Group (DSTG) within Defence, the AMC and various other universities, and that the Government took a decision several decades ago to excise a dedicated initial design capability from the Department of Defence, any upgrade of the existing private sector design capability is likely to be fragmented. The Committee should note that Australian shipbuilders including Austal Ships and Incat Tasmania have designed and constructed naval vessels for foreign countries. In light of this background, the Division would happily contribute to an understanding of the extent of the design activity and the skills of the professional workforce required to satisfy this aim of the Shipbuilding Program.

c.14. An indigenous design capability is an essential part of a sovereign naval shipbuilding capability, since the sustainability of the industry must at some stage be dependent on exports which must be tailored to meet the needs of the purchaser rather than just reproduce a product that meets Australia's requirements. Such a capability is also necessary to avoid the time lag and resulting premature obsolescence associated with the Navy using only "proven" foreign designs.

c.15. Should a decision be made to develop a national indigenous design capability, the issue of location of the design capability will need to be addressed, noting that the design outputs may be required to service shipyards in a number of locations and produce designs that can be processed into the different integrated ("Industry 4.0") IT systems used by those different shipyards. The IT infrastructure will most likely be the key enabling element. In order to expand access to the widest possible source of engineering/design talent from within Australia it should not be a pre-requisite that all individuals should relocate to a single central location. An investigation into best practice virtual design offices and the associated infrastructure and processes should be an early consideration in developing the design capability to avoid lack of workforce mobility becoming a defining factor in attracting the best staff.

c.16. On the other hand, a strategic approach that moves away from the central (virtual) design office concept would result in smaller design cells such as within, or associated with, individual shipbuilding companies or other potential prime contractors.

2.d. Ongoing examination of contracts and scrutiny of expenditure;

d.1. No comment provided as this is not an engineering issue, although we do have members with expertise in this area which could be provided to the Committee upon request.

2.e. The implementation of Australian Industry Capability Plans;

e.1. This term of reference would appear to be listed in relation to the availability of components and services from Australian providers. As such, it is a matter largely for individual prime contractors rather than an engineering learned society such as RINA.

e.2. While not specific to industry there needs to be enterprise related research and development plans that include work by DSTG, university and industry. The identification of aspects of the shipbuilding enterprise where technological advances or efficiencies are sought would be the starting point of the enterprise R&D roadmap which would require annual review to determine relevance/priority and progress by an independent panel of subject matter experts. The program would of course also require funding and fiscal oversight.

2.f. The utilisation of local content and supply chains;

f.1. The investment of indigenous industry in elements of the supply chain where no or limited capability currently exists will require the cost of establishing the capability to be recovered through a level of certainty in the continuity of future work; eg against a batch of 3 rather than 3 batches of 3. A key element to the success of the enterprise will be the ability of the Commonwealth as purchaser to provide this level of long term certainty in an efficient manner (ie industry not becoming lazy) and limiting any impact from a change of government.

f.2. From experience, an export capacity is key to success in this area. This must have commensurate commitment from industry and government

2.g. The transfer of intellectual property and skills to Australian firms and workers;

g.1. The transfer of intellectual property is an important aspect of shipbuilding with broad implications for ship sustainment. For example, RINA understands that Defence only purchased the design of the *Hobart* class ASW destroyers and so is left to its own devices in addressing any maintenance and sustainment issues that may arise.

g.2. Defence, as purchaser, needs to hold *design authority* status as holder of transferred intellectual property (IP) and to control deviations from the initially contracted design, whether originating from the designer, shipbuilder or within Defence. Experience gained through the life-cycle of a ship, from design through construction to sustainment, upgrading and eventual disposal needs to be systematically captured and added to the IP so that it is taken into account in

future naval shipbuilding projects.

g.3. Further to our comments on the previous term of reference, any export contracts may require the IP holder to transfer the relevant IP to the purchaser.

g.4. However, being a legal rather than engineering issue, RINA is not in a position to make further comment particularly with regard to the full term of reference.

2.h. The prospect of imminent job losses and redundancies;

h.1. The Division has, over the years, made a number of submissions to Senate Committees inquiring into naval shipbuilding, pointing to the inherent inefficiency of project cycles that end with accumulated human capital and know-how being discarded through job losses and redundancies. We trust that these submissions have been to some extent effective in the decision to adopt the NSP and that the implementation of the Program results in minimal "prospect of imminent job losses and redundancies".

h.2. That said, however, we are aware of a number of naval architects who have been prepared to shift interstate to participate in the NSP and thus not only avoid job losses and redundancies but also accumulate further valuable skills and experience as workforce demand shifts between companies and centres.

2.i. Opportunities and multiplier effects to local jobs and the economy; and

i.1. No comment provided.

2.j. Any related matters.

j.1. In commenting on term of reference c, this submission makes mention of "Industry 4.0" which we understand from various documents and presentations to be an intended feature of implementation of the Naval Shipbuilding Plan. We understand Industry 4.0 to involve integration of computer systems covering initial design, detailed design, parts definition and inventories, virtual reality modelling, production planning/control and building logistics through to computer records that facilitate efficient maintenance and sustainment in service. Many of the individual functions covered by such systems have been used for decades while others are new, so their integration could be very expensive, but their satisfactory integration promises longer-term substantial benefits in monetary and project schedule-keeping terms. RINA understands that Industry 4.0 has not yet been fully implemented by Navantia, as a leading force in naval shipbuilding, so we would be interested in the measures that have been, or are proposed to be, incorporated into current and future contracts to drive the implementation of Industry 4.0 to secure the efficient implementation of the Shipbuilding Plan.

j.2. RINA is also interested in whether the funding model adopted for the national shipbuilding enterprise will support the investigation/adoption of efficiency improvements through upgrade/acquisition of new production systems and facilities. A need exists to enable shipyards to remain cost competitive and efficient, thereby avoiding the continued use of outdated equipment and practices for the sake of short term savings as led to the demise of the large commercial shipbuilding industry in the 1960s and 70s. An appropriate funding model will be a driver of the need to consider innovative techniques, facilities and processes with

the cost of investment coming from the companies own funding and providing a legacy for future naval shipbuilding projects.

3. CONCLUSIONS AND CLOSING REMARKS

3.1 The Royal Institution of Naval Architects recognises the need to develop an indigenous naval shipbuilding capability, and strongly supports the proposed Naval Shipbuilding Program. The Institution, through its members in Australia together with its international resources, has the domain knowledge in this field, and we are enthusiastic to support the Government in its goal to achieve a sustainable NSP.

3.2 In particular, we would like to make the following points:

- Demand for maritime engineers is only just being met by current supply levels, the increase in naval ship production, operation and sustainment will be well beyond current supply levels of graduates. Increasing the number of maritime engineers in Australia should be one of the highest focuses for the NSC – the Institution is very happy to provide any appropriate assistance in this regard, noting that it is the responsibility of the NSC and its member bodies to meet the NSP's needs regarding provision of courses and student places.

- There is effectively no current supply line for para-professionals in maritime engineering, with the industry having to make-do with personnel from other areas – this should be rectified by the prompt establishment of appropriate training courses to meet the industry's needs.

- The NSC has not examined maritime engineering requirements in the industry, either at engineer or para-professional level; we see the low priority given to this through para 4.50 of the NSP as a glaring shortcoming in the NSC's establishment.

- Long term commitment to indigenous design capability, extending to exports, is essential to the success of the NSP.

- IP transfer is essential and must be assured in contract negotiation and contract conduct, and be available for transfer from one project to another.

- Integration of Industry 4.0 into shipyards is heavily reliant on the platform systems engineering that a maritime engineer performs, so implementation of Industry 4.0 will most likely involve different IT system components and branding between shipyards and projects.

- RINA Australian Division, through its membership, includes experience from every field of Australian naval ship construction, operation and sustainment over most of the past half-century. This wealth of knowledge can be made available to the Committee, Defence and related bodies.

- And finally a reminder, it is naval architects / maritime engineers that have the training and experience to plan for and understand the engineering, production and sustainment of ships - any development proposals that omit the appropriate promotion and development of naval architecture within the NSP will most likely fail in the long term.

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