

# RINA

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30 November 2014

The Chairman  
Senate Economics References Committee  
Parliament House  
Canberra ACT 2600

Dear Senator Dastyari

## **Inquiry into Naval Shipbuilding**

Further to our letter of 17 July 2014 in response to the Terms of Reference to Part I of the Inquiry, the Division is pleased to present its submission to Part II, namely “the future sustainability of Australia's strategically vital naval ship building industry”.

As explained in our July letter, The Royal Institution of Naval Architects (RINA) is an internationally renowned learned institution, based in the United Kingdom, whose members are predominantly professional engineers involved at all levels in the design, construction, maintenance and operation of marine vessels and structures. A high proportion of our Australian members are involved in the engineering, design, construction, equipment and operation of ships for the Royal Australian Navy, through their employment by shipbuilders and repairers, companies providing services and skills to the naval sector, government agencies and research bodies. We would emphasise that our role is as a specialised professional institution that operates in parallel with Engineers Australia and that we are not a trade union.

The Division's detailed submission is attached.

You will see that we have concentrated on aspects that lie within the professional expertise of our members, but the main points raised can be summarised as:

- Australia can and should develop a sustainable naval shipbuilding industry.
- Australia's naval shipbuilding industry must be sufficiently flexible to apply its manufacturing skills to deliver efficiently the diverse range of maritime capabilities needed by Defence.
- Like any other industrial manufacturing system, consistency of purpose is essential to improve the efficiency of the Australian naval shipbuilding industry.

- Consequently, the industry must be based upon a naval shipbuilding plan that provides for continuity of projects, and for skills to be developed and maintained so that they can be carried-over from one project to the next.
- Assessment of the performance of the existing Australian naval shipbuilding industry should take into account the stop-start nature of recent projects, compared with the continuity of projects and production of established overseas shipbuilders, together with the need for a similar workflow to be established for a sustainable naval shipbuilding industry.
- The Government should be aware the procurement of naval ships from overseas results in lost opportunities for young Australian professional engineers and naval architects to gain practical experience in design the types of ships used by the Navy and thus in the knowledge and skills to maintain those ships.
- Expectations of the cost and timely delivery of ships to be produced should take account of the completeness and complexity of the design at time of entering into the contract.
- Management of design modifications made during a production run should be managed by dividing the production run into batches of identical vessels.
- In the interests of improved safety and consistency, all future naval ships should be built to, and maintained in, class with an IACS member classification society.
- RINA Australian Division supports the enhancement of Defence's naval engineering capabilities in accordance with the recommendations of the Rizzo Review.
- Maritime Materiel Requirements should be improved to reflect experience gained through their implementation in naval shipbuilding projects.
- Appropriate arrangements should be put in place to secure competition for projects and contracts in a sustainable naval shipbuilding industry, but no recommendations are made in this submission as to how competition is to be achieved.

RINA Australian Division is confident that implementation of the measures suggested in this submission will substantially reduce risk to the Government in terms of naval shipbuilding projects' completion on-time and on-budget.

Should the Committee wish us to do so, we would be pleased to discuss these matters further in a hearing.

Please feel free to contact me in relation to this submission, using the details provided above.

Yours sincerely

R C Gehling

Secretary

## The Royal Institution of Naval Architects (Australian Division)

### DETAILED SUBMISSION ON THE FUTURE OF AUSTRALIA'S NAVAL SHIPBUILDING INDUSTRY

#### General

There are sound reasons of national security for Australia to maintain a sustainable naval shipbuilding industry.

While many of the systems and equipment incorporated into Australian naval ships may be imported, the means of incorporation of those systems and the overall characteristics and capabilities of the ships, and any related proprietary intellectual property can be kept secure.

Of course, national security is not the only reason for needing a sustainable naval shipbuilding industry. Other reasons include development of the knowledge and skills necessary to maintain naval ships in Australia, employment creation and economic stimulus to the regions involved.

Nonetheless, this submission is confined to the engineering and manufacturing issues involved in a sustainable shipbuilding industry, namely those issues within the professional expertise of RINA's members.

#### Shipbuilding Considerations

Australian naval shipbuilding projects, and those companies involved in them, have in recent years unfortunately been given a reputation for producing vessels late and over-budget, although not the case for the ANZAC-class frigates or the Armidale-class patrol boats.

As a learned society of professional engineers specialising in all aspects of ship design and construction, the Australian Division of the Royal Institution of Naval Architects (RINA) considers that it can assist the Committee in finding sustainability for Australia's vital naval shipbuilding industry. RINA's Australian members are engaged in all aspects of research, construction, building, survey and certification, maintenance and sustainment of naval ships, and management of ship acquisition projects, both within the government sector and in the private sector.

RINA's previous submission to this Inquiry addressed the terms of reference for Part I. To place this submission in perspective, it is useful to briefly examine the foreign shipbuilders proposed to be invited to respond to the limited tender referred to in Part I of this inquiry.

Daewoo Shipbuilding of South Korea is one of the world's largest shipbuilders, whose products are prominent not only on the world's sea-lanes but also in the offshore industry. From its commencement of shipbuilding in the 1970s, according to its web-site the company had produced 1438 ships for the world's fleet through to August 2013. Its main business is in series production of standard ship designs, although it is capable of applying its design and production systems to specialist vessels such as the floating oil production and offloading facility (FPSO) currently being constructed for the Inpex *Ichthys* oil and gas development off the Western Australian coast. The long production runs that are the backbone of Daewoo's shipbuilding work, and the fact that it is constantly developing new concepts for both new production runs and limited-run products, together with the construction and outfitting planning philosophy that ensures a relentless

throughput of production, guarantee that it is always operating at high efficiency. While the vast majority of this work is on commercial vessels, the design and production systems are readily applied to naval vessels. However, their design and production systems are intolerant to changes to standards and specifications once a project has commenced, and furthermore are intolerant to fitting of equipment and systems which may be specific to Australian Navy needs.

Navantia of Spain specialises in naval shipbuilding. Just as Daewoo has proven itself to be internationally competitive by winning a substantial share of the world commercial shipbuilding market, Navantia has been competitive in winning naval design and shipbuilding contracts, such as the Australian air warfare destroyer (AWD) and landing helicopter dock (LHD) ships, and does have elements of the design, planning and production philosophy used by Korean shipyards such as Daewoo.

What these shipbuilders have in their favour are:

- Knowledge of state-of-the-art design and construction facilities, and a suitable work-force resource
- Reliance on planning every aspect of design and construction so that building can meet a very tight schedule
- Proven design and production systems and catalogues of proven designs
- Continuous workload that does not require substantial ramping-up of skills or manpower from one project to the next
- Established material, equipment and sub-contractor supplier chains.

Accordingly, these shipbuilders are able to quickly and efficiently offer ships of designs that are either already proven or developed from proven designs. However, these designs need to be modified to the specific needs of the Australian Navy, for example to obtain a longer range to suit our extensive coastline and remoteness. Other significant modifications often relate to military capabilities, including combat and communication systems.

In addition, these “standard” designs will usually contain Korean or Spanish equipment and machinery that is not easily supportable in Australia, and maintenance will become an expensive and time-consuming nightmare. The initial ship design for Australia will need to reflect the requirement for equipment that can be readily sourced and/or supported in Australia.

It was on this basis that RINA's submission to Part I of this inquiry recognised the reality that the replenishment ships to which Part I related could not be readily sourced from Australian shipbuilders and existing Australian shipbuilding facilities.

That is not to say that Australian shipbuilders could not build these replenishment ships, and perhaps facilities could have been developed for them using the Common User Facility at Henderson in WA or as an adjunct to the ASC facilities at Port Adelaide, but a short production run of two ships from such facilities should not be expected to compete with established shipbuilding facilities such as Daewoo or to a lesser extent Navantia.

However, if previous governments had the foresight to put in place a naval shipbuilding plan, projecting the need for these two ships together with other large ships including the LHDs, then all

the Navy's requirements for new vessels in recent years could have been sourced from Australian shipyards.

For example, it is understood that the need to replace *HMAS Success* before 2011 with a double-hull tanker has been known since the early 1990s under governments of both colours, although short-term decisions have resulted in this ship being out of service (with associated costs) for substantial periods since then for refitting, double-hulling and life extension. Yet the need for replacement of this ship was presented to the Senate, and thus Part I of this inquiry, as being extremely urgent. The costs of keeping this vessel in service until now could have been substantially reduced by including the replacement in a fully resourced long-term naval shipbuilding plan.

### **Design Considerations**

Ideally a warship needs to be constructed several times on paper, or these days on computer, before it can be built as a physical entity. So consideration of the sustainability of the naval shipbuilding industry must take into account the design of the ships constructed by that industry.

There has been a tendency in recent years for warships to be regarded simply as a platform for a combat system — the 'fight' payload of the warship. A warship is in reality a tightly-integrated system and it is an inescapable reality that it must be able to 'float, move and fight' under all the conditions required of it during its service life. Without the ability to float, move, sustain her crew and provide all the systems needed to keep the combat system working the ship fails as a warship. The achievement of a fully-integrated, successful warship is a combination of design, construction and sustainment through life.

An important aspect of the ability of a shipbuilder to build a ship on time and on budget is maturity of design and the complexity of that design, and whether 'design for production' has been a priority.

Taking complexity first, a scarcity of space into which equipment, systems and accommodation are to be fitted is a feature of warships and a very expensive aspect of them. This issue relates even to a so-called proven design, where invariably there is a need to modify the existing design to accommodate different, updated or modified equipment and systems, such as weapons and combat systems as in the AWD. Furthermore the need to provide access for maintenance and possible replacement at some future date requires additional space which is not always included at the design stage, because many shipbuilders have little interest in through-life costs.

The ability of a shipbuilder to build a ship on time and on budget is maximised if the design is complete at the time the vessel's cost is estimated preparatory to finalisation of contracts and unchanged from then onwards. In fact, because of the added costs of changing a "fixed" design, it is not unknown in commercial shipbuilding, in particular, for a ship to be completed and immediately taken to a repair facility where any necessary modifications are carried out. However, there is a tendency for the detailed design of Australian naval ships to be far from finalised at the time of placement of contracts, and purchaser's requirements changed after that point to generally involve increased complexity, so escalation of costs and time to delivery should come as no surprise. The maturity of the detailed design of the AWD at the time of contracting is a case in point for which neither the shipbuilder nor the ship designer should be held responsible, although history indicates that they probably will be. As identified in the ANAO Report 22 on the AWD program, it is not only

the actual maturity of the design but the mutual understanding by both designer and shipbuilder of the construction practices and design details inherent in the design. Thus, the experience and continuity of skill development of the shipbuilding staff, particularly production engineers and supervisors, is vital to understanding the maturity of the design for construction by their, or sub-contracted module builders', production teams.

The cost to a shipbuilder of making modifications to a contracted design should not be underestimated. Typically, all processes involved in production of ships in a shipbuilder's orderbook are planned in fine detail so that they can provide assured handover dates for all ships, with monetary penalties applicable to all late deliveries. So, for example, a delay of one day caused by modification to the design of one ship could conceivably result in one day's late delivery penalty for all subsequent ships on the orderbook. In the case of a shipyard such as Daewoo delivering at perhaps a ship per week over an orderbook that extends forward more than two three years, the penalties would no doubt be considerable.

It should not be assumed that the option to use the AWD hull for the next generation of frigates will resolve these design considerations. While this hull may be "proven" as far as structure is concerned, and the equipment and systems requirements to make it into a frigate rather than an air warfare destroyer may be less complex and so require less "shoe-horning" to fit it into the available space, the basic design work as well as detailed design needs to be completed before production of ship sections should be commenced.

The above considerations do not take into account submarines, which involve a further increased level of complexity and shoe-horning of systems and requirements into a small package. Since RINA members have been deeply involved in the building and sustainment of the Collins class submarines, we would of course contend that the next generation of submarines could and should be built in Australia. No doubt national security considerations dictate that these ships should be maintained in Australia. However, in our view the decision on whether or not these ships should be built in Australia is subordinate to the need to develop a sustainable naval shipbuilding and repair industry and where a submarine building programme may fit into the development of that industry.

RINA strongly recommends that a sustainable naval shipbuilding industry must be based upon an industry plan involving a steady throughput of projects, so as to develop and maintain the skills required at all stages of any naval shipbuilding project. The peaks and troughs of skills requirements associated with recent naval shipbuilding projects have meant that skills cannot be further developed by moving on to the next project but are generally lost to other industries so that the next project, when it comes, has to be started from a very low base and with individuals knowing they only have employment for the life of their part of the current project.

Smoothing out of the peaks and troughs could be managed in a number of different ways.

Firstly, rather than place a contract for a relatively long production run of supposedly identical ships, then have progressive modifications made during that run, it would be desirable for the contracting to be managed in batches within which each ship is truly identical and of a design fixed at the outset. This approach would not only have the benefit of reducing costs associated with modifications to the design but would allow skills and experience gained to be incorporated into subsequent ships in a managed process akin to carrying skills and experience into the next project.

Secondly, gaps between major projects might be filled by production of non-combatants and other non-frontline ships for which the delivery timetable is not critical.

Thirdly, whilst the Australian shipbuilding industry must remain flexible in order to be able to produce a range of different product types, 'consistency of purpose' is important to maintain the overall integrity of the manufacturing system, from design, through production, to sustainment. The desirable aim to achieve a greater degree of consistency, transcends organisational and functional boundaries. Standards and standardisations have played a key role in driving progress towards improving efficiency in manufacturing, but the procurement of ship designs from different overseas countries becomes problematic due to differences in national philosophical approach, hence the need for greater consistency in Australia's application of materiel requirements and standards.

### **Maritime Materiel Requirements for New Ships**

RINA understands that the engineering guidance for the hull structure of new Australian naval ships is subject to a Maritime Materiel Requirement (MMR) which has been drawn into question in terms of its approach. The MMR requires ships to be either built to the "class" (ie. the "rules" established and enforced by the society) of a classification society that is a full member of the International Association of Classification Societies (IACS), or be capable of being "classed". However, this second route is problematic in that no-one can be assured whether a ship is capable of being classed unless it has been surveyed by the classification society during the design and construction stages, and certified as complying with that society's rules – third party use of the society's published rules is of itself insufficient to provide the necessary assurance.

The purpose of "class" has been developed over centuries by commercial shipping to provide independent verification that the ship's hull and machinery is of a standard and condition that is "fit for service" or, as some might say, an insurable risk. The rules are based on sound engineering principles and the accumulation of experience. Classification involves independent examination and verification of the ship's:

- Design (applied load cases, hull structure and arrangement, main and auxiliary machinery and associated systems)
- Construction, including verification of materials used, constructed in accordance with the design documentation, and satisfactory operation in service
- In-service surveys to ensure maintenance of standards.

In recent years, the complexity of ships structures and their analysis to ensure safety in service has been increasing. Many countries, including Australia, have faced difficulties in maintaining their internal expertise in keeping pace with these developments. The classification societies have therefore increasingly been called upon to provide these services for naval ships, first to naval ships of similar types and functions to civilian shipping and latterly to combatants.

Results from implementation of the Naval Materiel structural standard are understood to have been mixed;

- Satisfactory in relation to the ANZAC frigates, which were classed after construction by a non-standard method.

- Unsatisfactory in relation to the Armidale-class patrol boats which, while constructed to class under the DNV High Speed Light Craft Rules have suffered extensive cracking and do not appear to have been operated in accordance with the speed-waveheight restrictions that were agreed by Navy/Defence Materiel Organisation before the vessels were constructed and which are a fundamental part of those rules
- To be seen in relation to the AWD, which are intended to be left unclassified.

The second of these examples is particularly critical. It is imperative that a ship is operated within its design parameters, similar to the fact that a building designed for temperate climates should not be expected to be able to withstand a severe cyclone.

Deficiencies in structural standards for a ship may only become apparent in the latter years of its life, hence the importance of the in-service survey aspects of the standards implemented by classification societies. So any decision to avoid “classing” a ship based on problems in getting the ship into class in the first place is likely to become expensive in the long term, such as by shortening the ship’s projected service life. Similarly, any operational disregard of the engineering assumptions on which the design is based is likely to cause similar long-term problems at the expense of the reputation of the shipbuilder and the cost of the taxpayer.

The main points to be made in relation to this subject are:

- The importance of ensuring that the Navy’s ships, wherever built, meet appropriate standards to ensure their integrity, and the safety of the personnel they carry throughout their service life. Being “in class” with a member society of IACS is the internationally accepted benchmark for this, and Navy’s departure from this standard carries with it unmanaged risks.
- As stated above, consistency of purpose is important to improve efficiency. If MMRs cannot be applied consistently across different ship acquisition projects and classes of ships, then there is a loss of productive efficiency. The reasons behind any lack of consistency in the implementation of MMRs need to be understood and explained, since lack of consistency potentially undermines improvements in the efficiency of the manufacturing system.

That said, RINA welcomes the implementation of the recommendations of the Rizzo Review to upgrade the engineering capabilities of Defence. However, in the absence of an ‘in-house’ ship design capability being maintained within Defence, particular attention will need to be given to securing the relevant engineering skills to enable critical and credible assessment to be applied to designs, proposals and advice purchased from external sources, often located overseas.

### **Competition Considerations**

The number of possible bidders for new naval shipbuilding projects in Australia is always likely to be limited. This situation is not likely to be enhanced by the specialised facilities required for the building of some ships required by the RAN, such as submarines and the larger ships (eg. replenishment and AWD) referred to above.

Competition policy is obviously outside the ambit of RINA. However, one possible avenue to manage this problem could be for the Federal Government to retain ownership of naval shipbuilding



facilities as part of the naval shipbuilding plan suggested above, with the management of individual projects being contracted to individual companies that may, if they wish, make use of those facilities.

## Conclusions

- Australia can and should develop a sustainable naval shipbuilding industry.
- Australia's naval shipbuilding industry must be sufficiently flexible to apply its manufacturing skills to deliver efficiently the diverse range of maritime capabilities needed by Defence.
- Like any other industrial manufacturing system, consistency of purpose is essential to improve the efficiency of the Australian naval shipbuilding industry.
- Consequently, the industry must be based upon a naval shipbuilding plan that provides for continuity of projects, and for skills to be developed and maintained so that they can be carried-over from one project to the next.
- Assessment of the performance of the existing Australian naval shipbuilding industry should take into account the stop-start nature of recent projects, compared with the continuity of projects and production of established overseas shipbuilders, together with the need for a similar workflow to be established for a sustainable naval shipbuilding industry.
- The Government should be aware the procurement of naval ships from overseas results in lost opportunities for young Australian professional engineers and naval architects to gain practical experience in design the types of ships used by the Navy and thus in the knowledge and skills to maintain those ships.
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- Management of design modifications made during a production run should be managed by dividing the production run into batches of identical vessels.
- In the interests of improved safety and consistency, all future naval ships should be built to, and maintained in, class with an IACS member classification society.
- RINA Australian Division supports the enhancement of Defence's naval engineering capabilities in accordance with the recommendations of the Rizzo Review.
- Maritime Materiel Requirements should be improved to reflect experience gained through their implementation in naval shipbuilding projects.
- Appropriate arrangements should be put in place to secure competition for projects and contracts in a sustainable naval shipbuilding industry, but no recommendations are made in this submission as to how competition is to be achieved.
- RINA is confident that implementation of the measures suggested in this submission will substantially reduce risk to the Government in terms of naval shipbuilding projects' completion on-time and on-budget.