INTRODUCTION: PROPOSAL FOR A CLASS OF GENERAL PURPOSE VESSELS

This brief submission relates to the topic of Navy Force Structure, especially a perceived capability gap between the current and future Patrol Boat Force and the Frigate/Destroyer Force. It is suggested that there is the potential for a General Purpose Vessel to complement the specialist roles performed by other classes of Navy ships; not only Patrol Boats and Frigates/Destroyers, but also the more specialist ships including the Hydrographic/Oceanographic ships, Survey Motor Boats, and Coastal Mine-Hunter Vessels.

Given Australia’s maritime geography, comprising the Exclusive Economic Zone and southern ocean region that includes Macquarie and Heard Islands, and Australia’s Antarctic Territory, the proposal is that it is in Australia’s longer term interests to design and build a General Purpose Vessel capable of being adapted in a relatively short timescale to suit a variety of roles. A modular-type of outfit is appropriate. Some possible roles, such as offshore patrol, can be identified now, whilst other possible roles may not be envisaged currently, but could arise at short notice.

The above proposal is not new, nor is the proposed ship type an original concept. The late Bill Rourke (RADM RAN), a former Chief of Naval Materiel and Chief Executive Officer of Engineers Australia, maintained that the Navy should have ‘in its bottom drawer’ the design and detailed engineering drawings for a General Purpose Vessel. There have been precedents of which the BATHURST Class Corvettes (or Minesweepers) represent a typical example. Many foreign navies in times past and currently are developing Offshore Patrol Vessels, and there are many ship designers that can offer such vessels. The CASTLE Class for the UK Royal Navy is one existing example, but there are many others to consider.

Not all the typical vessel types are monohulls, and the Ministry Of Defence (MD) UK developed the vessel TRITON, a steel trimaran as a concept technology demonstrator. The TRITON is currently in service with the Australian Department of Customs to provide Border Protection.

Not all of the typical vessel types are designed and constructed from steel. The Australian shipbuilder Austal has been very active in the development of catamaran and trimaran designs using marine grade aluminium. Some of these vessels are currently in service, or entering service, with the US Navy to perform roles that include ocean patrol, littoral combat, or the rapid delivery of logistic support.

The Australian 2009 Defence White Paper, together with the accompanying Defence Capability Plan, included as a new Defence Navy Project, SEA 1180 to provide twenty Offshore Combatant Vessels. This represents one interpretation of the concept, of a multi-role vessel. In more recent versions of the Defence White Paper and Defence Capability Plan, Project SEA 1180 has been ‘postponed’, supposedly ‘due to a lack of technological maturity’. Specific reasons have not been given for the postponement, but some reasons can be guessed. The aim to replace the capabilities provided by twenty-six specialist ships, comprising fourteen ARMIDALE Class Patrol Boats, two LEEUWIN Class Hydrographic Ships, four PALUMA Class Survey Motor Boats, and six HUON Class Coastal Minesweepers, was demanding, for reasons that will be summarised. An objective was to realise savings in the costs of ownership due to benefits of commonality, although economic data to show the actual savings has been difficult to obtain.

The above demonstrates that the idea of a General Purpose Vessel for Navy is neither new, nor radical. As a matter of strategy, it seems the problem has been that the implementation of the strategy has failed. Some suggestions are offered as to why the implementation has failed, and how to overcome these issues. A limited sub-set of topics are discussed, including: area of operations, environmental conditions, dimensions, speed, range, accommodation, endurance, growth margins, propulsion systems, on-board systems, vessel-type, and construction rules and materials.
PROPOSED VESSEL CAPABILITIES AND REQUIREMENTS

Comment: Notional capabilities and requirements for the SEA 1180 Offshore Combatant Vessel (OCV) were published on a website hosted by the Australian Parliament House Senate¹, entitled: ‘PROJECT SEA 1180 PATROL BOAT, MINE HUNTER COASTAL AND HYDROGRAPHIC SHIP REPLACEMENT – OFFSHORE COBATANT VESSEL INITIAL CAPABILITY DESCRIPTION’. It is not clear how these capabilities and requirements came to be posted on the Senate web-site, or if they accurately represented Navy’s requirements at the time. However, they were signed by Chief Capability Development Group and Chief of Navy, dated 31 August 2011, and do provide a basis upon which to provide some comments and observations regarding the broad concept of a General Purpose Vessel, as distinct from an OCV.

Area of Operation: By way of example, for Project SEA 1180 OCV the IOC published on the Senate web-site referred to the following “OCV Region and Areas of Operation”:

“Based on the likely involvement of the OCV in the ADF’s Principal Tasks, National Hydrographic Tasking, and Australia’s Search and Rescue Region, the OCV Principal Region of Operation would extend north from 48° South latitude (Sub-Antarctic boundary in the Southern Ocean) to approximately 5° North latitude, and from approximately 95° East longitude eastwards to 180° East longitude (International Date Line). The majority of the tasking would be expected to occur in the Northern half of this Region, above the Tropic of Capricorn. Operations in the Sub-Antarctic and Antarctic would require sea frames (normally referred to as ‘ships’) with appropriate ice-rating and sea-keeping capabilities. The cost of this would not be an economical investment across the whole OCV Class and would be at the detriment of mission capabilities required more regularly and frequently for operations closer to the strategic centre of the APOE. Notwithstanding, MGI systems could still be deployed in mission modules embarked on appropriate vessels owned or chartered by other Government Departments to enable the RAN Hydrographer to meet charting responsibilities. This Region incorporates the following likely Areas of Operation:
   a. Australian Economic Exclusion Zone and Continental Shelf,
   b. Australian Search and Rescue Region,
   c. Vital Northern Ports and Offshore Infrastructure,
   d. Sea Air Gap,
   e. Northern Approaches and Strategic SLOC (Sea Lines Of Communication),
   f. Australian Charting Area, and
   g. South-West Pacific Island Countries.”

Macquarie Island is located 54° 30’ South, 158° 57’ East, and Heard Island and McDonald Islands are 53° 06’ South and 73° 31’ East. These island groups are an Australian external territory, but are not included within the Areas of Operation. This is thought to be an omission, and they should be included.

Environmental Conditions: For winter operations in latitudes to the south, including the regions of Macquarie and Heard Islands, the environmental conditions including air temperature, water temperature, wind velocity, and fully-formed sea state, can be extreme. The characteristics needed for a vessel to operate in such an environment, beyond reach of support, are quite different from northern coastal patrol. Vessel range, endurance, sea-keeping, reliability, redundancy, and internal environmental control systems, including heating systems as well as air conditioning systems, all become important design considerations and attributes.

Environmental Conditions (continued): By way of example, for Project SEA 1180 OCV the IOC published on the Senate web site referred to “Influence of the Geo-Physical Environment”, and stated:

“The defined OCV Region of Operation is characterised by its remoteness, vast expanses of both open sea and littoral areas, and sparseness of logistic support infrastructure. By the very nature of its roles an OCV would be expected to mostly operate independently, or perhaps as a pair in this environment. Therefore, the necessary attributes of the OCV will be long range, endurance, good fuel efficiency, and high levels of systems reliability and availability. This environment is also diverse, complex, harsh, and potentially hazardous in terms of navigation, sea-keeping, habitability, environmental sensitivity, and the performance of equipment and personnel. Sea surfaces span Tropical and Temperate (and also including even more demanding Southern) latitudes where swell and sea states are regularly high because of cyclonic or frontal (or Roaring Forties) weather activity across open ocean expanses. Oceanographic and meteorological conditions are also highly variable and will pose particular challenges for optimizing sensors and weapons. Speed (now reduced), endurance, and robustness will therefore be necessary attributes of the OCV sea frame to enable avoidance of potentially dangerous weather and protection of mission systems – from degradation, damage, and destruction and personnel – from fatigue, sickness, and injury. Robustness, sea-keeping, and endurance can be correlated to size, which also provides advantages for modular Mission System Element capacity and the ability to operate rotary wing aircraft at sea.”

Dimensions: By way of example only, for Project SEA 1180 OCV the version of the IOC published on the Senate web site referred to the measure ‘Displacement’, but used mixed terms, by referring to ‘at least 60 metres in length’. Displacement and Length are obviously different characteristics of a design, although the measurement of one is often dependent upon the measurement of the other. But other factors, such as ship type, hull form, and construction materials, also have an influence. For operations in northern waters, the notional length of at least 60 metres is also accompanied by a physical constraint, due to constraints on operating draft, and the infrastructure that currently exists for ship maintenance and repair in Darwin. If one considers operations in the Southern Ocean, then such a constraint imposed on ship length is unhelpful because additional ship length helps in the quest for more economical maximum speeds, improved sea-keeping, and does not necessarily constrain docking for ship repair. Ships costs are traditionally related to length, but it has often been argued that a pure cost/length relationship does not account for other factors that also influence ship cost, especially the cost of expensive mission systems. For the purpose of this submission, a significantly larger range of ship lengths would be proposed, including upwards from 60 metres up to perhaps 100 metres maximum. There are several examples of current OPV designs that are available within this length range.

Speed: The ARMIDALE Class Patrol Boats have a design requirement and capability to operate at a maximum speed in the order of twenty-five (25) knots. Discussions with experienced personnel have indicated that this Navy requirement is a consequence of a simple ‘Distance versus Time’ equation, derived from scenarios that include coastal patrol and transits, including transits from operational bases in Northern Australia to other ports around the Queensland coastline for ship repair and maintenance work.

The referenced OCV IOC document included the following speed requirements: “Economical Passage Speed – 11-14 Knots; Fast Routeing Speed - at least 18 Knots; Maximum Speed - at least 24 Knots sustained in Sea State 3; and Loitering Speed of 4–9 Knots for at least twelve Hours”. The speed requirements for the OCV seems reasonable, with the exception of the Maximum Speed of at least 24 Knots in Sea State 3 that is a significant driver, in terms of its likely impact on the selection of the ship type, propulsion machinery, and the acquisition, operating and through-life costs. For the purpose of this submission, a more modest maximum ship speed of up to 20 Knots in Sea State 3 would be proposed.
**Range:** By way of example only, for Project SEA 1180 OCV the version of the IOC published on the Senate web site referred to: “Range - no less than 3,500 Nm at Economical Speed”. Following from the above discussion of speed, a reduced maximum speed might result in the ability to carry additional fuel, and to use that fuel more efficiently, increasing the range up to perhaps 4,500 Nm or more.

**Accommodation:** By way of example only, for Project SEA 1180 OCV the version of the IOC published on the Senate web site referred to: ‘Accommodation - no less than 35 crew and mission bunk teams and capacity for between 20 and 30 additional austere bunks for an Embarked Force, Clearance Divers, or Transit Security Element”. This requirement seems reasonable to maintain without any change.

**Endurance:** By way of example only, for Project SEA 1180 OCV the version of the IOC published on the Senate web site referred to: “Endurance of at least 21 Days (80 Personnel) without replenishment”. This requirement seems reasonable to maintain without any change.

**Growth Margins:** By way of example only, for Project SEA 1180 OCV the version of the IOC published on the Senate web site referred to: “Growth Margins – at least 10%”, presumably expressed as a percentage of the maximum displacement in the ‘fully-loaded’ condition. This requirement seems to be at the low-end of what should be the target. Experience suggests that growth margins can be inadvertently consumed during the design and build processes, and that greater margins for growth should be set and monitored carefully during the detailed design and build processes to ensure that they are delivered.

**Propulsion Systems:** It is considered that the development of podded electrical propulsion systems could prove advantageous for the proposed general purpose vessel. This is because the benefit of eliminating the conventional propulsion shafting and rudders would create additional space in the after end of the vessel that can be used in a flexible manner to accommodate mission systems below the weather deck (either in an operational sense, or simply as storage space). Also, this would have consequences for the allocation of space to other functional requirements, such as ‘cold and cool rooms’, and ‘accommodation’, that would need to be moved forward in the general arrangement of the vessel. However, these are details for further consideration as part of the normal ship design process.

**On-board Systems:** By way of example only, for Project SEA 1180 OCV the version of the IOC published on the Senate web site referred to “Concept of Employment – Role B (Maritime (Littoral) Warfare)”, and included the comment: “The ability to embark and operate a Helicopter or UAV (Unmanned Aerial Vehicle) would enhance the OCVs capability for this role; however, the costs and any necessary capability trade-offs with other arguably more important mission systems elements would require careful consideration”. For the purpose of this proposal, the capability to operate, hangar and maintain a medium helicopter or UAV is considered to be a highly desirable requirement, albeit that this capability could be substituted for some other capability. Therefore, there could be variants fitted for helicopter operations, or variants fitted with other mission systems. Whether the ship could be re-configurable from one to the other in a relatively short period of time depends on further detailed analysis.

**Vessel-type:** Given that there are a wide range of different vessel types that are available, including: monohulls; catamarans (both conventional and Small Waterplane Area Twin Hull or SWATH forms); trimarans (and the list goes on); it is not the purpose of this submission to suggest a particular vessel type. Detailed analysis of specific and approved requirements is necessary to determine an optimal vessel type. However, to illustrate the proposal, a conventional monohull cannot be ruled out. This is especially true if the requirement for the maximum speed is reduced significantly to 20 Knots or less, and the maximum length dimension is increased to the order of say 100 Metres. In this range, the ‘Speed to Length Ratio’ (or more specifically, the ratio of the Speed (measured in Knots) to the square root of the Length (measured in Imperial units of Feet)), becomes $20 / \sqrt{328} = 20/18 = 1.11$. This still corresponds to a craft operating at close to the so-called ‘High Speed’ range, but is achievable using conventional technology.
**Construction Rules and Materials:** Given the above demanding requirements, and noting the proposed changes to the IOC requirements (including: area of operations; environmental conditions; reduced speed; increased length; and fitted for helicopter or UAV operations), and without wanting to eliminating other alternative vessel types, these proposed changes could enhance the merits of a conventional steel monohull vessel, designed to Naval Ship Rules or Classification Society Rules for large steel ships, and suitable for unrestricted operations world-wide. This is a different concept from the ARMIDALE Class Patrol Boats that were constructed from marine grade aluminium, and designed to the Commercial High Speed Light Craft Rules that are normally intended for Restricted Operations, albeit Navy insisted that the vessels were intended for Unrestricted Operations. Applying conventional naval engineering standards for steel hull construction, there is a realistic expectation that such vessels would prove to be robust, and that the likelihood of failure due to fatigue cracking will be significantly reduced.

**CONCLUSION**

At the strategic level, it is proposed that benefits would result from a Class of General Purpose Vessels, sitting between Patrol Boats and Frigates, that are designed in Australia, and for construction in Australia. In addition to providing an enhanced level of capability for the Royal Australian Navy, these vessels would be suitable to insert in the building program to ‘level-the-load’ on the local shipbuilding industry, where otherwise there could be gaps between major surface combatant and submarine building programs. The proposal is clearly dependent upon programming of sufficient funds via the Defence Capability Plan.