THE AUSTRALIAN NAVAL ARCHITECT

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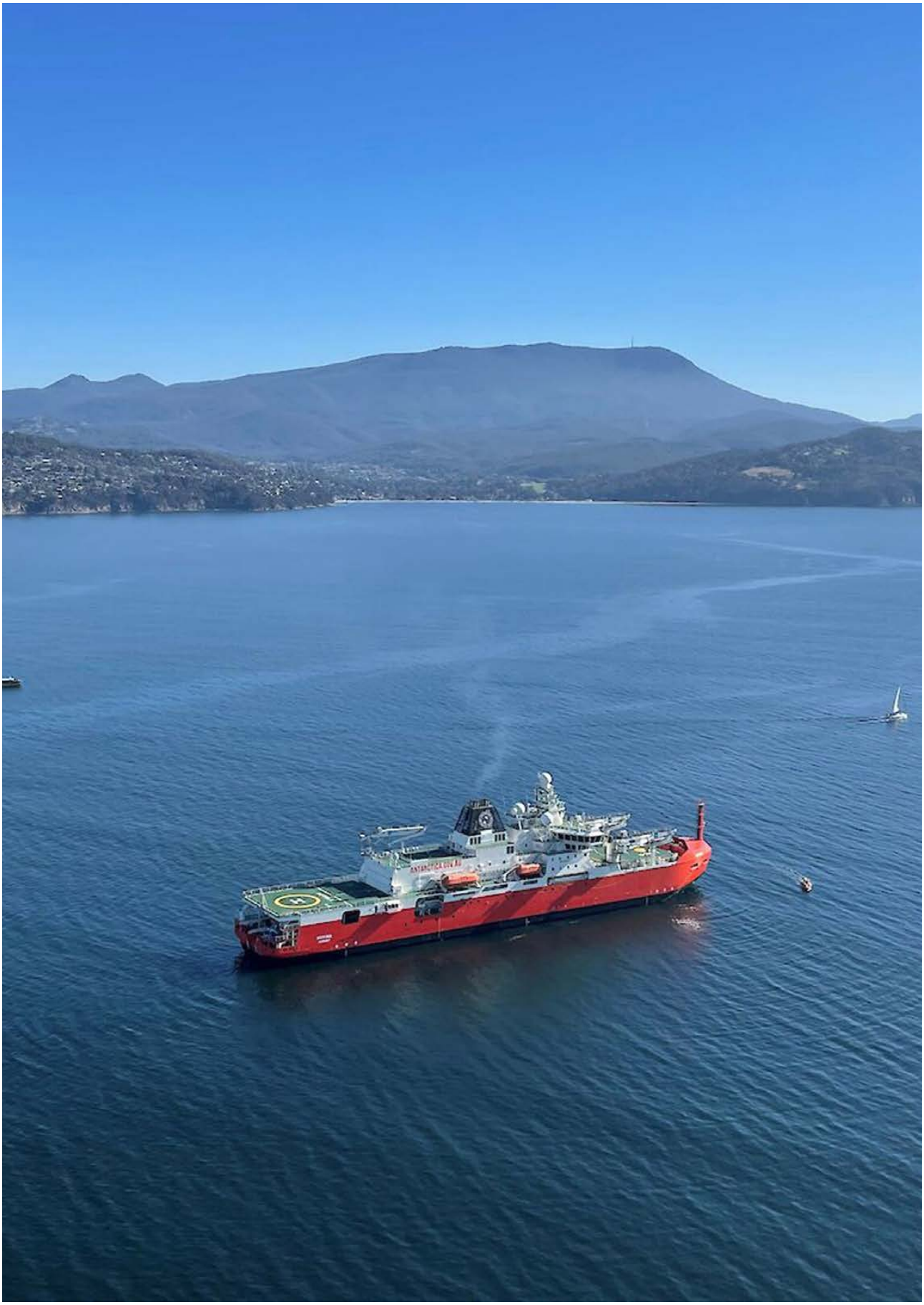
May 2023



RSV *Nuyina* arrriving in Hobart on 24 April after recent maintenence and repairs in Singapore
(Photo by Dave Lomas, courtesy Australian Antarctic Division)

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Cover Photo:

Kilimanjaro VIII, a new 53 m passenger ferry designed by Incat Crowther and built by Hobart-based shipyard Richardson Devine Marine for Azam Marine of Tanzania
(Photo courtesy Incat Crowther)

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RINA Australian Division
on the
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www.rina.org.uk/aust

From the Division President

I am writing this column on the evening of ANZAC Day, having spent much of yesterday and today digesting the Defence Strategic Review (DSR), the announcement of a panel to review the warship fleet, and many of the leading commentaries on the above; looking back and looking forward—my head is spinning! What I can say is that I appreciate that the Houston-Smith DSR has spelled out many home truths for us, all in fairly simple and plain-to-understand language and they are to be complimented for that. I just hope that at least some of their very practical recommendations are able to be carried through.

So what does this all mean for naval architects? It would have been nice to have the naval recommendations wrapped up in the DSR rather than us having to wait another six months or so, but I do understand the measured approach they are taking, even if at times one does silently think back to *Yes Minister*. Frustrating as it is, I think we can say that, whatever the outcome of the warship review panel (or whatever it will officially be called), there will be more than enough work for current and future Australian naval architects—we're just not sure where yet!

If the DSR does anything, it emphasises the ongoing need for more engineers in all disciplines, be they professionals, technicians or trades, so my previous emphasis on STEM in schools is even more important than ever, even if it didn't seem to get a direct reference in the DSR.

Now, where can RINA Australian Division and Sections add value here? It is **Naval Architects** who **Create Ships** and we must all take every opportunity which occurs to educate everyone that this is so, not just to our members but, please, open all technical meetings and other forums to as wide an audience as possible and, particularly, reach out to school and university students and encourage their participation (which might hopefully lead on to student/junior membership).

I know that many of you are not involved in the naval/government paths, but these comments really do apply to all, be it naval/government or commercial, offshore, renewables, fishing, pleasure, or any of the other important branches of our most diverse calling.

This leads me on to where RINA is actually placed at the moment to support you all. I am advised that, after some understandable delays, our new much-enhanced website will go live on 1 June, hopefully including My Career Path —I'm looking forward to it and trust that it will help you all in your own professional development and that of those who you are mentoring (or could mentor?).

On a regrettable note—our Division Vice President Belinda Tayler has had to step aside due to work and other commitments. Fully understood—thanks Belinda for your support and ongoing dedication to the NSW Section. Any volunteers to take up this position and/or managing our Improvement Committee will be well received!

Our very forward-looking RINA President, Prof. Catriona Savage, will be visiting Australia in late May for a bit of a whirlwind tour around her work commitments. I'll be working with her to try to expose her to as many of you and your thoughts/initiatives as possible—as they say: watch this space.

Jim Black

[*On 11 May Prof. Savage advised that she will, unfortunately, no longer be able to come over here but doesn't want to leave that promise hanging so is keen to discuss how we might arrange for some online activities instead. She advises that she is still keen to engage with Australian Division members wherever we think it might be useful—we'll work on this!*—JB]

As always, please feel free to contact me at any time with your comments, thoughts, recommendations or criticisms — anything whcih can help us move forward as the premier international maritime professional institution. Looking back and what we can learn: ANZAC; looking forward where we can contribute: AUKUS and DSR — positive challenges for us all!

Jim Black
President, RINA Australian Division
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Editorial

Not surprisingly a major topic of conversation in marine circles in recent weeks has been the pathway for Australia to obtain nuclear submarines which was announced in San Diego on 13 March by the President of the United States and the Prime Ministers of Australia and the United Kingdom. The way ahead includes Australia purchasing from the US three Virginia-class submarines starting in the early 2030s followed by the construction in the UK and Australia of a new-design submarine, SSN-AUKUS, for both the RAN and the RN. The Joint Leaders Statement, which can be found on Page 35 of this edition of *The ANA*, states that construction of the first SSN-AUKUS submarines will begin in the UK and Australia 'within this decade'.

Some have commented to me that the timescale for this new program appears very protracted. In my view, the intention to start building the first RAN SSN in Australia within this decade is a major challenge. There are only some seven years left before that milestone is due and there is much to be done. Not only do we have to prepare for the operation of several Virginia-class submarines and develop the facilities for SSN basing at HMAS *Stirling* in Western Australia, but we have to design and build a new, nuclear-capable construction facility in Adelaide to build a submarine the design of which is, presumably, still at an early stage. Essential information needed to start the design of a world-leading construction facility for our nuclear submarines includes basic information on the size and mass of the boat, together with a build strategy which will guide the layout of the facility and the necessary strength of foundations, pavements and other structures.

Detailed statements of requirements will have to be developed to guide the design, which must then be well advanced for the selection of construction contractors and the actual construction and outfit of the facility, sufficient to commence submarine construction 'within this decade'. In my view this workload makes seven years appear quite a tight period in which to make it all happen.

The design of SSN-AUKUS is also likely to take some considerable time, considering that the design of the US successor to the Virginia-class submarines, SSN(X) has recently begun, yet the construction of the first submarine to the new design is not expected to begin before 2034.

Can we do it? I think we can, with determined management and assurance of funding when it is required. We have done similar things before. There are parallels between the work required in this decade and that of the 1960s after the Government of the day approved the acquisition of a squadron of Oberon-class submarines for the RAN. The decision to acquire new submarines for the RAN was made in 1960, and to develop skills in the support of (then) modern submarines, a program of refits of the T-class submarines of the RN's Fourth Submarine Division was begun at Cockatoo Island in Sydney. Cabinet approval to order the first four Oberon-class submarines was given in January 1963.

Planning for a new base for the RAN boats and the refit facilities began in earnest in 1964 and the base, HMAS *Platypus*, was ready for the arrival of the first of the submarines, HMAS *Oxley*, in August 1967. The necessary refit facilities, at Cockatoo Island, were defined and designed by 1968 to enable construction to be completed in time for the first refit of HMAS *Oxley*. The facilities, which were very advanced at the time, were completed in 1971, just in time — seven years after the decision to proceed had been made.

Things were much simpler in the 1960s, and nuclear submarines are much more complex than the diesel-electric submarines of those days. We have a lot of work ahead to be ready to begin building SSN-AUKUS RAN 01 in Adelaide by the end of this decade—there is no time to waste.

John Jeremy

SSN-AUKUS is intended to serve in both the Royal Navy and the Royal Australian Navy
(Image courtesy Department of Defence)

LETTER TO THE EDITOR

Dear Sir,

I read Tim Gourlay's absorbing paper *Double-humped Roll Response for a Cruise Ship in Beam Seas* in the February 2023 edition of *The ANA* with a great deal of interest. I subsequently asked Tim several questions, which are listed below together with his replies, as they may well be of interest to readers.

Q My first thought was that "this is just parametric rolling. However, naval architects seem to define this as pitch-induced roll, usually in stern and quartering seas, although Ikeda et al. (2006) call it parametric rolling in their paper.

A Yes, the definitions of "parametric rolling" seem to vary greatly, so I avoided using this term. By the way, there's a nice MARIN video on "parametric rolling" of container ships in head seas, available at https://www.youtube.com/watch?v=vXYG52P4N3s.

Q With reference to Figure 10 in the paper: in the model tests, the short-period peak is at 40% of the resonant peak period, but parametric rolling usually occurs at 50% of the peak, so something else is going on. Curiously, the short-period peak is predicted by the nonlinear time-domain at almost exactly 50% of the resonant peak period, as you would expect for parametric rolling. This difference in the relative peak positions suggests that the nonlinear time-domain theory is either not getting the inertial and/or restoring coefficients right, or perhaps there is something inaccurate in the cross-coupling terms? What is the natural pitch period? Can you modify it in the predictions and see what effect it has on the short period hump?

A I think it's just a coincidence that the short period peak is at approximately 50% of the other peak. The 23 s peak is at the natural roll period, which depends on roll inertia and GM. The 8–11 s peak is where the wave-induced roll moment is a maximum; this just depends on the beam.

Q Does the nonlinear GZ calculation method take into account the effects of the wave orbital velocities? I would expect it to be included as a variation in the hydrostatic pressures, but just checking.

A No, I deliberately leave this effect in the "wave loads" calculated by the WAMIT software. At each heel angle and position in the wave, I subtract the upright heeling moment at the same position in the wave (which is part of the wave-induced roll moment) to give the GZ curve.

Q You have already noted that both the frequency domain and the two time-domain methods over-predict the resonant (long-period) peak, and suggest that this is due to under-prediction of the roll damping. Yet the non-linear time-domain method does quite a good job of predicting the magnitude of the short-period peak. Why wouldn't it under-predict the roll damping here, just like it does for the long-period peak? As with the question about Figure 10 above, it seems like something else is going on.

A Inviscid roll damping is small at long roll periods (e.g. 23 s), so most of the roll damping is viscous, which is really hard to predict. The Ikeda method for viscous damping can easily be out by a factor of 2 or 3. And the natural roll peak is heavily affected by the roll damping. So I'm not surprised that the 23 s roll peak isn't that well predicted.

At 8–11 s roll period, inviscid damping is a large proportion of the roll damping, and this is likely to be predicted pretty well in the WAMIT software.

Reference

Ikeda Y., Munif A., Katayama T. and Fujiwara T. (2006) Large parametric rolling of large passenger ship in beam seas and the role of bilge keel in its restraint, *Marine Systems and Ocean Technology*, v.2, 33-37, Springer.

With thanks to Tim Gourlay for permission to print his replies.

Kim Klaka

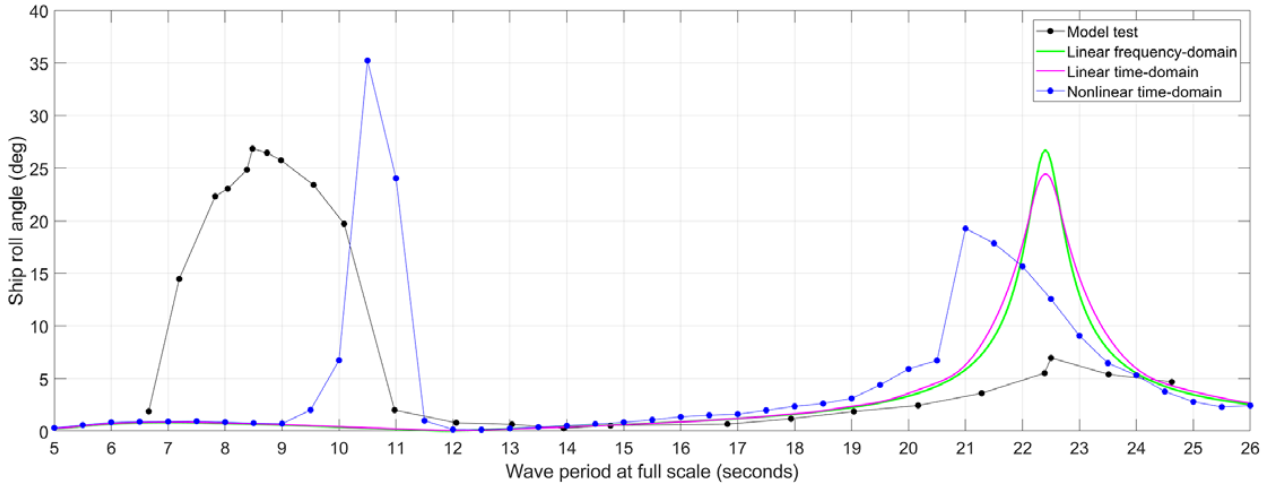


Figure 10: Comparison of measured and computed ship roll motions for the Ikeda et al. (2006) test case: cruise ship in regular beam seas of height 5.0 m
(Graph courtesy Tim Gourlay)

COMING EVENTS

NSW Section Technical Presentations

Technical presentations are generally combined with the ACT & NSW Branch of the Institute of Marine Engineering, Science and Technology and held on the first Wednesday of the month (February through October) at the Sydney Mechanics School of Arts, 280 Pitt St, Sydney, or at a yacht club, and streamed live, starting at 18:00 for 18:30 and finishing by 20:00. Guests are welcome.

The program of meetings remaining for 2023 (with exceptions noted) is as follows:

7 Jun Eric Fusil, Director of the Shipbuilding Hub for Integrated Engineering and Local Design, University of Adelaide
The Australian Future Submarine Multiverse: Between Myths and Realities

5 Jul Jeffery Kong, Project Engineer, Atlantic & Peninsula Australia
HMAS Choules *SEA3030 Mid-Life Upgrade*

2 Aug David Firth, Principal Engineer SEA1788, Naval Shipbuilding & Sustainment Group, Department of Defence
STS Young Endeavour *Replacement*
Royal Prince Edward Yacht Club, 160 Wolseley Rd, Point Piper

6 Sep CDRE Colin Dagg RAN (Retd), Assistant Secretary, Australian Naval Classification Authority
Australian Naval Classification

4 Oct RINA
TBA

7 Dec SMIX Bash 2023

Tasmanian Section Technical Presentations

Technical presentations are generally held on the second Thursday the month (February through September) in a room-and-Zoom format, alternating between the Derwent Sailing Squadron, 23 Marieville Esplanade, Sandy Bay, and the Auditorium at the Australian Maritime College, Launceston, and streamed live, starting at 17:30 for 18:00 and finishing by 19:30. Guests are welcome.

The program of meetings remaining for 2023 is as follows:

8 Jun Hobart Kelsey Treloar, Director, Southern Ocean Subsea
ROV Fundamental Design, Build and Operation

13 Jul Launceston Carl Morley, GM Operations, Thrust Maritime
Active Heave Compensated Winch — Offshore Operation

19 Aug Hobart Peter Thurling, Senior Project Manager, Gibbs & Cox Australia
The New AIMS Survey Vessel

14 Sep Launceston Michael Woodward, Director, National Centre for Maritime Engineering and Hydrodynamics, Australian Maritime College
Greenwashing in the Big Blue Sea

Victorian Section AGM

The Annual General Meeting of the Victorian Section of RINA will be held on the evening of Wednesday 24 May at the Mission to Seafarers at Dockland and streamed live via Zoom. The *Notice of Meeting* was emailed to all members of the Victorian Section on 18 April.

Interferry 2023

The 47th annual Interferry Conference, hosted by Spirit of Tasmania, will be held in Hobart on 4–8 November 2023. The formal conference program will take place on 6–7 November at the Grand Chancellor Hotel, and Interferry will conclude with a Technical Tour on 8 November.

Speakers are now invited to submit their proposal to speak at the 2023 Interferry Conference on the theme of *The Leading Edge—Elevating the Customer Experience and Sustainability*. This year's event will focus on presentations which highlight innovations that have already been successfully implemented—or that will be operational in the very near future—to improve customer service and environmental stewardship. Proposals must be submitted through the web portal no later than 31 May. Selected speakers will be notified by 17 July. The web portal is at https://interferryconference.com/call-for-speakers/.

Early-bird registration for the conference opened on 1 May, and regular registration opens on 16 September at https://interferryconference.com/registration-information/.

Indo Pacific 2023

Indo Pacific 2023 will be held 7–9 November 2023 at the International Convention Centre Sydney. Indo Pacific is a critical platform for engagement where customer and industry connect and commercial maritime and naval defence suppliers promote their capabilities to decision-makers from around the world.

The Indo Pacific International Maritime Exposition is the region's premier commercial maritime and naval defence exposition, connecting Australian and international defence, industry, government, academia and technology leaders, in the national interest.

The Indo Pacific International Maritime Conference (IMC2023) is organised by the Royal Institution of Naval Architects, the Institute of Marine Engineering, Science and Technology and Engineers Australia, and coincides with the Royal Australian Navy's Sea Power Conference and the International Maritime Exposition which is organised by AMDA Foundation Limited.

The Call for Papers has now closed; remaining key dates for paper submissions are as follows:

Author acceptance notification	19 May 2023
Registrations open	Mid-2023
Refereed paper submission deadline	14 Aug 2023
Other paper submission deadline	9 Oct 2023

For further information regarding the IMC 2023 International Maritime Conference contact the Conference Secretariat via email at imc@amda.com.au.

KEYNOTE SPEAKERS ANNOUNCED

imc 2023

INTERNATIONAL MARITIME CONFERENCE

7–9 NOVEMBER 2023

INTERNATIONAL CONVENTION CENTRE
SYDNEY, AUSTRALIA

Organised by The Royal Institution of Naval Architects, The Institute of Marine Engineering, Science and Technology and Engineers Australia, the International Maritime Conference 2023 Program will focus on the latest developments in naval architecture, marine engineering and maritime technology; both in the areas of defence and commercial shipping.

KEY DATES FOR IMC 2023:

Author Acceptance Notification	**Friday 19 May 2023**
Refereed Paper Submission	**Monday 14 August 2023**

IMC 2023 is held in conjunction with INDO PACIFIC 2023

For more information: **www.indopacificexpo.com.au/IMC2023**

Contact the IMC Secretariat: **imc@amda.com.au**

INDO PACIFIC 2023
7 - 9 NOVEMBER
INTERNATIONAL MARITIME EXPOSITION
INTERNATIONAL CONVENTION CENTRE, SYDNEY, AUSTRALIA

NEWS FROM THE SECTIONS

ACT

December Dinner and Drinks

The ACT Section held its annual December Dinner and Drinks event at the Capital Brewery, Fyshwick, on the evening of 6 December 2022, with members and friends catching up.

(L to R) Alistair Smith, Cameron Whitten, Ray Duggan, Ewan Farquharson, Joe Cole, Claire Johnson, Zhaohui Wang, Adrian Excell David Drohan, John Colquhoun, James Loram, Tristan Jennings, Warren Smith, Jeremy Nolan
at the December Dinner and Drinks
(Photo courtesy Lily Webster)

March Dinner and Drinks

The ACT Section also held a Dinner and Drinks event at the Capital Brewery, Fyshwick on the evening of 21 March.

Left side of tables from left Alistair Smith, James Loram, Peter Hayes, Richard Milne, David Firth, Ewan Farquharson and others. Right side of tables from right: Cameron Whitten, Shannon Phillips, Adela Greenbaum, Tamasin Welch, Jordan Rayson, John Ninham and others
(Photo courtesy Lily Webster)

Tour of Mountain Boats

On the evening of 26 April, a tour of the Mountain Boats wooden boatbuilding facility was organised by Lily Webster and hosted by the owner of the company Philip Scarfe, a mechanical engineer by training. It was attended by seven participants.

The modest facility of Mountain Boats is located in the Canberra suburb of Fyshwick and is housed in a pair of 20 ft and 40 ft shipping containers and an awning-covered area on a leased asphalt carpark behind the Dairy Road retail and business complex. The company was formed by Philip during the pandemic lockdown period, as he was looking for something rewarding away from his then-regular desk job.

Prior to starting the tour, Philip explained his desire to achieve a sustainable and environmentally-conscious boatbuilding process. This was, in part, the motivation of using wood as the primary construction material. However, Philip continues to look for adhesives and paints which have the least environmental impact as well as ways to eliminate single-use consumables (plastics) as part of the production process.

He also noted that his objective isn't to build highly-crafted and varnished traditional wooden boats, nor to be a wooden boatbuilding school. Instead, his objective is to build smaller boats for everyday use at an easily-affordable price.

(L to R) Front: Philip Schaffe (owner), Alistair Smith, Warren Smith
Back: Cameron Whitte, Rob Gehling, Peter Hayes, Martin Grimm
at the tour of Mountain Boats
(Photo courtesy Lily Webster)

The tour was similar to but expanded upon that which Philip shows on his website. Starting in the 20 ft container (the 'dust bowl') used to cut and mill boat parts, Philip explained the use of templates for milling parts which have considerably cut down the time required to construct the boats from his original prototype. All wood cutting and milling is isolated to this container to avoid sawdust contamination of the boat assembly area. Moving on to the 40 ft container, one end is used as a stock room for wood, epoxide adhesives and polyurethane paints as well as cut parts. This area is also used for adhesive and resin mixing. At the other end of that container is a jig used to consistently assemble the 8 ft pram-hull boats which is his current mainstay. After assembly, the boats are coated with various resin paints before being cured at low temperature in an oven suitable for this size of boat. The oven is simply required to speed up the curing process at a relatively consistent temperature. This allows a more rapid turn-around between application of coat layers, so that as one boat is in the oven, the next can be prepared for its turn.

The 8 ft boat is based on the D5 dinghy design, and can be customised to the owner's desire with, for example, a sail (using furling sail from Sea Kayak Sails), oars, yuloh (for stern sculling) or small (1–2 hp) electric or petrol outboard.

Philip has also constructed a prototype 11 ft open dinghy which was shown during the tour. Philip described this as

a wooden version of the classic aluminium tinny. He is aiming for a weight remaining below 130 lb, comparable to its aluminium or fibreglass peers. The design is based on David Payne's "Woodie" but updated to incorporate foam buoyancy into the sides of the boat. This can be powered by up to a 15 hp outboard motor.

Philip fielded a range of questions from the participants before the cold evening got the better of us and we sought warmer indoors where those in attendance gathered for a casual dinner at the nearby Capital Brewing Co.

Further information about Mountain Boats is available at: https://www.mountainboats.com.au/.

Martin Grimm
Jordan Rayson
Lily Webster
Kerry Johnson

Queensland

Riverside Marine

Robin Row and Peter Batri of Riverside Marine, gave a presentation on *Riverside Marine*, to meeting at Riverside Marine, Newstead, and streamed live on 20 April. The presentation was attended by 9 with an additional 2 online.

Founded in Brisbane in 1926 by Norman Campbell, Riverside Marine has grown from its beginnings as a gravel-barge operator to one of the leading marine companies in Australia. Riverside now operates through its subsidiary companies, managing tugs in Port Hedland, towage services for LNG vessels in Port Dampier, towage services in Hay Point, Magnetic Island ferries, industrial sand dredging and logistics, and marine research vessels.

This presentation covered the development of the company from its founding to the present day.

The presentation was recorded and is expected to be available soon on the RINA YouTube channel.
Tom Ryan

South Australia and Northern Territory

Saab and Shipbuilding: Part 1 Surface Ships

Lars Rönnquist and Johan Aaserud of Saab Kockums, gave a presentation on *Saab and Shipbuilding: Part 1 Surface Ships* as a webinar hosted by RINA using the Zoom software platform on 19 April.

This presentation covered the development of surface combatant vessel design by Saab, commencing with the company's historical roots, the global and Australian operations, and then the areas of warship design in which the company is active today. A second presentation in May will expand these topics to cover Saab's work in the submarine domain.

The Presenters

Lars Rönnquist is Vice President and Head of Saab Kockums Liaison Office (Australia). He started his career as a hydrodynamicist at SSPA Sweden AB, prior to joining Kockums in 1990, where he has been engaged in numerous submarine technology programs. Over the last 20 years he has focussed on Saab Kockums' business development and marketing, particularly in the South East Asia region.

Johan Aaserud is Capability Manager Submarines with Saab Australia. He is a former Swedish Navy submariner, a naval architect and a marine engineer. On leaving the navy in 2012 he joined the Australian submarine builders and maintainers ASC Pty Ltd, and this was followed by a move to Saab Australia in 2019 where he joined the Underwater Group to focus on Platform Systems.

Andrew Harris

Tasmania

Australian Wooden Boat Festival

The Tasmanian Section had a presence at this year's Australian Wooden Boat Festival, from 10 to 13 February, as part of a Training and Careers display. The display was part of the Maritime Market Place at Princes Wharf No. 1, and so was surrounded by other maritime products, services and organisations.

The Training and Careers display was sponsored by Bentley, Seafood Maritime Training, Kedge Marine Surveyors, and supported by industry representative, Southern Ocean Subsea. The display was keenly manned by volunteers from those companies, Taylor Bros, Incat Tasmania, Crisp Bros, to name a few, and members of RINA Tasmanian Section. Social media support and high school and college contact distribution and invitations were supported by TISC.

Princes Wharf No. 1
(Photo courtesy Chris Davies)

The Training and Careers display was a unique opportunity for students, sailing clubs, scouts and guides to meet and talk with maritime industry representatives and experience hands-on world-leading Tasmanian innovation and technology. With the support of the sponsors, students and clubs had the opportunity to interact with

- Ship bridge simulators used to train Marine Engine Drivers for Huon, Tassal, Navigators and Incat.
- Ship training simulators which are used to train the ship masters of the future.
- Training vessels and machinery used to teach vessel handling and marine-engine driving.
- Sea survival and safety equipment used on vessels as part of crew training.
- The latest equipment and technology used by accredited surveyors to ensure that domestic commercial vessels are compliant with safety standards.
- Naval architects and engineers who have knowledge of all aspects of design, construction, safety, maintenance and operation of all marine vessels and structures.

Tasmania has a unique maritime heritage which is respected worldwide. Its maritime sector supports many industries to grow and prosper and extends to shipbuilding, aquaculture, civil construction, transport, fishing, power generation and tourism, to name just a few. With so many opportunities in our island state for a maritime career, this was an excellent opportunity for students and educators to dip their toes in the water.

Some of those who crewed the RINA Tasmanian Section stand Kelsey Treloar (Director, Southern Ocean Subsea), Dougal Harris (Bentley), Nigel Winter (Crisp Bros Haywards), Chris Davies (Chair Tasmanian Section of RINA and Principal, Corrosion Solutions), Richard Boult (Secretary Tasmanian Section of RINA) (Photo courtesy Chris Davies)

The RINA cocktail function at the Australian Wooden Boat Festival was held onboard ML *Egeria*, the event being well attended with all tickets sold and was generously supported by Brierley Hose and Handling, AMC Search and Bentley Software.

Chris Davies

Some attendees at the RINA cocktail function:
(Photo courtesy Richard Boult)

Some attendees at the RINA cocktail function:
Gregor McFarlane (Australian Maritime College) Dougal Harris (Bentley), David O'Sullivan (Curator Historic Vessels, Australian National Maritime Museum),
Scott Blee (Sabdes Yacht Design)
(Photo courtesy Chris Davies)

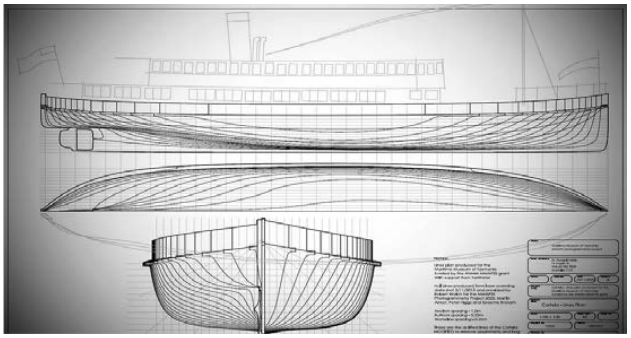
Saving Tasmanian Maritime Heritage: MV *Cartela*

Tim Oxley, Consultant to the Steamship *Cartela* Trust, gave a presentation on *Saving Tasmanian Maritime Heritage: MV* Cartela at a room-and-zoom meeting (in person at the Derwent Sailing Squadron in Hobart, Zoomed to the Australian Maritime College in Launceston, and streamed live via Zoom to the wider fraternity) on 9 March. This presentation attracted 8 attendees in Hobart, 4 in Launceston, and nine participating online on the evening.

Tim began his presentation by saying that MV *Cartela* is a 111-year-old Tasmanian-built timber river steamer, and a significant part of Tasmania's maritime history. but is currently in serious need of restoration. However, the project needs facilities, personnel, resources and funding.

Principal particulars of *Cartela* are

Designer	Alfred Blore
Builder	Purdon and Featherstone, Battery Point, Tasmania
Launched	1912
Length	37.48 m
Breadth	7.52 m
Draft	2.60 m
Displacement	262 t
Speed	12 kn



Lines plan of *Cartela*
(Drawing courtesy Steamship Cartela Trust)

Cartela
(Photo from Cartela website)

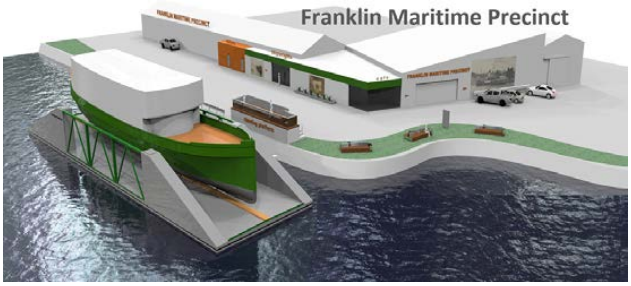
Cartela has a fascinating history. She was leased by the Royal Australian Navy as an Examination Vessel during the First World War when she was only 18 months old. She is Number 237 on the Australian Register of Historic Vessels. She was the high-speed light craft of her day, and is believed to have received the 'Cock of the Derwent' trophy, awarded to the fastest steamer, with the trophy normally displayed on top of the foremast. It is believed that this was last presented in the 1950s, and the trophy was discovered in *Cartela*'s forepeak.

Tim Oxley with *Cartela*'s 'Çock of the Derwent' Trophy
(Photo courtesy Steamship Cartela Trust)

There are three principal issues for the restoration:

- Where can she be hauled out for longer-term work?
- Who can do the work?
- Funding?

The good news is that, at the Australian Wooden Boat Festival in early February, the Premier of Tasmania announced a grant of $1 million from the Tasmanian Liberal Government which will be used to build and install a shiplift (meaning floating dock) for *Cartela* and other vessels as part of the Franklin Maritime Precinct.



Franklin Maritime Precinct and proposed shiplift
(Image courtesy Steamship Cartela Trust)

With funding secured, the Steamship Cartela Trust can now progress the restoration project of this iconic vessel.

The Cartela Trust plans to restore the vessel to operational standard, with significant benefits for Tasmania and the Huon Valley in particular. Restoring this vessel will provide training and employment opportunities as well as attracting tourists to the region.

Options for re-design of the vessel depend very much on whether it is a restoration to original, restoration to a known operating condition, or re-configuration as a tourist vessel. This would affect not only the choice of power (original steam, a Gardner 8L3B, or re-conditioning the current Caterpillar D343), but also the extent of superstructure, interior layout, galley facilities, etc.

To enable the work on *Cartela*, the Trust proposes a shiplift to be operated at Franklin, Tasmania. Very few options exist for haul-out in Tasmania, especially for longer-term work, and this problem faces other owners of larger wooden boats who visit Tasmania every two years for the Australian Wooden Boat Festival, such as *Windewarde Bound, Lady Nelson, Duyfken,* and *Julie Burgess*, among others.

Franklin already has a well-deserved reputation for building and repairing smaller wooden boats, and this project would add to that.

The shiplift is being designed by local engineer Jim Gandy, with assistance from naval architect Richard Boult.

Preliminary particulars of the shiplift are

Length OA		42.0 m
Beam		15.4 m
Depth	pontoon	1.40 m
	towers	4.82 m
	overall	6.22 m
Docked vessel		
	Beam (max)	10.0 m
	Draft (max)	3.60 m
Docking draft		5.47 m
Lift Capacity		300 t

This facility and the associated skills will provide a solution to the problem of restoring Australia's larger wooden boats, and bring new business opportunities to Tasmania.

The project has already attracted interest from several potential customer vessels attending the Australian Wooden Boat Festival, who have indicated interest in using the facility at Franklin.

The restoration of *Cartela* will be a significant undertaking, but the benefits to Tasmania and the Huon Valley are considerable. Restoring *Cartela* to operational standard would not only preserve a piece of Tasmania's maritime history but also provide training and employment opportunities and attract tourism to the region.

The Trust would like to hear from RINA members with experience in restorations and propulsion options. Contact project manager Tim Oxley at oxley.tim@gmail.com

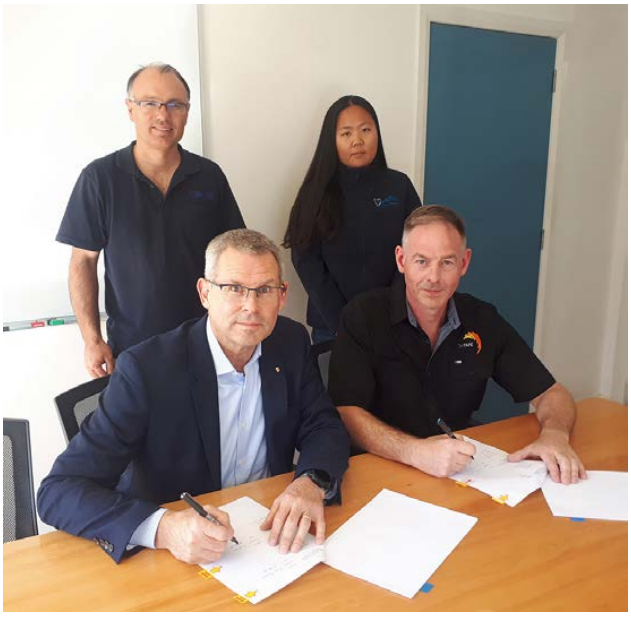
Tim's presentation was, unfortunately, not recorded.

Tim Oxley

Five-year Agreement between AMC and RINA UK

A five-year agreement was recently signed between the Australian Maritime College and RINA's Head Office, with Principal of the AMC, Michael van Balen signing for the AMC, and Chair of the Tasmanian Section of RINA, Chris Davies, signing on behalf of RINA, with Michael O'Connor and Paige Xu as witnesses. The signing was completed in the boardroom of Taylor Bros, on their huon pine boardroom table, with thanks to Phil and Greg Taylor.

Richard Boult



Front: Michael van Balen (L) and Chris Davies
Back: Michael O'Connor and Paige Xu
(Photo courtesy Richard Boult)

Western Australia

RINA Stand at AOG Energy 2023

RINA WA Section had Stand B40 at the AOG Energy Expo 15–17 March at the Perth Convention and Exhibition Centre. The display included magnificent LEGO models of Australia's new ice-breaking research vessel *Nuyina* and RMS *Titanic.*

LEGO model of *Nuyina*
(Photo from Australian Antarctic Program website)

RINA's Knowledge Forum at AOG 2023

RINA WA Section held a Knowledge Forum on Friday 17 March at AOG Energy 2023 at the Perth Convention and Exhibition Centre.

The first session on Offshore Operations was chaired by Vesna Moretti of the Department of Defence, and included these presentations:

- *New Innovations, New Configurations, Continuously Empowering the Next Generation of Possibilities* by Bjørn-Evert van Eck Rasmussesn of Mammoet Australia.
- *Construction Vessel Requirements and Market for Australian Offshore Windfarms* by Ken Goh of Knud E. Hansen Australia.
- *Oil and Gas, Defence and Renewables—A World of Opportunity for Hull Structural integrity* by Matthew Williamson and Alex Mosnier of Floating Solutions Consulting.

The second session on Maritime Applications of Data Science and Autonomous Systems was chaired by Sam Abbott of Austal, and included these presentations:

- *Monitoring Station-keeping Integrity of Large Offshore Assets* by Claire Thomas of AMOG Consulting.
- *The Next Evolution in Autonomous Underwater Data Collection* by Mark Roberts of Kongsberg maritime.
- *Applying Proven Systems Engineering to Achieve Clean Efficiency for Autonomous Operations* by Suzanne Hutchison and Martin Shadbolt of Nova Systems.

The third session on Green Shipping was chaired by Jim Black, President of RINA Australian Division, and included these presentations:

- *Shipping and the Energy Transition* by Douglas Raitt of Lloyd's Register.
- *Operating Envelope and Thermal Performance of a Liquid Hydrogen Unloading System* by Harry Lesmana of LFM Energy.

Wind Propulsion — Current Developments

Ken Goh of Knud E. Hansen Australia and Greg Johnston of Advanced Wing Systems gave a presentation on *Wind Propulsion — Current Developments*, at the Flying Angel Club in Fremantle and streamed live on 27 April. The presentation was attended by 15 with an additional 5 online.

The RINA Wind Propulsion Conference was recently held in London with papers and delegates from all corners of the world. Ken Goh presented his company's

recent research work in design of modern wind-powered commercial vessels. He provided an executive summary of the conference presentations, highlighting the main themes and areas of research, engineering and applications of this rapidly-developing industry.

Greg Johnston of Advanced Wing Systems presented semi-rigid wing (SRW) technology which uses a unique method of creating a wing section shape from semi-rigid sail membranes instead of soft sail panels with battens. The section shape is variable in thickness, camber and twist to provide a highly-efficient wing in varying conditions confirmed by CFD and large-scale testing. The SRW can produce high lift coefficients and very high lift-to-drag ratios. The presentation covered the development of the SRW and use in the 36th America's Cup, to designs for a free-standing, self-stowing technology which has a low stowed height and a relatively small deck footprint for application to commercial shipping.

The presentation was not recorded.

The Presenters

Ken Goh is a Senior Mechanical Engineer and the General Manager for Knud E. Hansen Australia. The company specialises in the design of many types of highly-customised vessels, including wind propulsion, wind turbine installation jack-up vessels, research vessels, cruise ships, yachts, ferries, naval auxiliary vessels and ice-breakers, notably the new Australian icebreaker, RSV *Nuyina*.

Greg Johnston is an engineer with a lifetime passion for sailing. His experience includes 16 and 18 ft skiffs, Etchells, sportsboats and ocean racing yachts from 36 ft to 66 ft, and has trained with the crew on board *Australia II*. He pioneered the use of Gore-tex fabric for sailing and his foul weather gear received an Australian Design Award. Greg has been involved in the development of the SRW technology since its inception and is responsible for the engineering design. Having been involved in the wing development for NYYC *American Magic* for the previous America's Cup, Greg is now actively working on commercialising SRW technology for merchant shipping with EU Horizon funding.

Ken Goh

Victoria

Technical Challenges in Developing Offshore Wind

Chris Carra, Director of Offshore Energy at AMOG Consulting, and Ralf Skowronnek of Skowronnek & Bechnak GmbH (leading risk advisors to the offshore wind sector), gave a presentation on *Technical Challenges in Developing Offshore Wind in Australia* to a meeting at the Mission to Seafarers in Docklands and streamed live via Zoom on 2 March. This presentation attracted 6 attendees and a further 10 participating online on the evening.

With an ever-increasing number of offshore wind-farm proposals, this is an area of great importance to the maritime industry in Australia; we are in a great position to take in the knowledge generated by engineers from around the world.

Commonwealth and State Governments are both endorsing offshore wind as the next frontier for energy generation, and so there will be significant offshore activity in our coastal waters. However, Australia remains behind the likes of China and Europe in developing our wind resource which is of higher quality than either of those regions. This presentation outlined some of the technical challenges in developing offshore wind and bringing the lessons learned back into the Australian context. Specifically, this presentation outlined the challenge of Australianising different offshore wind technologies, presented the what, why and how of some specific failures from floating wind in Europe, and the lessons learned from oil-and-gas operations in southern and eastern Australia to ensure that the offshore wind industry learns from these mistakes.

Worldwide there are some 30–35 GW of wind-energy generation (45% of which is in China), but this is climbing rapidly with an estimated 17 GW in production. Only 10% of this capacity is from the 215 current offshore wind farms. Offshore wind offers more-consistent wind profiles with potentially-better spacing between turbines, but at the cost of much greater installation and maintenance costs. Installation and maintenance advances therefore offer a great way of taking advantage of this enormous potential…..enter the offshore engineer.

The opportunities for Australia are immense compared with Europe and China (the two main centres of existing wind turbines), but the environment is very hard to deal with…. enter the offshore engineer.

Ralf and Chris can see a range of solutions from fixed structures to tension-leg platforms and spa buoys, but semi-submersible and barge-type arrangements are also feasible designs. However, the challenges don't stop with design. Ralf and Chris detailed a number of challenges in the supply chain, installation, maintenance, port infrastructure and, ultimately, the cost and potential return.

The conclusion is, though, that the opportunities for Australia are immense. Like the offshore-engineering challenges of the past, Australia stands to benefit immensely by tackling these challenges.

The presentation was recorded and is expected to be available soon on the RINA YouTube channel.

Adventures in Antarctica

Captain Jorgen Berg gave a presentation on *Adventures in Antarctica* to a meeting at the Mission to Seafarers in Docklands and streamed live via Zoom on 16 March. This presentation attracted 8 attendees and a further 7 participating online on the evening—but competing with the opening night of the AFL season!

Jorgen's presentation covered his four trips to Antarctica onboard Danish supply vessels. He was born in Denmark and his first voyage was as a deck apprentice for ten months onboard Lauritzen lines' MV *Kista Dan* (an Ice Class 1 ship with a fully-enclosed crow's nest and helideck) in 1962–63, doing a resupply voyage for the British Antarctic Survey. Jorgen described the voyage from the UK, where the scientists and expedition personnel embarked, to Port Stanley in the Falklands, then Deception Island, and on to Antarctica. His video of how *Kista Dan* was driven to break through ice was unforgettable—watch it on YouTube! Despite the ship's ice-breaking ability, sometimes she could be stuck fast in ice for up to 30 days! Jorgen also showed some photos of *Kista Dan*'s interesting stern design features which protected the propeller and rudder from ice damage.

As a historical footnote, Kista Dan had previously, in 1953–54 (and prior to Jorgen's time on her), been used by Dr Phillip Law to establish Mawson Station for the Australian Antarctic Division. Also, as a matter of interest, *Kista Dan* was the first of the Lauritzen Lines vessels to subsequently sport the vivid red/orange colour which has since become emblematic of polar ships.

Kista Dan
(Photo from Australian Antarctic Program website)

Jorgen later saw active service in the Royal Danish Navy, serving in mini-corvettes from 1967 to 1969. Then, with his appetite for the South Atlantic and Antarctic whetted, he returned on a further three separate voyages in 1970–71 as First Officer, then 1974–75 and 1976–77 as Chief Officer, all onboard MV *Thala Dan*.

Thala Dan
(Photo from Australian Antarctic Program website)

He spent a total of 18 months onboard these vessels, undertaking various re-supply tasks in different locations. He gave some interesting comparisons of different methods used to transport cargo from the ships to the shore; progressing from rubber inflatable barges to DUKWs to LARC-Vs. He also explained, and showed pictures of, aircraft being carried on the ships and flown to spot routes through the ice. Jorgen finished by giving an overview of more contemporary resupply methods and of modern icebreaking ships used by Australia and other countries.

Jorgen now lives in Australia, after many years of seagoing experience and senior port-management roles in the USA, Dominican Republic, France and Denmark.

The presentation was recorded and is expected to be available soon on the RINA YouTube channel.

Tom Dearling

New South Wales

Annual General Meeting

The NSW Section held its 25th AGM on the evening of 5 April, following the March technical presentation in the Kirribilli Room at the Royal Sydney Yacht Squadron, with Belinda Tayler in the chair.

Belinda, in her second Chair's Report, touched on some of the highlights of 2022, which included eight joint technical meetings with the IMarEST (ACT & NSW Branch), with attendances varying between ten for Dave Giddings' presentation on *Modern Technology Resins, Coatings and Glues* and 92 for Lachlan Toohey's presentation on *Hover-capable Autonomous Underwater Vehicles: Design and Use Cases.* SMIX Bash 2023 was successful and was attended by 200, including a number of interstate guests.

Adrian Broadbent had circulated the Treasurer's Report prior to the meeting. With technical presentations being all online in 2022, our expenses have been minimal. SMIX Bash is funded separately through the Social account which currently has a healthy balance which will enable preliminary arrangements for SMIX Bash 2023.

Elettra Ganoulis was elected to the Committee at the January meeting of the NSW Section Committee, and all other members have agreed to continue in current positions for a further year, giving us a full Committee. As a result, the Committee for 2023 is as follows:

Chair	Belinda Tayler
Deputy Chair)	Phil Helmore
TM Program Coordinator)	
Treasurer)	Adrian Broadbent
AD Council Nominee)	
Secretary	Lauren Stotz
Auditor	David Wong
Members	Craig Boulton
	John Butler
	Valerio Corniani
	Elettra Ganoulis
	Ehsan Khaled
	Molly McManus
	Alan Taylor

Committee Meetings

The NSW Section Committee met on 14 March and, other than routine matters, discussed:

- SMIX Bash: Accounts for SMIX Bash 2022 finalised with a modest surplus; IMarEST share of surplus to be paid and donation to SHF made; booking for *James Craig for* SMIX Bash 2023 to be confirmed.
- TM Program: Schedule of presentations revised slightly, and one presentation by IMarEST to be arranged.
- AGM: To be held at the Royal Sydney Yacht Squadron following the April technical presentation.

The next meeting of the NSW Section Committee is scheduled for 23 May.

Electric-drive Technology for Tugs

Tom Charter, Damen Shipyards Representative for Australia, New Zealand & South Pacific, and Sale & Purchase Manager with Australian Independent Shipbrokers/Asiaworld Shipping Services, gave a presentation on *Electric-drive Technology for Tugs—The Future is Now*, to a joint meeting with the IMarEST in the Harricks Auditorium at Engineers Australia's new premises at 44 Market St in the Sydney CBD and streamed live on 9 February. The presentation was attended by 24 with an additional 125 online.

Introduction

Tom began his presentation with some brief details of Damen's operation, which involves a team of 12 000 people over 36 shipyards across five continents.

This project actually began back in 2014 with the delivery of the Damen ASD 2411 diesel tug *Hauraki* to the Ports of Aukland Limited (POAL), who were already investigating future options. In 2016 POAL stated that their goal was to be emissions neutral by 2025, and emissions free by 2040.

In 2018 a feasibility study on full-electric operation of tugs was completed, and in 2019 the concept design came to fruition. Construction commenced in 2020, and the first vessel, *Sparky,* was delivered in 2022. The vessel was awarded the ITS (International Tug and Salvage) Boat of the Year 2022, and *Time* magazine's Best Invention—Transportation 2022.

Sparky

Sparky is the first Damen RSD-E 2513 tug. The vessel has a length of 24.73 m, and a draft of 6 m, with two azimuthing thrusters with 3 m diameter propellers giving a bollard pull of 70 t, the same as the ASD 2411 diesel tug *Hauraki*.

The vessel is powered by eight battery racks holding 2240 batteries, totalling 2784 kWh of power. This is anticipated to save about 465 t of CO_2 in diesel emissions annually.

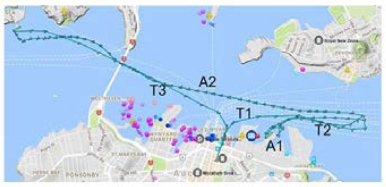
Sparky
(Photo from workboat365 website)

Considerations

Redundancy would be needed for delivery and docking voyages and for fire-fighting operations. Electrification is already present in the port and so there is readily-available and affordable renewable power.

The operational profile of a typical harbour tug shows less than 2% of full load, with significant periods at idle and low load.

A detailed operational analysis was conducted on the existing operation of *Hauraki.* This entailed a profile with two towing jobs right after each other. The first job was relatively nearby the home base, and the second job was further away.

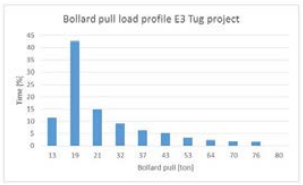


Operation	Average speed [kts]	Duration [min]
T1 - Transit 1	9.1*	11
A1 - Assist 1	-	38
T2 - Transit 2	4.1	37
A2 - Assist 2	-	94
T3 - Transit 3	8.1	10

Hauraki jobs profile
(Image courtesy Damen)

The tale and figure below show the typical profile for a tug during an assisting operation. The profile is based on the research in the E3 tug project and is used for the A1 and A2 operations. The E3 tug profile is used for the calculation because the load profile cannot be derived from the AIS data.

Mode	BP [t]	Time [% assist]	Time job 1 [minutes]	Time job 2 [minutes]
1	13	11.5	4	11
2	19	42.7	15	40
3	21	14.9	6	14
4	32	9.1	3	9
5	37	6.2	2	6
6	43	5.3	2	5
7	53	3.4	1	3
8	64	2.4	1	2
9	70	1.9	1	2
10	76	1.7	1	2
11	80	0.1	0	1
		Total:	38	94



Typical operational profile
(Image courtesy Damen)

Available Technologies

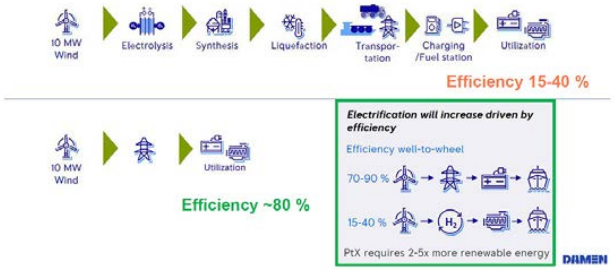
The technologies available include after-treatment for diesel fuels, bioFuels and eFuels which will give reductions in CO_2 emissions, but zero emissions really require electric propulsion or hydrogen/fuel cells.

	A	B	C
	Low emissions	CO_2 reduction	Zero emission
Technology (short term < 4y)	Aftertreatment	BioFuels	E-propulsion
Technology (long term > 4y)	(Aftertreatment)	eFuels	H_2 / Fuel Cell
Driver	IMO regulations (NO_x/SO_x) EU (NO_x/SO_x/PM)	Paris Agreement 2015 IMO EU	Paris Agreement 2015 IMO EU

Available technologies
(Image courtesy Damen)

Economic Viability

The efficiency of a system to generate hydrogen, liquefy, transport and use it in a fuel cell for power is much lower than the efficiency of directly using electricity for power.



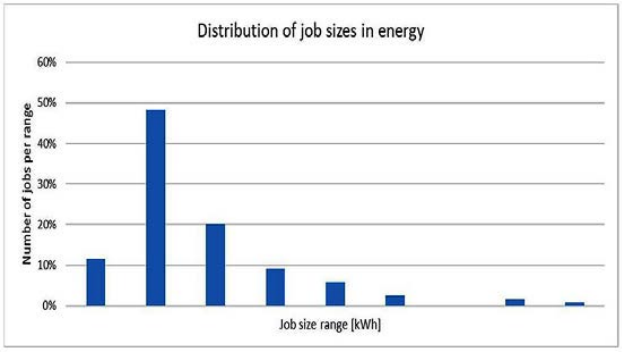
Economic viability
(Image courtesy Damen)

Electric System

Damen came into this project with the philosophy that they are a system integrator. They wanted a modular and scalable design which could be used world -wide, and with the lowest total cost of ownership.

The energy storage capacity was adapted to meet the

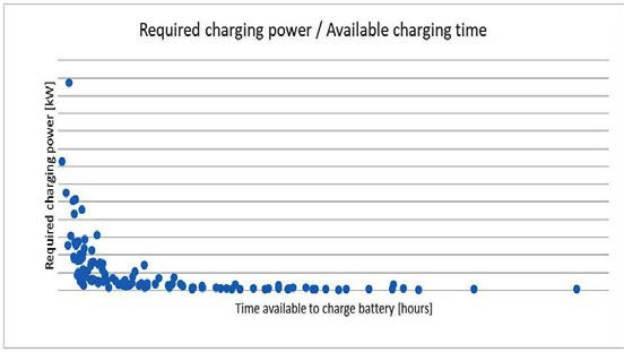
POAL operational requirements. These included up to four berthing/unberthing operations per charge with 50% battery capacity remaining, complete re-charge within two hours, and high-autonomy operations on diesel generator sets for extended transits to maintenance facilities when required.



Distribution of job sizes in energy
(Chart courtesy Damen)

Charging Power

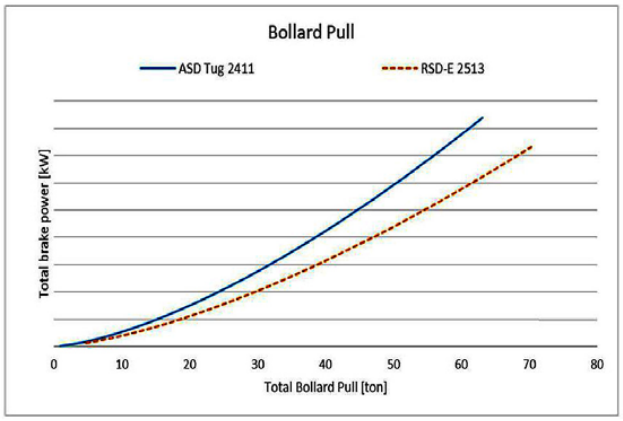
For the required charging power, they analysed the operational profile, subject to the requirement of complete charge within two hours. They could, of course, have back-up charging from the generator sets, but this was not factored in to the profile.



Required charging power
(Graph courtesy Damen)

Discharging Power

Sparky is able to achieve 70 t bollard pull and 12 kn free-running speed on batteries. On the diesel generator sets 40 t bollard pull is achieved. The vessel has been optimised for propulsion efficiency, and bollard pulls are achieved with less power output than a diesel-driven tug.



Power vs bollard pull
(Graph courtesy Damen)

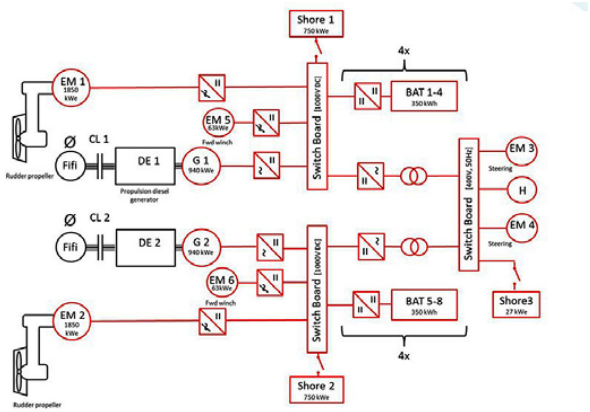
Battery System

The battery system is based on the Toshiba lithium titanium oxide (LTO) battery module with the Toshiba battery-management system (BMS) up to string level, including protection. Racking uses the Eschandia Marine System BMS. The expected lifetime is 30 000 cycles or 30 years. The system is classed by both DNV and BureauVeritas.

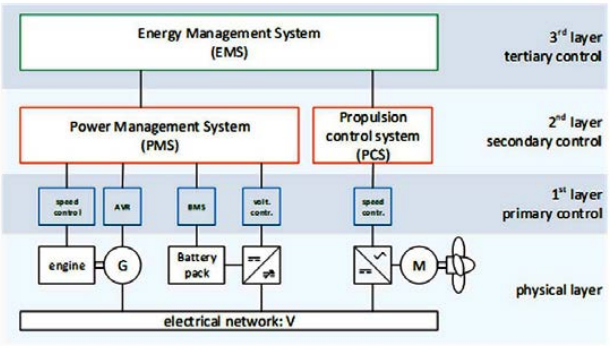
Generator Sets

Sparky is fitted with twin generator sets for back-up, range extension (for delivery and maintenance voyages) and fire fighting. Caterpillar C32 diesel engines which are IMO Tier 3 certified with Damen SCR systems driving Leroy Somer generators for 940 eKW each at 1800 rpm. There is also an optional fire-fighting pump.

Electric and Control Systems



Electric system schematic
(Drawing courtesy Damen)



Control system schematic
(Drawing courtesy Damen)

Operating Modes

Battery Mode

- Under way—Full battery mode with zero emissions.
- Moored—Vessel is at the quayside and being charged by the shore charging station.

Genset Mode

- Under way—Both C32 diesel engines are powering the generators for propulsion without battery power.
- Moored—Both C32 diesel engines are powering the generators for charging without shore power.
- Fire fighting—Both C32 diesel engines are powering the fire-fighting pump and the generators for propulsion simultaneously without battery power.

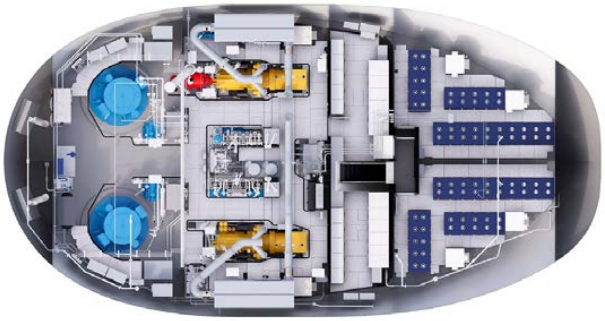
Hybrid Mode

- Under way—Both C32 diesel engines are powering

the generator for propulsion and/or battery charging. When necessary, batteries are supplying boost power. Maximum performance and autonomy of the vessel are available in this mode.

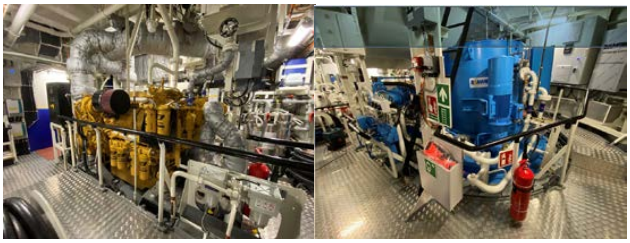
- Moored—Vessel is at the quayside and both C32 diesel engines are powering the generator for fast charging the batteries together with the shore charging station. Completely charging the batteries within 1 h is possible in this mode.

General Arrangement



Arrangement below main deck
(Image courtesy Damen)

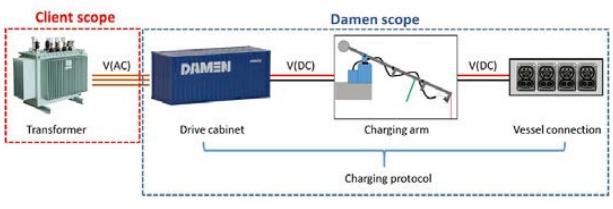
Battery room | Switchboard room



Engine room | Rudder propeller room
(Photos courtesy Damen)

Charging Requirements

The time for the batteries to charge fully from shore power is 2 h at 1.5 MW. Connection and disconnection can be completed in 5 min.



Shore power charging schematic
(Diagram courtesy Damen)

A charging arm of robust and simple design provides for tidal difference compensation and allows one-man operation from the quayside or on board the vessel.

Charging arm | Connection terminal box
(Photos courtesy Damen)

The charging cables are automotive High-power Charging (HPC) cables which are compact and lightweight, allow easy handling, and are an off-the-shelf product. The 1.5 MW charging power requires four 375 kW cables, and the shore-power connection terminal box is located on the starboard funnel.

Conclusion

Damen's RSD-E 2513 tug *Sparky* provides zero emissions (and hence no future CO_2 tax), low electricity costs due to high efficiency, low maintenance costs, low financing costs, no fuel costs, and low total cost of ownership. The technology is available and the infrastructure is available. The future is now!

Questions

Question time was lengthy and elicited some further interesting points.

The presentation was recorded and is expected to be available soon on the RINA YouTube channel.

The vote of thanks was proposed, and the "thank you" bottle of wine presented, by Adrian Broadbent. The vote was carried with acclamation.

Tom Charter (R) and Adrian Broadbent
(Photo Phil Helmore)

Remediation of the LHD Propulsion Issues

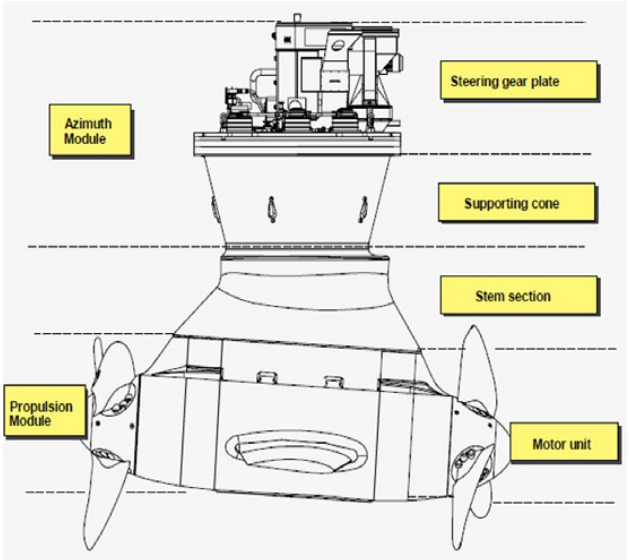
Philip Baldwin, Independent Contractor to Defence, Maritime Sustainment Division, gave a presentation on *Remediation of the LHD Propulsion Issues*, to a joint meeting with the IMarEST in the Henry Carmichael Theatre, Sydney Mechanics School of Arts in the Sydney CBD, and streamed live on 1 March. The presentation was attended by 20 with an additional 29 online.

Introduction

Phil began his presentation with the background to the issues. The Australian LHDs, HMA Ships *Canberra* and *Adelaide,* entered service in 2014 and 2015. Principal particulars of the vessels are

Length OA		230.82 m
Length WL		207.20 m
Length BP		207.20 m
Beam	(maximum)	32.00 m
	(moulded)	29.93 m
Depth	(moulded)	27.50 m to Flight Deck
Draught		6.80 m
Displacement		27 400 t
Main engines		2×MAN 16V32/40 gensets each 7.45 MWe at 6600 V 60 Hz 3 ϕ
		2×GE LM2500 GT gensets 22 MWe
Propulsion units		2×Siemens azimuthing thrusters

HMAS *Canberra*
(RAN photograph)



Overview of propulsion unit
(Drawing from Siemens technical manual, courtesy Defence)

The problems affecting the performance of the two Australian LHDs were profound, complex, and often interrelated. There were two aspects to the issues: technical and commercial. To deliver effective technical solutions there was a need to agree on commercial terms. However, this presentation looks only at the technical issues.

The LHDs were delivered with a number of complex problems which affected the propulsion system directly and impacted the general performance of the platform:

- Corrosion of the propellers: first the nuts holding the propeller blades onto the boss corroded. These were replaced with duplex stainless steel nuts, but then the propeller blades corroded!
- Excessive leakage of water and oil into the pod bilges.
- Cavitation erosion of the propeller blades.
- Complaints from ship's staff about high vibration levels: A notation of CEPAC2 (for Crew and Embarked Personnel Accommodation Comfort 2) had been awarded to the vessels by Lloyd's Register. However, as-built CEPAC2 measurements turned out to be non-compliant with LR rule requirements. High vibration levels were attributed to cavitation, consistent with blade erosion.

Investigations

A Transition and Remediation Program (TaRP) team was assembled, and led the extensive propulsion investigations into:

- propeller blade cavitation and erosion;
- propeller corrosion issues; and
- pod equipment issues.

Key players in the investigations were:

- Commonwealth of Australia (CoA): Naval Technical Bureau (NTB)/Directorate of Naval Engineering (DNE), Defence Science and Technology Group (DST), LHD Systems Program Office personnel, and LR's Technical Investigation Department (TID).
- Industry: Navantia (ship designer and system integrator), and Siemens (pod OEM)

Investigations initiated in 2016 included

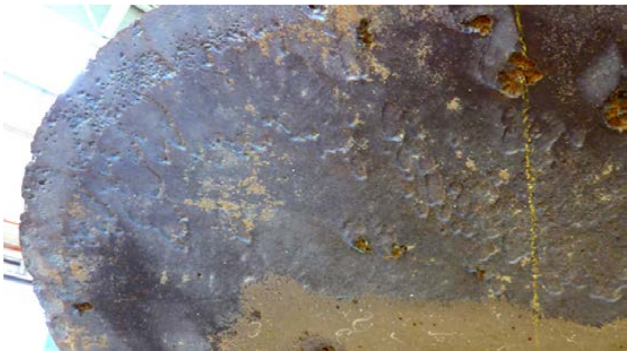
- Corrosion Investigation: This was led by NTB and DST and identified a number of issues which were leading to galvanic corrosion of the propeller blades including the impressed-current cathodic protection (ICCP) not performing to the design intent.
- Vibration Investigation: LR's Technical Investigation Department (TID) was contracted in July 2016 to undertake whole-of-ship structural vibration and CEPAC2 surveys, but no ship time was allocated.

Then, within a single 24 h period in early March 2017, HMAS *Canberra* suffered excessive water/oil ingress in the propulsion pods resulting in a pod being locked and the vessel returned to Fleet Base East, and HMAS *Adelaide* was identified to have oil-quality issues, resulting in the vessel returning to Fleet Base East with a pod unavailable.

Consequently, in April 2017 the TaRP was formed to investigate and remediate LHD material shortcomings. Both LHDs were docked, HMAS *Addelaide* in May/June and HMAS *Canberra* in September/October. Pods were returned

to standard with a five-year overhaul and new three-bladed propellers fitted on both vessels.

HMAS *Adelaide* propeller blade with tip-vortex cavitation and corrosion material removed at May 2017 dry docking after 19 months in service
(Photo courtesy Defence)



HMAS *Adelaide* propeller blade showing corrosion under stable sheet cavitation at May 2017 dry docking after 19 months in service
(Photo courtesy Defence)

Sea Trials in 2017

Following the docking of HMAS *Adelaide*, an extensive trials program was undertaken with the following aims:

- Re-commissioning of the overhauled propulsion pods.
- Determine the structural vibration characteristics of the LHD platform via an empirical modal analysis (EMA), and the structural response with the ship underway.
- Assess compliance with CEPAC2 requirements for vibration only (not noise).
- Measure hull pressures above the propellers.
- Observe propeller hydrodynamic performance.
- Conduct local vibration analysis of the ship's structure and machinery as required.
- ICCP and hull potential measurement and analysis.
- Multiple additional trials and tests related to sewage-treatment plants, air-conditioning plants and chilled-water systems, fire pumps, etc.

After the trials on HMAS *Adelaide,* the trials the programme was refined for HMAS *Canberra* to look at specific areas of concern, e.g. the main switchboards and masts.

Structural Analysis

The empirical modal analysis was conducted and showed:

- On the Flight Deck and Superstructure, a mode was identified at 7.4 Hz corresponding to the propeller first blade rate at 148 rpm, characterised by rolling motion of the Flight Deck and Superstructure. The solution would be to reduce the propeller pressures exciting the hull.

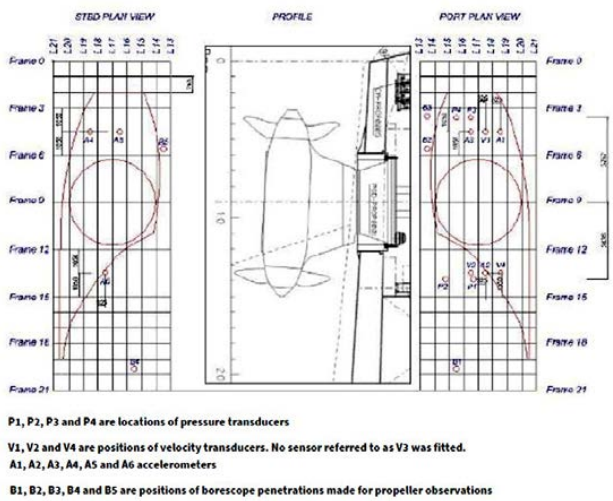
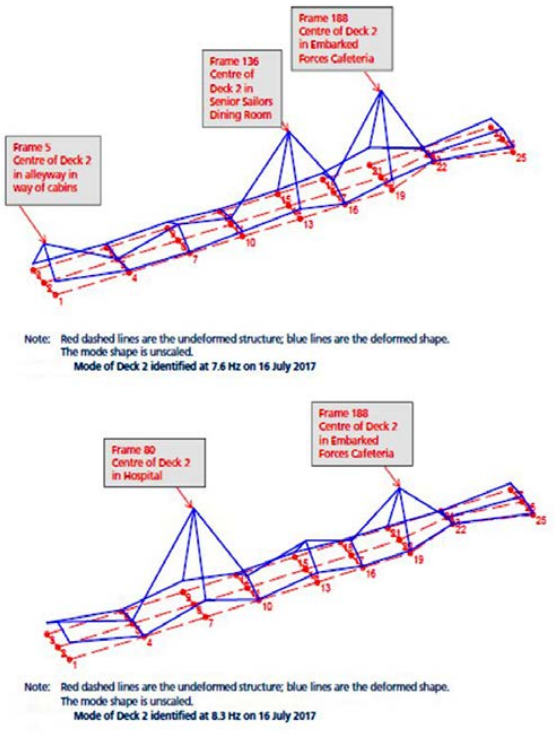


Diagram showing locations of propeller pressure observations
(Diagram courtesy Defence)

- On 2 Deck, modes were identified at 7.6 Hz and 8.3 Hz corresponding to propeller first blade rates of 152 and 166 rpm respectively. The solution would require structural modifications to 2 Deck and reducing the propeller pressures exciting the hull.
- On the Aft Mast, local modes were identified at 5.9 Hz and 6.8 Hz, with vibration amplitudes exceeding MIL-STD-167-1 for electronic equipment. The solution would require local structural modifications to the mast and reducing the propeller pressures exciting the hull.

The maximum propeller pressures exciting the hull were measured at just above 5 kPa zero-to-peak at close to MCR. Vessels with passenger and crew comfort typically have lower hull pressures, e.g. 2–4 kPa.

For the excitation force, the first blade rate of the propellers was determined to be the dominant source of vibration.



Results of empirical modal analysis on 2 Deck
(Diagram by LR TID, courtesy Defence)

Accommodation Comfort

In the trials program, the vessels were tested for compliance with LR's CEPAC2 notation, but with only vibration measured, no noise measurements. It was found that 52 compartments were above CEPAC2 limits for vibration, and 40 of the 52 were on 2 Deck! The Primary Casualty Reception Facility (PCRF; i.e. the hospital) was particularly badly affected, with CEPAC2 limits exceeded at a number of speeds. Exceedances could be expected to occur at lower speeds than at 85% MCR, the trial speed, but several exceedances were identified in the PCRF at even lower speeds.

Propulsion Pods

Two new propulsion pods were ordered in April 2018 for two main reasons: in the event of a total failure of a pod, for operational reasons a two-year lead time for a new pod was deemed unacceptable, and at mid-life refit, the time required for pod motor overhaul would result in an unacceptably-long docking maintenance period.

The main reason for the two-year lead time for new pods was that the material used to manufacture the motor permanent magnets comes from Russia, and that was before the war in Ukraine!

The Way Ahead — Structural Vibrations

The structural vibration problems were complex and multifaceted.

Navantia undertook further investigations on their prototype vessel, *Juan Carlos I*, including EMA of a pod in dry dock and found a natural hull frequency of approximately 7.8 Hz at 156 rpm. This aligned and was coincident with predominant natural frequencies found here, particularly on 2 Deck.

Navantia estimated up to 4% variation of thrust seen by the forward and aft propeller blades. They also found erosive cavitation and excessive hull pressures related to complex wake fields.

The solution options included redesign of the propellers, and/or stiffening the platform, i.e. structural changes.

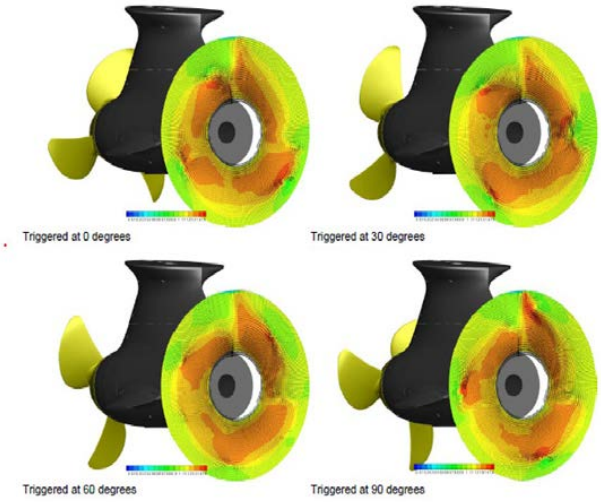
Propeller Redesign

Propeller redesign was considered the simplest and cheapest option, but it was *not* simple or cheap!

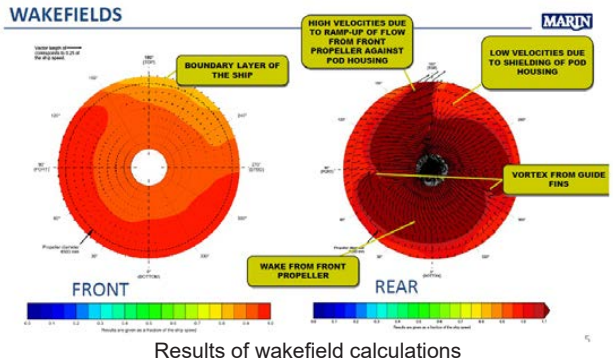
One option was to increase the number of blades on the propellers. This option would reduce the thrust seen by each blade, improve the wake-field flow onto the aft propeller, and lower the speed and therefore the power (excitation force) at which resonance occurs.

Prior to delivery of the Australian LHDs, the pod OEM/Navantia had engaged MARIN to modify the aft propeller pod to improve performance, and MARIN had tank tested a model. In late 2018, MARIN was provided with SATs propeller cavitation video and trials data from HMAS *Canberra*. They then re-ran earlier tank tests and adjusted scale and model coefficients to replicate, under tank test conditions, the hydrodynamic performance and cavitation observed at sea. This provided assurance that future tank testing of a new propeller design would closely replicate the actual performance at full-scale. Early in 2019, MARIN conducted particle-image velocimetry (PIV) testing and CFD modelling to determine the wake-field characteristics at the rear of the pod (behind the rotating forward propeller) i.e. on entry to the rear propeller. This information was shared with the pod OEM and Navantia to inform the re-design.

MARIN's pod model with forward propeller, and the green line showing the measurement plane of the PIV system to determine the wakefield flow into the aft propeller
(Photo from MARIN Report 27507-6-DT, courtesy Defence)



Orientation of front propeller and resulting velocity fields
(Image from MARIN Report 27507-6-DT, courtesy Defence)



Results of wakefield calculations
(Image from MARIN Report 27507-6-DT, courtesy Defence)

Four-bladed Propeller Design Study

A design study for a four-bladed propeller was initiated in May 2019, with the CoA contracting Navantia to manage the study. The propeller design specifications called for the same formal design criteria as the original plus, in priority order:

- Low shaft excitation forces.
- Prevention of cavitation erosion damage.

- Reduced vibration caused by propeller cavitation.
- Efficiency.
- A delayed cavitation inception speed.
- Prevention of inboard propeller noise.
- Reduction of hull pressures from 5 kPa to between 2 and 4 kPa.

The original intent of the study had been for the pod OEM to work with MARIN on propeller redesign. However, the OEM was not in favour of the four-bladed approach, and teamed with another propeller designer to redesign the three-bladed propellers, making this a Mk 5 variation for the aft propellers.

Navantia teamed with MARIN to design a four-bladed propeller solution. Navantia, as the ship integrator, was tasked to advise the CoA on which was the optimal design.

The OEM had reservations about the motor shaft dynamic performance, in particular lateral vibrations—their preliminary calculations indicated that the 6 mm motor air gap would close if four-bladed propellers were used. CoA was not convinced of the validity of these findings as there was insufficient evidence to support them.,

OEM Propeller Design

The propeller designer developed a three-bladed propeller design to the OEM's requirements. These propellers were highly skewed (37 degrees of skew), both forward and aft. The design required a redesign of the pod fins, where the redesign specifications called for the original fins to be retained.

3D model of the complete OEM redesign for the LHD vessels
(Image courtesy Defence)

MARIN Propeller Design

MARIN designed a four-bladed monobloc propeller (compared to the original design in which the blades were bolted to the boss). The monobloc design was a result of being constrained by the requirement to keep the boss to the original fundamental dimensions but incorporate an extra blade. The benefit was that the propellers had much cleaner lines and removed the need for the bolted securing arrangements of the blade which contributed to turbulence. The disadvantage would be that, if one blade were to be damaged, it would require replacement of the whole propeller. In the redesign the forward propeller was skewed and the aft propeller highly skewed. The forward and aft boss caps were different in length and form.

Tank Testing of New Propeller Designs

A number of different types of tests were undertaken:

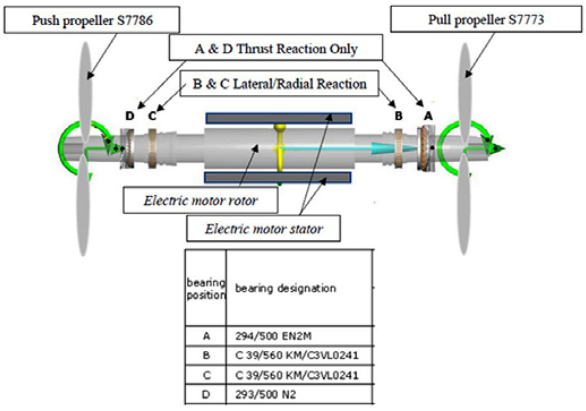
- Open-water tests, with a pod model towed along the tank without the model hull to determine the loading of the forward and aft propellers and the open-water efficiency.
- Propulsion tests, with the model pod attached to the hull model to determine the power and shaft rpm of each design, run at both 100% and 80% MCR.
- Cavitation tests in open water with observations carried out in various conditions with the pod model towed along the tank without the model hull.

The results of the propulsion tests showed that the speed/power performance of both designs were almost identical, with the shaft rotation rate about 1 rpm higher than the design specification.

The cavitation tests showed that the three-bladed bladed design had erosive cavitation on both the forward and aft blades. The four-bladed design showed no erosive cavitation, and root cavitation on the aft blades could be eliminated by design modification. The hull-pressure fluctuations levels were lower for the four-bladed design than the three-bladed design overall. The three-bladed design had higher harmonics, with amplitudes greater than 1 kPa. The total hull excitation force in the vertical direction (F_z) was about 50% less for the four-bladed design than for the three-bladed design.

Pod Shafting Vibration Analysis

The pod OEM's initial calculations indicated that four-bladed propellers would result in unacceptable levels of lateral shaft vibrations and the air gap in the motor would close. There were differences of opinion on the methodology for the determination of propeller forces and the analysis of the shafting vibratory response. Consequently, the CoA decided that independent modelling and analysis was required and contracted LR TID (Southampton) through Navantia to conduct shafting vibratory analysis using input data (propeller forces) from both MARIN and the pod OEM. Extensive modelling was conducted.



Bearing general arrangement of the pod OEM's three-bladed redesign
(Drawing by LR TID, courtesy Defence)

In summary, the results showed:

- Axial vibration: No first or second harmonic blade-rate axial vibrations occurred in the speed range, so this was unlikely to be a cause of concern.

- Torsional vibration: Extensive model scenarios were completed, including manoeuvring, and results indicated that torsional vibrations were unlikely to be a cause for concern.
- Lateral vibration: The maximum half-range vibratory lateral direct stress evaluated by forced damped analysis across 14 operating manoeuvres was 25.74 MPa, and unlikely to be a cause for concern.
- High-cycle fatigue combined torsional and reverse vibration: High-cycle fatigue safety factors for 10^{10} cycles including torsional and bending stress concentration was assessed against DNV guidelines, and a safety factor of 4.75 resulted, and so waas unlikely to be a cause for concern.
- Total Stress and Low-cycle Fatigue Combined Torsional and Reverse Bending: For notched shaft locations a safety factor was calculated at 4.63, indicating that yield reversals were unlikely to occur.
- Electric motor air gap: The minimum safety factor on the electric motor air gap of 3.28 mm was 26.8 and 3.6 for vibratory and total lateral shaft displacement, respectively. This meant that, in the worst condition, the air gap was 3.6 times larger than the radial movement of the shaft and the electric motor air gap would not be compromised.

The conclusion of the shaft vibration analysis was that, with the MARIN four-bladed propellers, the propulsion unit vibratory response was acceptable.

Re-design Conclusions

The overall conclusions of the redesign and testing program were:

The pod OEM's propeller designer produced three-bladed propellers which fulfilled all CoA requirements *except for* erosive cavitation, and the hull pressure fluctuations at the second and third blade passing frequencies were considered too high. This was therefore not a valid option without modifications.

The MARIN four-bladed propellers fulfilled all of the CoA requirements, noting that they had the potential to reduce thrust fluctuations by 77% of the original three-bladed propellers at 7.8 Hz, whereas the OEM three-bladed propellers had the potential for a 32% reduction of thrust fluctuations. Shaft vibration analysis indicated that the performance of the four-bladed propellers would be satisfactory.

After further discussions and negotiations with the pod OEM, the CoA selected the MARIN four-bladed propeller design.

Four-bladed Propeller Procurement

The CoA contracted Navantia (Australia) to:

- Produce manufacturing drawings for the new four-bladed propellers and their bosses.
- CoA review of drawings conducted by the Naval Technical Bureau/Directoratre of Naval Engineering.
- Obtain LR class approval for the new design in accordance with LR's Naval Ship Rules as at January 2019.
- Procure three ship sets of the four-bladed propellers, with the delivery of the first set in time for HMAS *Canberra*'s planned docking in September 2020.
- Identify suitable propeller manufacturers capable of meeting all of the requirements, and utilise Australian industry if possible.
- Manufacturing acceptance criteria in accordance with ISO 484/1 Shipbuilding—Ship Screw Propellers Manufacturing Tolerances, Part 1: Propellers of Diameter greater than 2.5 m.

Navantia sent a request for tender to three Australian and six international companies, covering Asia, Europe and the USA. Tender evaluation was conducted by a joint Navantia–CoA team.

Australian industry was unable to cast propellers of this size; the mass of the aft propeller at 14.5 t required a 20 t mould in-country and were uncompetitive on price. Not all international suppliers responded. However, the successful manufacturer provided a complete tender response and was able to meet all of the requirements, including the tight schedule, and so was awarded the contract.

Propeller Manufacture

Quality assurance was provided by the LR local office/surveyor, as CoA and Navantia were unable to conduct any inspections because of pandemic-imposed travel restrictions. The manufacturer provided very comprehensive production schedules and progress reports for the three ship sets of propellers. Each of the propellers in a ship set is different, although the boss caps are the same for both forward propellers, and the aft boss caps are the same for both aft propellers.

Setting up the mould for one of the new propellers
(Photo courtesy Defence)

Sea Trials

The first ship set was fitted to HMAS *Canberra*, and this was followed by propulsion plant commissioning and acceptance in six phases.

Following acceptance, there were vibration surveys, propeller observations and CEPAC2 noise and vibration measurements conducted to determine the effectiveness of the new propellers. Multiple non-propulsion-related trials were also carried out.

Environmental conditions for trials required Sea State 3 or less, with a depth of water of at least five times the nominal draft of 7 m. The helm was kept to a minimum, with a maximum of five degrees, for steady course trials.

Propulsion trials included pod run-in and heat runs, steering trials, and a crash stop.

Structural Vibration Survey

A structural vibration survey was carried out to re-evaluate the structural response of the vessel at the same locations as those measured in 2017 and to determine the background (environmental) levels of vibration in the magazines and on the Nulka launchers.

For the survey, vibration transducers were installed at key locations in the ship, with three different configurations to cover the extensive survey for three separate days of trials. Pressure transducers were also installed in the hull plating above the forward and aft propellers, which were accessed via the pod void spaces.

For the vibration survey, the propeller speeds were increased progressively up and down through the operating speed range. During run ups, measurements were taken in 2 shaft RPM increment steps up to the maximum shaft rpm and, at each speed, data was recorded for two minutes. During run downs, measurements were taken in 3 shaft RPM decrement steps from maximum shaft rpm, followed by 5 shaft RPM decrement steps from mid-power to minimum rpm.

Propeller Observations

Borescope observations of propeller performance were conducted during run ups and run downs at zero helm by simultaneously viewing from four locations on the port side. Small-angle manoeuvring trials were conducted at 0, 6 and 10 degrees of helm at 90, 115, 140, 160 and maximum RPM. The observation trials took approximately 10 h to complete, as they were required to be taken in daylight with the sun on the side where observations were being made.

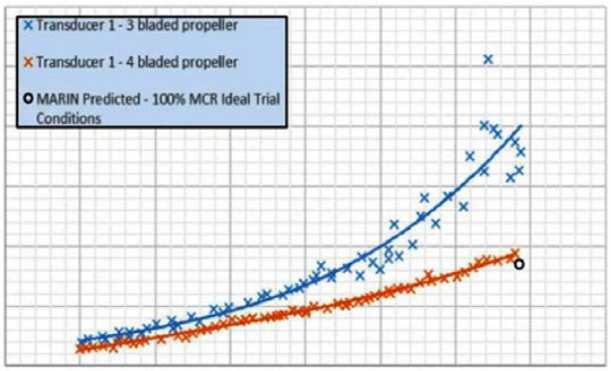
The objective of the propeller observations and pressure measurements was to determine the comparative changes in terms of propeller cavitation and associated hull pressure levels of the four-bladed propeller design against the original three-bladed design. The main findings were:

- No sheet or root cavitation was observed during run ups or run downs on the forward propeller. Tip vortex cavitation was observed from 130 to maximum shaft RPM, but assessed as non-erosive.
- No sheet cavitation was observed on aft blades as they passed top-dead-centre. Tip vortex cavitation was present from 62 RPM and boss vortex cavitation from 74 RPM, but assessed as non-erosive.
- Cloudy dispersed cavitation was observed on the suction side root of the aft propeller from 95% of maximum RPM.
- The maximum pressure-pulse single-amplitudes for the forward and aft propellers were within the design acceptance levels.
- Pressure pulse levels for the four-bladed propellers reduced by 52% and 29% for the forward and aft propellers respectively, compared to the original three-bladed propellers.

The graph of pressure pulse measurements has an abscissa of shaft RPM and an ordinate of pressure; no units are shown as this is commercially-sensitive information.

In summary, the observations and measurements showed strong correlation with the model tests conducted during the four-bladed propeller design study. The outcome supported and justified the comprehensive methods used to investigate and remediate the propeller problems.

A diver's inspection of the four-bladed propellers after 12 months service found them to be in as-new condition with no cavitation or corrosion damage.



Forward propeller pressure pulses at first-order blade rate
(Graph by LR TID, courtesy Defence)

CEPAC2 Trials

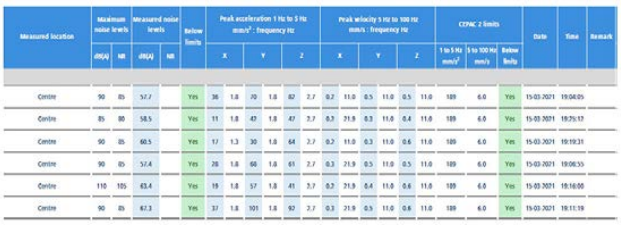
Crew and Embarked Personnel Accommodation Comfort 2 (CEPAC2) sea trials were conducted and required measurement of vibration and noise in about 500 compartments at 90% MCR. Three measurement teams were accompanied by ship's staff for guidance and compartment access. Measurements were completed in 14 hours in one day

CEPAC2 harbour trials were conducted at anchor under normal harbour conditions, but with a reduced number of compartments for survey. Some machinery was required to be operated during the trial, e.g. air conditioning and lifts. These trials were also completed in one day.

Summary of CEPAC2 Noise and Vibration Measurements
(Table by LR TID, courtesy Defence)

Deck/Level	Number of measurements with the vessel underway		Number above CEPAC 2 Noise limit	Number above CEPAC 2 Vibration limits
	Noise	Vibration		
Level 06	1	1	0	0
Level 05	17	12	2	0
Level 04	26	19	4	0
Level 03	14	13	2	0
Level 02	19	17	0	0
Level 01	48	44	0	0
Deck 1	52	50	0	0
Deck 2	173	156	17	0
Deck 3	70	64	0	0
Deck 4	37	35	5	0
Deck 5	24	20	1	0
Deck 6	19	17	0	0
Total	500	448	31	0

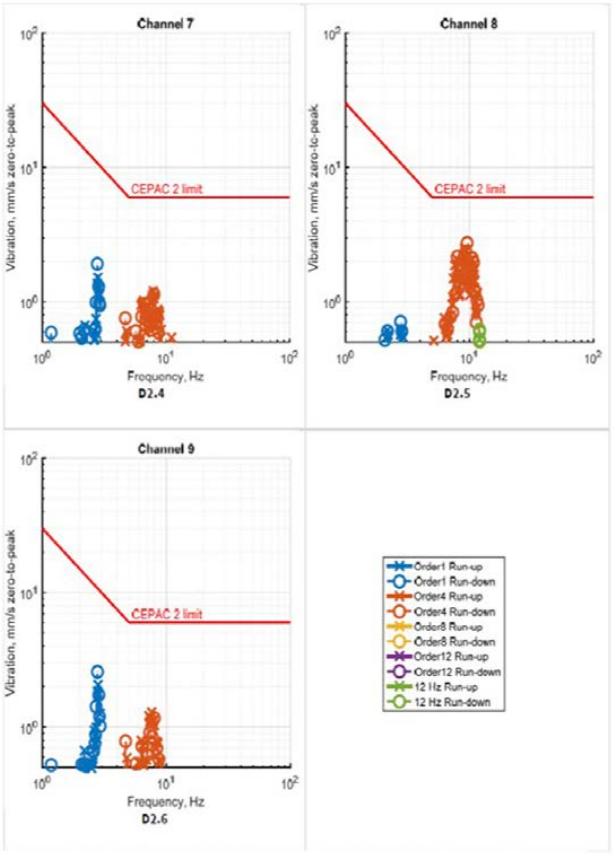
Sample of CEPAC2 results
(Table by LR TID, courtesy Defence)



Reductions in Vibration Levels Compared to 2017

The following reductions in vibration levels, compared to the levels measured in 2017, were achieved in various locations around the vessel:

- Hull plating above the propellers: 60–70%
- Deck 5, main switchboards N1 41% and N2 62%
- Deck 2, Frame 5: 59% (previously above the applicable limit)



Frame 80 PCRF (hospital) vibration levels during run up/run down
(Graphs by LR TID, courtesy Defence)

- Deck 2, Frame 80 in way of the PCRF (hospital): 82% (previously above the applicable limit)
- Deck 2, Frame 138 in way of the Senior Sailors' and Officers' Dining Rooms: 50%
- Deck 2, Frame 189 in way of the Embarked Forces Cafeteria: 68% (previously above the applicable limit)
- Deck 2, Frame 272: 51%
- Level 01, Frame 279: 62%
- Level 04, Commanding Officer's Sea Cabin: 59% (previously above the applicable limit)
- Level 05, Navigation Bridge: 61% (previously above the applicable limit)
- Level 05, Flight Control Room: 59% (previously above the applicable limit)
- Central Mast: 43%

Summary

Propulsion problems suffered by the Australian LHDs were caused by excessive cavitation and thrust variations, with hull pressure pulses higher than normal. Extensive technical investigations were subsequently undertaken to determine the nature and magnitude of the problem. Propeller redesign was considered the most cost-effective solution, and so a design study was undertaken which used empirical field data to inform the design and refine model and scale coefficients for tank testing. Extensive finite-element modelling of the shafting was completed to provide assurance that the system vibratory response within the operating speed range was acceptable and within classification society specifications. Redesigned four-bladed propellers have reduced the vibrations levels in the LHDs to acceptable levels which will not adversely affect the performance of the ship's systems and personnel.

Questions

Question time was lengthy and elicited some further interesting points.

The presentation was recorded and is expected t be available soon on the RINA YouTube channel.

The vote of thanks was proposed, and the "thank you" bottle of wine presented, by Adam Williams. The vote was carried with acclamation.

Phil Baldwin (L) with Adam Williams
(Photo Phil Helmore)

Finite Element Analysis: Computed Prediction vs Reality

Sean Langman, Managing Director, Noakes Group, gave a presentation on *Finite Element Analysis: Computed Prediction vs Reality*, to a joint meeting with the IMarEST in the Kirribilli Room, Royal Sydney Yacht Squadron, and streamed live on 5 April. The presentation was attended by 15 with an additional 7 online.

Introduction

Sean began his presentation by saying that he is a firm believer in the value of finite-element analysis (FEA), as it can give him the answers that he wants. One of his main interests in life is making boats safer and yachts go faster, and one element of the go-fast equation is a compromise between lightness and strength. FEA can ensure that you have the strength in the right area to take the envisioned loads.

And therein lie two of the problems: you have to know (or be able to estimate with some degree of assurance) what the

loads will be, and you have to analyse a sufficient part of the structure to ensure that the loads are being transferred from the point of application to the overall surrounding structure. The first law of computing also applies to FEA: if you put garbage in, you will get garbage out!

Sean then went onto illustrate with several examples.

oneAustralia

Most people remember the dramatic photos of John Bertrand's o*neAustrala* breaking in halves and sinking within three minutes during round four of the round-robin stage of the America's Cup challenger series in a match race between *One Australia* and *Team New Zealand* on 5 March 1995.

oneAustralia sinking on 5 March 1995
(Photo from SMH website)

By way of background, it was a rainy, blustery day in San Diego, with winds gusting to 22 kn. The seas off Point Loma were confused, if not especially high, topping out at about 1.5 m. Several of the racing syndicates, wary of risking their multimillion-dollar International America's Cup-class yachts, radioed the race committee to recommend postponement, including *Team New Zealand*, *France3*, *Nippon Challenge* and o*neAustralia*. Race Director, Pat Healy, noting that the winds were forecast to gust no higher than 18 kn and were then blowing at only 12 to 14 kn, rejected all appeals.

In the race, *Team New Zealand* started well and led by 15 seconds at the first mark and was 21 seconds ahead when the boats made the second mark and turned back upwind. The breeze had picked up and was blowing some 20 kn. Halfway up that third leg, 45 mins into the race Bertrand, steering his boat through the heavy swells, heard a sound "almost like a cannon going off" and the honeycombed carbon-fibre hull of *oneAustralia* had hit a wave and cracked dead in the middle, a few metres behind the mast.

Unfortunately, the *cause* of the failure was not shared or made public at the time, although now summarised on https://www.sailingscuttlebutt.com/2019/03/05/americas-cup-sinking-one-australia/, for example.

What had happened was that the primary genoa winch had failed and, in order to keep sailing, the crew had transferred the sheet to the running-backstay winch. The boat had not been designed to take the genoa load applied at twice the distance from the forestay, and the hull simply broke under the doubled bending load.

All of this shows up clearly with finite-element analysis — the hull can take the usual genoa load, even under wave impacts, but cannot take it when applied so far aft at the running-backstay winch.

Fortunately, no lives were lost!

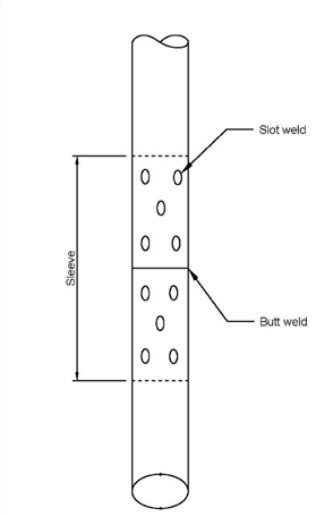
STS *Young Endeavour*

Young Endeavour is not technically a sail training ship, as the STS would imply; she is a youth development ship.

Young Endeavour
(RAN photograph)

There have been two areas of concern.

The first is that, ten years ago they replaced the masts, prior to her world voyage, sailing past the two great capes, Cape Horn and the Cape of Good Hope. The masts are in 6061 T6 aluminium, and could not be extruded in one length, and so had to be joined — the largest mill in the world at that time was in South Africa, but has now been superseded by one in Melbourne. The FEA concentrated on the strength of the butt joint. On this vessel, the yards have to turn, and so there are gaps in the rigging, and the load paths are complex. The solution they came up with was to sleeve the joint for 1 m either side of the butt in the extrusions, and to stagger the slot welds through the mast to the sleeve, as shown in the diagram.



Schematic of *Young Endeavour*'s mast join
(Drawing Phil Helmore)

Analysing this in FEA gave insight into how close the slot welds had to be to keep within the allowable stresses for the 6061 T6 aluminium.

The second area of concern, more recently, was the bowsprit where the young crew often sit. The bowsprit was in need of repairs, and it was considered advisable to upgrade the whole unit in several ways. The first problem was that all the shell plating was severely corroded and required replacement; i.e. a new bowsprit. Also, the new sprit provided a better platform for sitting, and the guardrail system was upgraded, with rod rigging for the higher top rail. When the ship had arrived from the UK in 1988, the ship's rigging had not been set up as tautly as usual for this type of vessel, and so Sean had tightened everything up.

Here Sean passed around the original bobstay pin which was worn, and showing signs of fatigue.

Analysing the bowsprit and rigging with FEA showed where the maximum stresses occurred, and where they needed material to keep those within limits, bearing in mind that Lloyd's Register was looking over their shoulder. One interesting aspect for this vessel is that the rig is usually tightened by tensioning the backstay; here they maximised the angle of the bobstay to minimise the tension in the forestay, and then tensioned the forestay itself.

Moneypenny

Moneypenny is a Reichel Pugh 69 built by McConaghy Boats and was languishing out of the water in a boatyard in Rhode Island, USA. She was designed as a centreboarder and had already been lengthened by 1.2 m, but without any FEA being done to check for extra loading. While laid up on the hard, a big storm came through and there was damage to the cabin top and to the hull on lines port and starboard of the centreboard opening.

Noakes Group purchased *Moneypenny* to fulfill a contract won with Naval Group as a team-building project and brought back to Australia. The damage was repaired and, with the help of FEA they located a problem in the slamming area. With hindsight, they should have included more of the structure aft of the forward bulkhead in order to ensure the transmission of loads into the surrounding structure. Additional frames were added in the bow and unidirectionals used for reinforcing in way of the centreboard opening damage. The boat was renamed *Naval Group,* and competed in the 2018 Sydney–Hobart Yacht Race, finishing 11th over the line and 39th overall on IRC.

Moneypenny as *Naval Group*
(Photo from Rolex Sydney–Hobart Yacht Race website)

In order to make the boat go faster, a VPP was used to help determine loadings and, of course, the FEA had to be completely remodelled. They then added further frames in the midship area. She competed in the 2019 SHYR as *Naval Group* again, finishing 8th over the line and 10th overall on IRC.

After Noakes' association with Naval Group ended, Sean changed the name back to *Moneypenny.* Further FEA analysis of the X-frame showed that the keel bulb could be moved further aft, giving less surface area (and, hence, less frictional resistance), improving steering and allowing the fin to twist and develop more lift. *Moneypenny* competed in the 2022 SHYR, finishing 10th over the line and 8th overall on IRC.

Conclusion

Sean has taken to finite-element analysis, as it gives him the answers he wants, which are all directed at making boats safer and to go faster. You have to be careful with what you analyse, and the loads which you impose, but the tools are there to be used!

Questions

Question time was lengthy and elicited some further interesting points.

The presentation was recorded and is expected to be available soon on the RINA YouTube channel.

The vote of thanks was proposed, and the certificate and "thank you" bottle of wine presented, by John Jeremy. The vote was carried with acclamation.

Sean Langman (L) with John Jeremy
(Photo Phil Helmore)

Seaworthiness Assurance in the Royal Australian Navy

CAPT Sands Skinner RAN, Director, Navy Materiel Seaworthiness Assurance Agency, gave a presentation on *Seaworthiness Assurance in the Royal Australian Navy*, to a joint meeting with the IMarEST in the Henry Carmichael Theatre, Sydney Mechanics School of Arts in the Sydney CBD, and streamed live on 3 May. The presentation was attended by 20 with an additional 19 online.

Introduction

Sands began his presentation with the definition of some key concepts in assurance.

Regulation is any measure or intervention which seeks to change (or maintain) the behaviour of individuals or groups.

Ensure is to make sure, certain or safe.

Assure is to give confidence or to reassure.

Why does Regulation Exist?

It shouldn't surprise anyone that both regulation and assurance are not free goods; they require energy and resources—financial, time, and human thought and capacity. So why do we do it?

Regulation is a natural and inherent part of human society. For our society to function and advance, there is a need to shape, control and change the behaviour of people. The reality is that most parts of our lives are either informally or formally regulated to some degree—what we wear; units of time, distance and weight; how fast we drive; the food we eat, etc.

Regulation is enforced through assurance. Whilst some people consider assurance activities a burden or constraint on their free will, others appreciate the clarity and efficiency which regulation provides in an increasingly-complex world. Society does this for mostly benevolent and practical reasons, such as to assure personal safety, create order and reduce transaction costs.

As important as 'Why' we do it is 'Where or When' we do it, particularly when we are discussing formal regulations. Typically, we introduce regulations to protect society from a negative outcome which is otherwise less likely to be controlled. This can be because market forces do not necessarily produce required outcomes, think monopolies, or where there can be negative externalities, for example, impacts on third parties, think mandatory Compulsory Third Party Insurance vs voluntary Comprehensive Car Insurance. We also do it when there are high cost of controls, to prevent corner cutting and provide a consistent standard and, finally, we regulate where there is a knowledge asymmetry, typically in technically-complex fields.

In the last example, think of the transactional cost to society if ferry construction and maintenance were not regulated and passengers had to form their own assessment of the seaworthiness of the Manly ferry, each and every time they boarded. Similarly, whenever we fly anywhere, we trust that airlines are safe, not necessarily because it's in their commercial interests, but because CASA assures us that they are.

Finally, regulations are shaped by what is important to us, and this is often heavily influenced by seminal events.

Take, for example the *Exxon Valdez* environmental disaster.

Exxon Valdez

On 2 March 1989, the VLCC *Exxon Valdez* ran aground, penetrating her single hull and discharging an estimated 250 000 to 750 000 barrels of crude oil into Prince William Sound, Alaska. This event occurred in pristine regional Alaskan wilderness causing immense environmental damage. The resulting litigation and clean-up cost well over $3 billion USD with continued effects. It was the largest oil-spill disaster in the USA until *Deep Water Horizon*, and remains the largest due to bulk crude oil transport.

Exxon Valdez
(Photo from theatlantic.com website)

In response, the USA passed the Oil Pollution Act of 1990 which excludes single-hulled tankers of 5000 tons or more from US waters which, in turn, led to the European Union also banning single-hulled tankers from 2010. This led to the adoption of double-hulling as the new standard for this class of shipping, despite its increased build complexity and cost.

In 2009 the 264 m tanker *SKS Satilla* struck a submerged jack-up rig in the Gulf of Mexico. The US Coast Guard reported that, despite sustaining significant damage and taking on an 8 degree list to port, an environmental disaster was averted because the vessel was constructed with a double hull and the inner hull was not breached. All 1.3 million barrels of oil were safely offloaded.

Road Toll

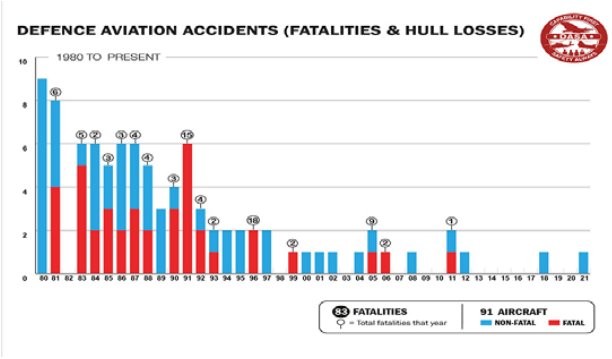
Another example can be found in the introduction of regulations to curb an increasing road toll over time. The gradual decline of deaths per capita and some of the seminal shaping events and regulations which have impacted it are evident in a graph.

Road toll deaths per 100 000 people
(Graph courtesy RAN)

Not all of this improvement is due to regulation, with vast improvements to vehicle safety also being driven by market forces (think Volvo); however, regulation and assurance have undoubtedly been significant contributors.

The Case for Regulation in Defence

Airworthiness was the first of the modern regulatory frameworks within Defence. The chart below shows the total number of defence aviation accidents from 1980 to now. The bars represent numbers of aircraft lost, blue as non-fatal losses and red as fatal losses. The numbers above the bars represent the numbers of lives lost in the calendar year due to those accidents. If you focus on the early years leading up to 1990 it is evident that aircraft accidents were a regular feature, to the point that they were considered the cost of doing business in defence aviation. 1991 in particular was a seminal year with the loss of 6 aircraft, all fatal, with 15 lives lost.



Defence aviation accidents
(Chart courtesy Defence)

As a result, in 1997 the position of Director General of Technical Airworthiness was established and appointed as the Technical Airworthiness Regulator of the ADF. The organisation set about promulgating the Technical Airworthiness Regulations TAREGs), the Technical Airworthiness Maintenance Manual and the Aviation Design Requirement Manual, amongst other important regulatory documents.

Despite being constructed as best-in-class, the system was not without issues. It was an amalgam of best practice from all three services, which meant that it was bespoke and, as such, very difficult and complex to maintain. It was also very prescriptive and rules-based as opposed to more modern goal-oriented, or outcome-based, regulations.

Notwithstanding these relatively-minor detractions, the TAREGs established the first system across Defence which governed how aircraft were designed, built, maintained and operated to approved standards, by qualified and authorised personnel, using approved processes to ensure safety of flight.

These would form the cornerstone of Defence aviation regulation for nearly two decades, and would come to provide the building blocks for the Navy Technical Regulatory System. But not yet, and not without impetus.

HMAS *Westralia* Fire

On the morning of 5 May 1998, a fire occurred in the engine room of HMAS *Westralia* as she was proceeding to sea off the coast of Fremantle in Western Australia.

Shortly after a fuel leak was detected in the engine room, a fireball, extending some two metres, erupted in the main machinery space. This was followed by repeated fireballs. Both evacuation of personnel and fire-fighting efforts were

made extremely hazardous by the intensity of the fire. The heat of the fire caused metal doors to buckle, making them inoperable, and the degree of heat in the metal on the railings of the escape ladders and deck plates caused burns on contact. Visibility was reduced to zero as the air was permeated with smoke and toxic gases. Hot plastic dripping from the light fittings fell on personnel as they fought the fire. Conditions in the main machinery space eventually deteriorated to the extent that all personnel in the area had to be evacuated. Four Navy personnel were overcome by toxic fumes and smoke, and perished in the fire.

HMAS *Westralia*
(Photo courtesy RAN)

Shortly after the accident, a Board of Inquiry was convened to ascertain its causal factors. The Board found that the fire was caused by fuel spraying under pressure from a hole in a newly-fitted flexible fuel hose on the starboard main engine coming into contact with a hot machinery component. The new flexible fuel hoses were fitted by a subcontractor to ADI during March and April 1998. The flexible fuel hose change to the main engines was a configuration change which bypassed the prescribed processes. It was not approved by appropriate authorities and did not comply with Lloyd's Register's requirements. Although the hoses were capable of withstanding the expected static system pressure, the arrangement was poorly engineered and the design did not take into account dynamic considerations.

The Board made 114 recommendations and, in doing so, it attempted to take a broad view of the systemic causes as well as the specifics of the flexible hoses. The BoI concluded that the weaknesses identified were symptomatic of wider problems within the RAN and ADI. Recommendations included configuration management, quality assurance, system safety management, inadequate engineering processes, and technical expertise.

On Quality Assurance, the BoI found that the principal organisations involved in the fuel hose work (ADI, the hose manufacturer and Ordering Authority Western Australia) were all accredited to a quality standard, but that the quality-management systems in place were either inadequate or inadequately implemented to prevent the provision of a nonconforming product.

Navy Technical Regulatory System

In response to the *Westralia* BoI, and in concert with direction from CDF to establish three environmental regulators, by 2002, the Navy Technical Regulatory System was promulgated. The NTRS was modelled from the successful Technical Airworthiness System; specifically, the *Technical Airworthiness Regulations*. As such, it carried the same hallmarks of complexity and prescriptiveness—but was further undermined by considerable under-resourcing compared to the DGTA organisation.

It also suffered from a perceived lack of regulatory teeth in exercising its remit. In aviation—if an organisation loses its authorisation—it stops work; in the maritime environment the outcome was less clear, potentially due to a perceived risk difference between the two environments. When a vessel suffers a failure, it is typically benign and recoverable—when an aircraft suffers a failure, things have a very high potential of ending catastrophically.

Such was the case in 2005 when Sea King helicopter 'Shark 02' crashed on Nias Island.

Sea King 'Shark 02' on Nias island

On 2 April 2005, a Royal Australian Navy Sea King helicopter 'Shark-02' crashed on the island of Nias in Indonesia whilst participating in an Australian Defence Force humanitarian aid operation, causing the tragic death of nine Australian Defence Force members and severely injuring two more.

The subsequent BoI determined that the primary cause of the accident was a failure of the flight-control system caused by separation of the fore/aft bellcrank from the pitch-control linkages in the aircraft's mixing unit. The mixing unit couples and directs pilot input controls to the main and tail rotor systems of a helicopter. This separation was the result of a series of errors and non-compliances with the Maintenance Regulations which, ultimately, led to the deficient fitment of the split-pin and nut which secured the pivot bolt of the fore/aft bellcrank to the mixing unit assembly. The deficient fitment was not detected because a quality inspection was not conducted. This maintenance activity occurred some 57 days before the accident.

The BoI found that the causal factors were directly related to inadequate maintenance. An uninstalled split pin allowed the nut and bolt securing the fore-aft bellcrank in the mixer unit to work free, in effect disconnecting the pilot's control of the aircraft.

The Board further found a complex interaction of individual and systemic failings across the ADF contributed to the inadequate maintenance and, ultimately, the accident. The Board made 256 Recommendations, which were all adopted. The BoI found causal themes of non-compliant practices, poor communication, lack of understanding, compliance, inadequate airworthiness surveillance/assurance, and no clear accountability.

Airworthiness—the Case for Change

The Sea King BoI and new WHS Legislation provided the basis for a review. In 2011 Defence commenced a sweeping review into best-practice aviation safety regulations, to address both the recommendations of the Board of Inquiry and to satisfy the legal obligations placed on duty holders

by the new Workplace Health and Safety Legislation.

The review identified that the TAREGs had evolved organically over 20 years; however, they had not evolved in line with contemporary principles of regulating, which had also shifted from a rules-based prescriptive system to a goal-based and hazard-focussed frame.

The review found specifically that the TAREGs were bespoke for ADF aviation, and highly prescriptive with very limited flexibility provisions beyond an undesirable exemption from the regulations. It also found the system internationally isolated and unable to recognise, or be recognised by, other partner nations. The TAREGs, as bespoke and unique regulations, were also extremely onerous to maintain.

DASA and DASR

The review settled on the European Aviation Safety Authority and its European Military Aviation Regulations (EMARs), as the basis for the new Defence Aviation Safety Regulations (DASR) and in 2016, the CDF and Secretary announced the establishment of the Defence Aviation Safety Authority (DASA).

The new regulations promulgated by DASA were based on an internationally-recognised framework adopted by EASA and aligned with the FAA. It critically provided the clear lines of accountability that the Sea King BoI found lacking, clearly identifying Command as responsible for ensuring safety, and the Safety Authority as responsible for assuring safety. The regulations were structured to be largely outcome focussed, with prescribed means of compliance and the ability to demonstrate alternate means of compliance.

The regulations are hazard based—every regulation is designed to control a hazard. From an assurance perspective, success is measured not in the binary of compliance or not, but in the effectiveness of a system in controlling the underlying hazard.

It also enshrines the concept of risk-based assurance, where the level of assurance applied is assessed against the risk of an unsafe occurrence developing. This allows for the effective application of the assurance resource to those areas deemed most in need of attention or support.

Finally, it is worth pointing out that the regulations are safety centric. Just as CASA isn't interested in the profitability of an airline, DASA and the DASR do not regulate operational effect. It is quite possible for an aircraft to be considered 'airworthy' and 'safe' without a single functioning mission system and be unable to perform anything but basic flight.

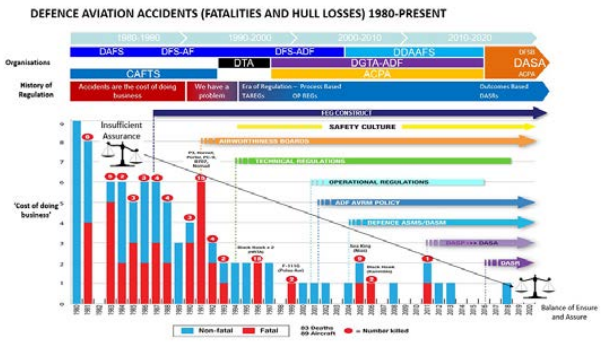
Effects

So, as we reach the present day in our examination of aviation regulation, we reintroduce the chart showing Defence aviation accidents, this time overlaid with the systemic regulatory and safety system improvements which have been introduced since 1991.

Whilst, as with the road toll, not all safety gains are due to the highlighted systemic changes, they clearly contribute significantly.

NTRS

Whilst Defence's aviation regulation was enjoying some successes, the NTRS was less so, and this was headlined very



Defence aviation accidents updated
(Diagram courtesy Defence)

publically by the Navy's failing at the time of Cyclone Yasi.

Here Sands showed a video, with comments on the events leading up and subsequent to the establishment of our new Defence Seaworthiness System by:

VADM Russell Crane, Chief of Navy 2006–08
VADM Michael Noonan, Chief of Navy 2018–22
RADM Colin Lawrence, Head Navy Engineering 2016–21
VADM Tim Barrett, Chief of navy 2014–2018
Hon. Stephen Smith MP, Minister for Defence 2010–13
RADM Mike Uzzell, Head Navy Engineering 2011–16
VADM Ray Griggs, Chief of Navy 2011–14

The Rizzo Review and the NTRS

As discussed by Admiral Griggs in the video, the report led by Mr Paul Rizzo entitled *Plan to Reform Support Ship Repair and Management Practices,* commissioned in the wake of both Cyclone Yasi and the near grounding of HMAS *Kanimbla*, was about considerably more than just support ship repair and maintenance. Its themes applied across Navy and provided the blueprint for the development of the current Navy Seaworthiness System.

The report was summarised by the ABC as identifying: organisational complexity and blurred accountabilities, inadequate risk management, poor compliance and assurance, a 'hollowed-out' Navy engineering function, resource shortages, and a culture which placed the short-term operational mission above the need for technical integrity.

The Rizzo review considered the NTRS to have failed, levelling four key criticisms at it:

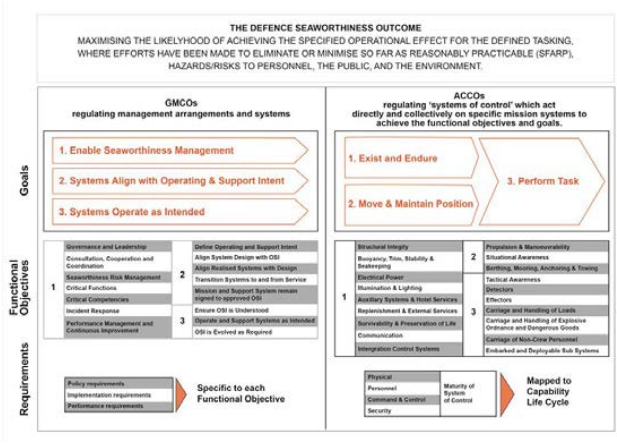
- The NTRS had established Authorised Engineering Organisations (AEO), similar to those in Aviation, but they were all DMO or Navy Organisations. Where work was conducted in industry, no regulatory oversight was provided, instead relying on contract provisions to ensure compliance with requirements. The report also found that, unlike aviation, there are no Authorised Maintenance Organisations (AMO).
- Regulations were out-of-date, spread across many documents, and required review.
- While the regulatory concepts were sound, compliance was lacking.
- Assurance frameworks were considerably lacking.

Defence Seaworthiness Management System

In June 2012, a Joint Directive was issued by the Secretary and CDF to the Chief of Navy (CN), authorising the development of the Defence Seaworthiness Management

System. The Directive identified CN as the Defence Seaworthiness Authority (DSwA) over Defence, who subsequently appointed Head Navy Engineering (HNE) as the Defence Seaworthiness Regulator (DSwR).

The DSwR is the single Defence Seaworthiness Regulator, responsible for establishing, managing and continually improving a system known as the Defence Seaworthiness Management System (DSwMS) to regulate and assure the management of seaworthiness. The Defence Seaworthiness Regulations Manual, outlining this system, was promulgated in 2017. The regulations are codified in 15 Governance and Management Compliance Obligations (GMCOs) and 19 Activity and Condition Compliance Obligations (ACCOs), all goal-based outcome-focussed obligations.



Defence seaworthiness outcome
(Diagram courtesy Defence)

The DSwMS defines a 'seaworthy outcome' as one which maximises the likelihood of achieving operational effect for the defined tasking, where efforts have been made to eliminate or minimise, so far as is reasonably practicable, hazards or risks to personnel, the public or the environment.

The system requires that each maritime mission system be managed under a Seaworthiness Case. The Seaworthiness Case is a 'living' body of information which together provides the context, claims, arguments and evidence necessary to support seaworthiness judgments relating to a maritime mission system and its enabling support system. The claim of a 'seaworthy maritime mission system' is made and argued through the implementation of the compliance strategy, within the context of each individual maritime mission system's Operating and Support Intent.

The Operating and Support Intent is central to the management of Seaworthiness. The DSwMS requires that a Capability Manager has an authorised Operating and Support Intent for each maritime mission system. It consists of the requirements, constraints and assumptions for the maritime mission system, which can be traced, through a maritime program, to government direction. In essence it is the concept which ties together how a capability will be both operated and supported. It identifies that these two concepts are intrinsically linked and should remain balanced through the capability life cycle. Where there is an imbalance, for example where there is an increased operational requirement which is provided at the expense of maintenance, then there is an increased risk of an unseaworthy outcome—as we saw with the LPAs at the start of the last decade. This is not to say that the Seaworthiness System limits the ability of Capability Managers to deliver Operational Effect, but it does place obligation on them to manage the risks associated with doing so, now and into the future.

Critically, the Seaworthiness System requires Capability Managers to consider their decisions through the context of the whole capability lifecycle—not just to borrow from tomorrow's Navy to meet the obligations of the now. And, finally, the system provides clear accountabilities within Navy for the delivery of a Seaworthy Outcome.

Navy Materiel Seaworthiness Policy

Navy's response to the Defence Seaworthiness Regulations—how it meets its compliance obligations—are codified in the N Library. This Library provides a common, logical and hierarchical structure for the eight sub-libraries which contain Navy's critical knowledge management references. The N Library establishes clear authority and accountability for policy development and implementation.

At the heart of the Materiel Seaworthiness construct is the entity called an Authorised Materiel Seaworthiness Delivery Organisation (AMSDO). If you work in, or with Defence, this is the most likely touch point that you will have with our Seaworthiness System. It is a reimagining of the old SPO and Engineering Organisation constructs to provide integration of engineering, maintenance and supply support functions to our fleet. It is structured around authorised Organisations (AEOs, AMOs and ASOs), with qualified, experienced, authorised and accountable principles working to an executive consisting of both the NSSG Director and Navy Capability Manager Representative.

Seaworthiness Assurance Framework

Seaworthiness has adopted a system of assurance based on a Three Line of Defence (LoD) Governance Framework.

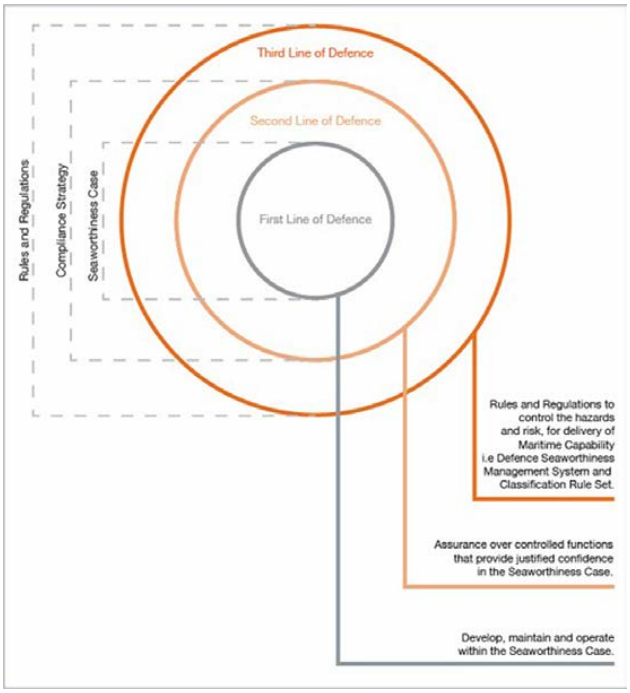
The 3rd LoD develops the rules and regulations which govern the system; it then monitors and assures that systemic and emerging risks are identified, managed and remediated by Capability Managers through adherence to the DSwMS Regulations.

The 2nd LoD builds the organisation's compliance strategy to the regulations—it is the systems response to the requirement, and conducts assurance activities to provide confidence in the integrity of the system which has been used to develop the Seaworthiness Case.

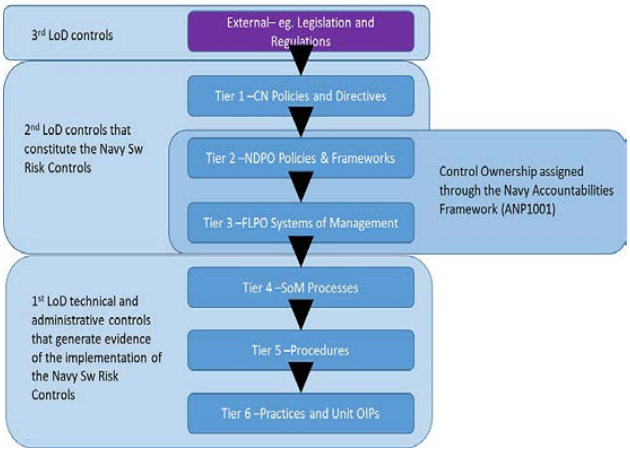
The 1st LoD establishes and maintains the Seaworthiness Case. It does this through a robust set of processes, plans and controls which comply with the Seaworthiness System to deliver the outcome. In essence it is the first physical checkpoint which assures that controls, directly applied through the ACCOs, are being effectively implemented to minimise the short to medium term hazards at the mission system level;

Navy's implementation of this governance and assurance mode, controls are embedded within the N Library and assurance is conducted over those controls.

Sands' organisation, the Navy Materiel Seaworthiness Assurance Agency, conducts assurance at the 2nd Line of Defence, over the Materiel Seaworthiness Policies and Systems established in the Tier 2 and 3 documents of the N library.



Seaworthiness assurance lines of defence
(Diagram courtesy Defence)



Tiers in the seaworthiness assurance lines of defence
(Diagram courtesy Defence)

Airworthiness and Seaworthiness Comparison

In reviewing airworthiness and seaworthiness systems, some comparison are inevitably drawn. Both reflect modern outcome-based regulatory suits, although the seaworthiness system has more fully embraced a goal-based regulatory framework.

Whilst both are concerned with safety, they differ, in that airworthiness explicitly does not regulate capability, where seaworthiness exists to regulate the nexus between capability and safety. This is largely informed by events which have shaped their evolution. As we have seen, formative aviation events are nearly always safety critical whereas Navy events are as often capability centric, such as in Cyclone Yasi.

Both have now established clear lines of accountability, where duty holders within the system have clear understandings of their accountabilities and responsibilities.

Both systems represent contemporary best practice for their environments; however, the seaworthiness system is still bespoke to the RAN whereas aviation regulation is based on an internationally-recognised standard. The establishment of the Australian Naval Classification Agency and formal integration of classification society rule sets will seek to remediate some of this.

Finally, both systems have adopted a risk-based assurance framework; however, aviation has no intermediary, the regulatory is also the assurance agency and operates on a two-tier system, compared to the three line-of-defence system implemented in the seaworthiness system.

Conclusion

Seaworthiness assurance in the RAN has had a long gestation period, commencing with airworthiness for the ADF as a result of aircraft losses in the 1980s and 1990s and the loss of Sea King helicopter 'Shark 02'. The fire on HMAS *Westralia*, the near-grounding of HMAS *Kanimbla,* the lack of availability of Navy vessels for relief operations following Cyclone Yasi, and the culmination of events precipitating the Rizzo Review led to the establishment of the Navy Seaworthiness Management System, which is how the RAN now assures seaworthiness of its fleet.

Questions

Question time was lengthy and elicited some further interesting points.

The presentation was recorded and is expected to be available soon on the RINA YouTube channel.

The vote of thanks was proposed, and the "thank you" bottle of wine presented, by Len Michaels. The vote was carried with acclamation.

Phil Helmore

Sands Skinner (L) with Len Michaels
(Photo Phil Helmore)

CLASSIFICATION SOCIETY NEWS

Hydrogen-fuelled Research Vessel to ABS Class

A hydrogen-fuelled research vessel commissioned by the Scripps Institution of Oceanography of the University of California San Diego will be built to ABS Class.

Designed by Glosten, the vessel will feature a new hydrogen-hybrid propulsion system which integrates hydrogen fuel cells alongside a conventional diesel-electric power plant, enabling zero-emission operations. The design is scaled so that the ship will be able to operate 75 percent of its missions entirely using hydrogen. For longer missions, extra power will be provided by diesel generators.

The 150 ft (45.7 m) vessel will be equipped with advanced instruments and sensing systems, along with state-of-the-art laboratories, enabling multidisciplinary research, advancing understanding of the physical and biological processes active in California's coastal oceans.

"ABS is proud to pioneer the development of hydrogen as marine fuel technology with these partners in a project which has the potential to make a significant contribution to the understanding of our oceans. This project will be closely watched by the industry as it breaks new ground and demonstrates the capabilities of this promising alternative fuel at sea," said Christopher Wiernicki, ABS Chairman, President and CEO.

For information on the application of hydrogen at sea, download the ABS Whitepaper *Hydrogen as a Marine Fuel* at https://absinfo.eagle.org/acton/media/16130/hydrogen-as-marine-fuel-whitepaper.

ABS News, 14 February 2023

LR awards Mitsui with AiP for Ammonia-fuelled Liquified Gas Carrier

Lloyd's Register has awarded Mitsui E&S Shipbuilding Co. with Approval in Principle (AiP) for its ammonia-fuelled liquified gas carrier. The vessel, developed by Mitsui E&S Shipbuilding, Mitsui OSK Lines and Tsuneishi Shipbuilding as part of a Joint Development Project (JDP), is a medium-sized liquified gas carrier which is equipped with a main engine currently under development and capable of using ammonia as fuel.

Ammonia has long been transported as cargo by liquified gas carriers, but so far it has not been used as a marine fuel. Mitsui's vessel will use part of the ammonia loaded as cargo as fuel, with the goal of achieving net-zero CO_2 emissions during the vessel's voyage.

Seen as a high-potential alternative fuel to support the maritime energy transition, ammonia emits no CO_2 when it is burned; however, its characteristics of flammability, toxicity, and corrosiveness mean that safety and infrastructure are crucial for its safe adoption.

In line with this, LR conducted a thorough HAZID analysis and Preliminary Appraisal of Rules (PAR), using their guidelines and in-depth knowledge of ship safety for vessels using ammonia as fuel to ensure high standards of safety in the design process.

Seiji Hamanaka, LR Yokohama Technical Support Office Manager, said "We are proud to support this JDP and its ongoing decarbonisation efforts with the award of Approval in Principle for Mitsui's ammonia-fuelled liquid CO_2 carrier. LR is pleased to offer our vast experience on HAZID for ammonia safety as part of Mitsui OSK Lines, Tsuneishi Shipbuilding Co. and Mitsui E&S Shipbuilding Co.'s design."

Ken Furuya, Executive Officer, General Manager of Sales Dept, Mitsui E&S Shipbuilding said "We, Mitsui OSK Lines, Tsuneishi Shipbuilding and Mitsui E&S Shipbuilding, would like to express our appreciation to LR and Class NK for their support and cooperation in this JDP. This AiP is an important milestone for us. We will continue to make an effort to complete this project successfully. Anticipating an increase in the need for ammonia as a marine fuel and greater demand for transporting it, the three companies are committed to playing a role in society's overall decarbonisation efforts by providing clean ocean transport solutions with zero-emission ocean-going vessels."

LR News, 14 April 2023

DNV joins Standards Working Group on Methanol Bunkering

DNV has joined a working group on methanol bunkering, managed by the Standards Development Organisation at Singapore Chemical Industry Council (SCIC SDO), the classification society announced at Singapore Maritime Week.

The SCIC, appointed as the Standards Development Organisation by Enterprise Singapore, formed the Working Group on Standard Development for Methanol Bunkering, in consultation with the Maritime and Port Authority of Singapore (MPA). The working group, which includes government agencies, bunker suppliers, bunker craft operators, engine manufacturers, testing and certification bodies, shipowners and operators, and terminal operators, as well as classification societies such as DNV, will be developing a Technical Reference (TR) for methanol bunkering for Singapore, the world's largest bunkering hub.

The TR will cover custody transfer requirements (quantity and quality) for the delivery of methanol as a bunker fuel. It will examine all aspects of bunkering, from the bunker tanker to the receiving vessels, examining the operational and safety requirements for methanol bunkering, as well as crew training and competency.

"Initiatives like the Working Group established by SCIC SDO, are essential as the energy transition accelerates, and the maritime industry moves towards a multi-fuel future," said Cristina Saenz de Santa Maria, Regional Manager South East Asia, Pacific & India at DNV Maritime. "For methanol and other alternative fuels to continue to build traction within shipping, we need to build confidence and encourage a wider uptake. This can only be accomplished through standards which enhance safety while providing a comprehensive and practical framework for all stakeholders. At DNV we have been working with our customers for many years on alternative fuels to enhance the sustainability of

their operations and are very proud to be included in the Standards Working Group."

The announcement of the development of the TR comes alongside record-breaking orders for vessels capable of using alternative fuels. DNV's Alternative Fuels Insight (AFI) platform, which tracks orders and bunkering locations for alternative fuels, logged orders for 35 methanol-fuelled vessels in 2022—more than the 26 vessels currently in operation. Likewise for LNG, the most popular alternative fuel to date, the newbuilding orders in 2021 and 2022 will more than double the fleet in service upon delivery.

"Interest in methanol is growing rapidly, gaining ground on the most widely adopted alternative option, LNG," said Lukasz Luwanski, Regional Business Development Director at DNV Maritime. "Designs for methanol-fuelled vessels tend to be less complex, which means that construction is typically less expensive than a comparable LNG-fuelled vessel. On the other hand, due to incoming GHG regulations, a switch to 'green' methanol will be required much sooner than for a vessel which is LNG powered. This will make the Working Group's TR a very timely and important reference point for the industry," added Luwanski.

DNV was the first classification society to release a notation covering every aspect of using low flashpoint fuels, including safe design, fire safety, control and monitoring. It has regularly built on these recommendations, including the *Alternative Fuels for Containerships* document, which was recently updated with a new chapter covering methanol and aims to provide neutral, fact-based, and scientifically sound decision support for newbuilding projects in the segment. Currently more than 70% of the 25 methanol powered vessels operating are with DNV.

DNV News, 26 April 2023

FROM THE CROWS NEST

Tribute to Ken Warby MBE (9 May 1939–20 February 2023)

It is with sadness that *The ANA* records the passing of Ken Warby MBE on 20 February 2023.

For almost 45 years, the three-point hydroplane *Spirit of Australia* has been the world's fastest boat. It was built in a suburban Sydney backyard by its legendary designer, builder and driver, Ken Warby. For his first world record in 1977, its jet engine was an RAAF surplus engine, and his spare one at that, substituted when a screwdriver got sucked in and ruined the much better one. The whole affair was nothing fancy, it was even a wooden boat, but it was carefully and logically conceived.

Ken said "You don't drive the boat, you wear it". It was all about his own feel and instinct, developed from his experience and a reflection of his character. This combination was what created the boat in the first place. Ken was not a larrikin who got by with luck on his side; he was a gifted mechanical engineer whose experience from teenage years onwards helped him to develop an instinct for what was needed and what was going to be right. Over a period of four years, he set about methodically and patiently building the boat in stages—testing, refining, taking it to another level and repeating the process. There was always a margin in hand, so that when things didn't go to plan the issue could be resolved before moving up the speed dial.

Ken was astute enough to tap into professional help when needed. Prof. Tom Fink and Dr (now Em/Prof.) Lawry Doctors from the University of New South Wales wind-tunnel-tested his design, providing a reassuring result. Their conclusion was that Ken had the shape right. Later, the RAAF came to his support onsite with their jet engine maintenance team, and on Tom Fink's advice, and with a bit of his own thrown in for good measure, to get that last bit of speed with the power he had from an old engine, Ken cut just over 2 in (5 cm) off the bottom of the rudder with an oxy-acetylene torch to reduce drag. This was 1977, he was at Blowering Dam in New South Wales, and he broke the Unlimited World Water Speed Record. He returned on 8 October 1978 to better that attempt with a new engine, piloting his amazing craft to 317.6 mph (511.1 km/h). He remains the only person ever to have designed, built and driven their boat to the Unlimited World Water Speed Record.

Spirit of Australia remains one of the key exhibits in the Australian National Maritime Museum collection, where it is proudly on display adjacent to the main gallery entrance. You can see where he cut the rudder down too. I met Ken with then-Senior Curator, Daina Fletcher, in 1998. Together we wrote an article celebrating the 20th anniversary of his 1978 record, published in the ANMM journal, *Signals*, Issue 44. Former ANMM Media Manager, Bill Richards, was also a very close friend of Ken's, and the museum benefited greatly from this close association. Needless to say, at the time we never anticipated he would still be holding this record now.

Ken Warby died aged 83, but his legacy lives on. Ken and his middle son David have designed and built a new boat, *Spirit of Australia II*, for a new attempt on the Unlimited World Water Speed Record. David and his team are following the same methodical process that Ken did, building up speed in stages for their record attempt, which will once again be on Blowering Dam. The new boat is a very refined version of the original *Spirit of Australia*—still wooden, but with a lighter and more powerful jet engine, built in David's Warby Motorsport factory in Newcastle, New South Wales.

It's a different world now, there is seemingly endless red tape and layers of approval to do things. Spontaneity and self-reliant creativity, using what was available or affordable, were once hallmarks of the Australian character, but this can-do attitude has been gradually strangled by regulation and authority. You can't build a jet boat in your suburban backyard and park it on a trailer in the street anymore. Council and the neighbours just won't have it. But that is at the heart of the story of Ken Warby and his boat—the true spirit of Australia, the attitude that got us a long way for a long time.

David Payne
Honorary Research Associate
Australian National Maritime Museum

Ken Warby and *SoA* after setting the current
Unlimited World Water Speed Record
(Photo from Warby Motorsport website)

WSR Spirit 2

On 8 October 1978, 45 years ago, Ken Warby blasted across Blowering Dam to set his second (and current) Unlimited World Water Speed Record of 317.6 mph (511.1 km/h). A tribute to Ken Warby appears above.

Dave Warby of Warby Motorsport is attempting to break his father Ken's Water Speed Record in their latest vessel, *Spirit of Australia 2.*

The Warby Motorsport team is scheduled to return to Blowering Dam for the weekend of 27–28 May to try their recent modifications to the rear end of the boat and, hopefully, this will settle the issue down and allow the team to move on to their goal safely. The team will honour Ken's passing at the site which made him a legend; fingers crossed for good weather!

Phil Helmore
Martin Grimm

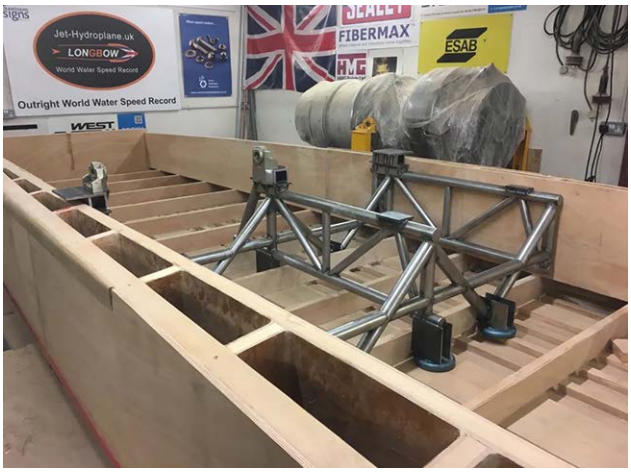
Spirit of Australia 2 at speed on the Manning River
on 26 November 2022
(Photo from Warby Motorsport Facebook page)

WSR *Longbow*

Britain has re-entered the contest for the Water Speed Record with a new vessel, *Longbow*, having commenced construction in April 2018.

The mounting cradle for the twin Rolls-Royce Viper jet engines has been completed, delivered to David Aldred's garage/workshop in Lancashire and provisionally set in the hull. Next comes the design of the steel plate to connect the cradle to the main timber stringers of the boat. With the cradle being in round steel tube and the stringers themselves being curved in shape, this was not as straightforward as it might at first appear, so David has been back and forth measuring inside the hull and then playing about with the drawing on his PC. The design of the steel plate has been finalised, and construction is under way.

Longbow website



Engine- mounting cradle for *Longbow*'s jet engines
set up in the boat
(Photo from Longbow website)

SP80 Aims for World Sailing Speed Record

The world sailing speed record is currently held by Australian Paul Larsen in *Vestas Sailrocket 2* at an average speed of 65.45 kn (121.1 km/h) over the 500 m track.

SP80 is the vessel being designed and built by engineering students from the Swiss engineering school École Polytechnique Fédérale de Lausanne (EPFL) to attempt the world sailing speed record and take it back to Europe. They are aiming for a speed of 80 kn (148 km/h) using a boat with shaped hulls, propelled by the usual kite wing, while the overall stability is achieved via super-ventilating hydrofoils.

With the main parts completed (main hull, crossbeam and floats) and assembled in early 2023, there are a few steps left before the boat's first navigation:

- Integration of the mechanical systems needed onboard, such as the steering systems of both the boat and the kite, or the safety equipment for the pilots.
- Production of a rudder and a foil.
- Installation of the power module, the key element which connects the boat and the kite.

"Once those steps are done, the first trials will be focussed on optimising this unique boat. Before reaching 80 kn (148 km/h), we will learn to apprehend the boat's behaviour and to coordinate ourselves between pilots. The goal is to accelerate step-by-step until December 2023 before working on the boat during the winter break. We will then come back to Leucate by spring 2024 with a sharpened boat for a first world sailing speed record attempt" said Benoit Gaudiot, the pilot on the boat.

After two years of construction, the boat is expected to navigate for the first time in the summer [*European* — Ed.] of 2023 off the beach of Rouet. In addition to a base on the harbor provided by the town of Leucate, the partnership includes the provision of the "Manufacture de la glisse" by the Agglomeration of Grand Narbonne, a facility which will allow the team to set up its workshop and offices a few minutes away from the sea.

"We're thrilled to finally settle in Leucate, which will offer us optimal conditions to break the absolute world sailing speed record. Thanks to the hospitality of the town of Leucate and the Grand Narbonne Community of Agglomeration, our boat

will sail as of its first run at the location we chose for our future record attempt. We will therefore be able to optimise it along the Rouet beach, in the same conditions as on D-day," said Mayeul van den Broek, SP80's CEO and pilot.

SP80 website

Sail GP Series 3

Series 3 kicked off in Bermuda on 15–16 May 2022, with Australia, Great Britain, Canada, Denmark, USA, New Zealand, Spain, France, and Switzerland all competing.

Subsequent events have been held in Chicago (USA), Plymouth (UK), Copenhagen (Denmark), St Tropez (France), Andalucia (Spain), Dubai (UAE), Singapore, Sydney and Christchurch (New Zealand).

The final event in Series 3 was held in San Francisco, USA, on 6–7 May 2023. The Grand Final was sailed between Australia, Emirates GBR and New Zealand, with Australia taking gold, New Zealand silver and Emirates GBR bronze.

The Australia SailGP Team has now won the coveted SailGP Trophy three times, winning it in Seasons 1, 2 and 3. One of the original six teams which started the Championship in 2019, the Australian crew includes skipper Tom Slingsby, four America's Cup winners, and two-time Australian Female Sailor of the Year, Nina Curtis.

Season 4 starts in Chicago, USA on 16–17 June 2023.

For all the details, visit the Sail GP website at https://sailgp.com.

Phil Helmore

GENERAL NEWS

Joint Leaders Statement on AUKUS

On 13 March 2023, the President of the United States and the Prime Ministers of Australia and the United Kingdom met in San Diego and issued the following statement:

In September 2021, Australia, the United Kingdom and the United States announced AUKUS—a new security partnership which will promote a free and open Indo-Pacific that is secure and stable.

The first major initiative of AUKUS was our historic trilateral decision to support Australia acquiring conventionally-armed, nuclear-powered submarines (SSNs). Today, we announce our pathway to achieve this critical capability.

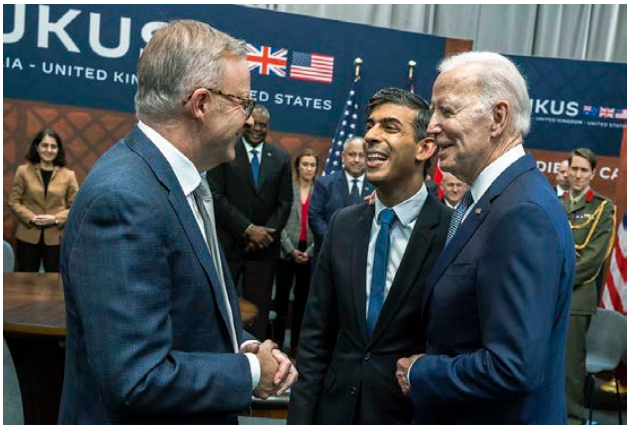
Together we will deliver SSN-AUKUS—a trilaterally-developed submarine based on the United Kingdom's next-generation design which incorporates technology from all three nations, including cutting-edge US submarine technologies. Australia and the United Kingdom will operate SSN-AUKUS as their submarine of the future. Australia and the United Kingdom will begin work to build SSN-AUKUS in their domestic shipyards within this decade.

In order to deliver conventionally-armed, nuclear-powered submarines to Australia at the earliest possible date, we intend to pursue the following phased approach, moving through each phase based on mutual commitments from each nation:

Beginning in 2023, Australian military and civilian personnel will embed with the US Navy, the Royal Navy, and in the United States and United Kingdom submarine industrial bases to accelerate the training of Australian personnel. The United States plans to increase SSN port visits to Australia beginning in 2023, with Australian sailors joining US crews for training and development; the United Kingdom will increase visits to Australia beginning in 2026.

As early as 2027, the United States and United Kingdom plan to begin forward rotations of SSNs to Australia to accelerate the development of the Australian naval personnel, workforce, infrastructure and regulatory system necessary to establish a sovereign SSN capability.

Starting in the early 2030s, pending Congressional approval, the United States intends to sell Australia three Virginia-class submarines, with the potential to sell up to two more



The AUKUS leaders meeting in San Diego
(US Navy photograph)

if needed. This step will systematically grow Australia's sovereign SSN capability and support capacity.

In the late 2030s, the United Kingdom will deliver its first SSN-AUKUS to the Royal Navy. Australia will deliver the first SSN-AUKUS built in Australia to the Royal Australian Navy in the early 2040s.

This plan is designed to support Australia's development of the infrastructure, technical capabilities, industry and human capital necessary to produce, maintain, operate, and steward a sovereign fleet of conventionally-armed, nuclear-powered submarines. Australia is fully committed to responsible stewardship of naval nuclear propulsion technology.

When we announced the AUKUS partnership in September 2021, we committed to set the highest nuclear non-proliferation standard. The plan we announce today delivers on this commitment and reflects our longstanding leadership in, and respect for, the global nuclear non-proliferation regime. We continue to consult with the International Atomic Energy Agency to develop a non-proliferation approach which sets the strongest precedent for the acquisition of a nuclear-powered submarine capability.

Our plan elevates all three nations' industrial capacity to produce and sustain inter-operable nuclear-powered submarines for decades to come, expands our individual and collective undersea presence in the Indo-Pacific, and contributes to global security and stability. In these

outcomes, AUKUS reflects the principle that shared action, taken in partnership, can benefit all.

Implementing AUKUS will also require robust, novel information-sharing and technology cooperation. Our nations are committed to further trilateral collaboration which will strengthen our joint capabilities, enhance our information and technology sharing, and integrate our industrial bases and supply chains while strengthening the security regimes of each nation.

For more than a century, our three nations have stood shoulder to shoulder, along with other allies and partners, to help sustain peace, stability, and prosperity around the world, including in the Indo-Pacific. We believe in a world which protects freedom and respects human rights, the rule of law, the independence of sovereign states, and the rules-based international order. The steps we are announcing today will help us to advance these mutually beneficial objectives in the decades to come.

New Agency and new Regulator to deliver Australia's Nuclear-powered Submarine Program

It was announced on 6 May that the Commonwealth Government will establish a new agency and a new regulator as part of its commitment to delivering Australia's conventionally-armed, nuclear-powered submarines.

The Australian Submarine Agency (ASA) will be established by Executive Order and be responsible and accountable for the management and oversight of Australia's nuclear-powered submarine program.

Australia's acquisition of conventionally-armed nuclear-powered submarines through the AUKUS partnership will be critical to ensuring that our Defence Force has the capabilities needed to keep Australians safe.

In leading the delivery of Australia's nuclear-powered submarines, the ASA will be responsible for cradle-to-grave management, including: acquisition, delivery, construction, technical governance, sustainment, and disposal.

The ASA will also enable the necessary policy, legal, non-proliferation, workforce, security and safety arrangements. The RAN, led by the Chief of Navy, will continue to be responsible for training submariners and operating Australia's submarines.

The Nuclear-powered Submarine Taskforce, which currently operates as part of Defence, will transition to the ASA on 1 July 2023.

It will be headed by a Director General, the appointment of which will be announced by the Government at the appropriate time.

The Government will also establish a new independent statutory regulator, the Australian Nuclear-Powered Submarine Safety Regulator (the Regulator).

The new Regulator will have the functions and powers necessary to regulate the unique circumstances associated with nuclear safety and radiological protection across the lifecycle of Australia's nuclear-powered submarine enterprise. This includes associated infrastructure and facilities.

The Regulator will be independent of the Australian Defence Force's chain of command and directions from the Department of Defence.

This will be a fundamental part of a system of regulation. It will work with existing Australian regulators to support the safety of our submariners, Australian and international communities, and the environment.

Both the ASA and the Regulator will be non-corporate Commonwealth entities within the Defence portfolio and report directly to the Minister for Defence.

Defence Strategic Review

On 24 April the Commonwealth Government released the public version of the Defence Strategic Review (the Review), the Government's response to the Review, and the National Defence Statement 2023.

Commissioned in the first 100 days of Government, the Review sets the agenda for ambitious, but necessary, reform of Defence's posture and structure.

The Government's response to the Review sets out a blueprint for Australia's strategic policy, defence planning and resourcing over the coming decades.

The Government has agreed, or agreed in-principle with further work required, to the public Review recommendations, and has identified six priority areas for immediate action:

- acquisition of nuclear-powered submarines through AUKUS to improve our deterrence capabilities;
- developing the Australian Defence Force's (ADF) ability to precisely strike targets at longer-range and manufacture munitions in Australia;
- improving the ADF's ability to operate from Australia's northern bases;
- initiatives to improve the growth and retention of a highly-skilled defence workforce;
- lifting our capacity to rapidly translate disruptive new technologies into ADF capability, in close partnership with Australian industry; and
- deepening of our diplomatic and defence partnerships with key partners in the Indo-Pacific.

Realising the ambition of the Review will require a whole-of-government effort, coupled with a significant financial commitment and major reform.

The Government is making the hard decisions necessary to cancel or reprioritise Defence projects or activities which are no longer suited to our strategic circumstances, as outlined in the Review.

The Government's response to the Review includes specific directions to Defence with immediate effect, while establishing a methodical and comprehensive process for long-term and sustainable implementation.

To inform this, the Government has accepted the Review's recommendation for an inaugural National Defence Strategy in 2024, which will be updated biennially.

The National Defence Strategy will encompass a comprehensive plan of Defence policy, planning, capabilities and resourcing, including reprioritisation of the Integrated Investment Program, in line with the recommendations of the Review.

The Government will work with industry, the community and stakeholders to implement the work and the recommendations of the Review.

The public version of the Defence Strategic Review is available at https://www.defence.gov.au/about/reviews-inquiries/defence-strategic-review.

The Defence Strategic Review identifies the immediate maritime domain investment priorities in the following terms:

- The acquisition of conventionally-armed nuclear-powered submarines will transform Navy's capability. Nuclear-powered submarines are key assets, both in effecting a strategy of denial and in the provision of anti-submarine warfare and long-range strike options.
- An enhanced-lethality surface combatant fleet, which complements a conventionally-armed nuclear-powered submarine fleet, is now essential given our changed strategic circumstances.
- As a maritime nation dependent on our sea lines of communication, it is essential that the shape, size and scope of the Navy's surface combatant fleet are appropriate for the levels of risk we now face.
- Such a fleet should consist of Tier 1 and Tier 2 surface combatants in order to provide for increased strike, air defence, presence operations, and anti-submarine warfare.
- Enhancing Navy's capability in long-range strike (maritime and land), air defence and anti-submarine warfare requires the acquisition of a contemporary optimal mix of Tier 1 and Tier 2 surface combatants, consistent with a strategy of a larger number of smaller surface vessels.
- This would significantly increase Navy's capability through a greater number of lethal vessels with enhanced long-range strike (maritime and land) and air-defence capabilities, together with the ability to provide presence in our northern maritime approaches.
- We have recommended that the Government directs an independent analysis of Navy's surface combatant fleet capability to ensure the fleet's size, structure and composition complement the capabilities provided by the forthcoming conventionally-armed nuclear-powered submarines. The analysis must assess the capability requirements to meet our current strategic circumstances as outlined in the Review. This should include assessment of cost, schedule, risk, and the continuous shipbuilding potential of each option. This examination should be completed by the end of Q3 2023.

The Government subsequently announced that the independent analysis of the RAN's surface fleet would be undertaken by VADM William H. Hilarides USN (Retd) with Australia's former Finance Secretary, Rosemary Huxtable and VADM Stuart Mayer RAN (Retd).

Undersea Support Vessel Purchased for the ADF

The Australian Government has procured a dedicated Undersea Support Vessel. Deputy Secretary Naval Shipbuilding and Sustainment, Tony Dalton, said that the new acquisition would be used to further advance a range of trials and activities leveraging new technologies in the undersea domain.

"Defence is demonstrating its commitment to providing a cutting-edge capability, which will expand the ADF's ability to deliver multiple undersea project outcomes," Mr Dalton said.

After a selection process led by an independent broker, the Norwegian-flagged MV *Normand Jarl* has been procured for $110 million and is currently undergoing inspection and certification activities in Singapore before sailing to Australia under an Australian flag later this year. The ship will be renamed Australian Defence Vessel (ADV) *Guidance*.

The primary role of ADV *Guidance* will be to support undersea surveillance systems trials, including the ability to deploy undersea crewed and uncrewed vehicles, and robotic and autonomous systems.

At 107 m long, 22 m beam and displacing 7400 tonnes, ADV *Guidance* will be able to sustain a range of Defence activities due to its modular mission systems, allowing specialist Defence teams and load-outs to be embarked to meet various system trial requirements.

"ADV *Guidance* will be instrumental in developing and testing robotic and autonomous underwater systems, ensuring that Defence can compete and succeed in a wide variety of complex undersea environments," Mr Dalton said.

The future ADV *Guidance* at work tending offshore wind power generators
(Photo courtesy Dept of Defence)

Austal Philippines Delivers the Largest High-speed Catamaran Constructed by Austal

In March Austal Philippines delivered the 115 m high-speed vehicle-passenger ferry *Express 5*, to Molslinjen of Denmark, following the successful completion of sea trials in Balamban, Cebu.

The Auto Express 115 high-speed catamaran ferry is the largest ferry (by volume) constructed by any Austal shipyard, in the company's 35 year history. During sea trials, the vessel achieved a top speed of 40 kn, and bettered class quality standards for noise and vibration in the passenger decks, with a quiet and smooth ride.

Austal's Chief Executive Officer, Paddy Gregg, said that the delivery of *Express 5* was a testament to the resilience and capabilities of the Austal Philippines team, who constructed the vessel through the pandemic and following the effects of Super Typhoon Rai in 2021.

"*Express 5* is the largest vessel, by volume, which Austal has ever constructed, and to deliver this new high-speed ferry despite the impact of the pandemic over 2020–22, and Super Typhoon Rai in 2021, is simply outstanding.

Austal Philippines has delivered *Express 5* to Molslinjen of Denmark. The 115 m high-speed catamaran ferry is the largest vessel (by volume) ever constructed by any Austal shipyard in the company's 35 year history
(Photo courtesy Austal Philippines)

"Despite the challenges faced, the Austal Philippines team has delivered the most impressive vessel ever to join the Molslinjen fleet. The high-speed ferry performed exceptionally well during sea trials and will soon provide a class-leading service to Bornholm in Denmark.

"Our warmest congratulations to Molslinjen on the delivery of this future-ready fast ferry, with the capability to incorporate hybrid-fuel engine technology, so achieving lower emissions and greater economy," Mr Gregg said

At a delivery ceremony, Austal Philippines President, Wayne Murray, thanked his team who have now delivered 21 vessels from the Balamban, Cebu, shipyard in just 10 years.

"*Express 5* is the 21st ship delivered to an overseas operator by Austal Philippines, highlighting the tremendous value added to the Philippines shipbuilding industry since 2012.

"It's fitting that our latest and greatest ship is also the largest ever delivered by an Austal shipyard, anywhere in the world — the team are rightly very proud and are to be congratulated," Mr Murray said.

Express 5 has the capacity for 1610 passengers, space for 450 cars (or 617 lane metres for trucks plus 257 cars) over two vehicle decks and an operating service speed of 37 kn. It is powered by an LNG-capable, medium-speed power plant which offers a powerful yet economic and environmentally-friendly solution. On board, passengers will enjoy leather-appointed reclining seats with USB ports, wi-fi, a full bistro and bars, a children's play area and multiple audio-visual screens.

The sleek looking 115 m catamaran was designed by the same Austal Australia team which developed the original, signature raked-bow hull for Molslinjen's *Express 4* delivered in 2019; and includes Austal's proprietary motion-control and MARINELINK-Smart systems.

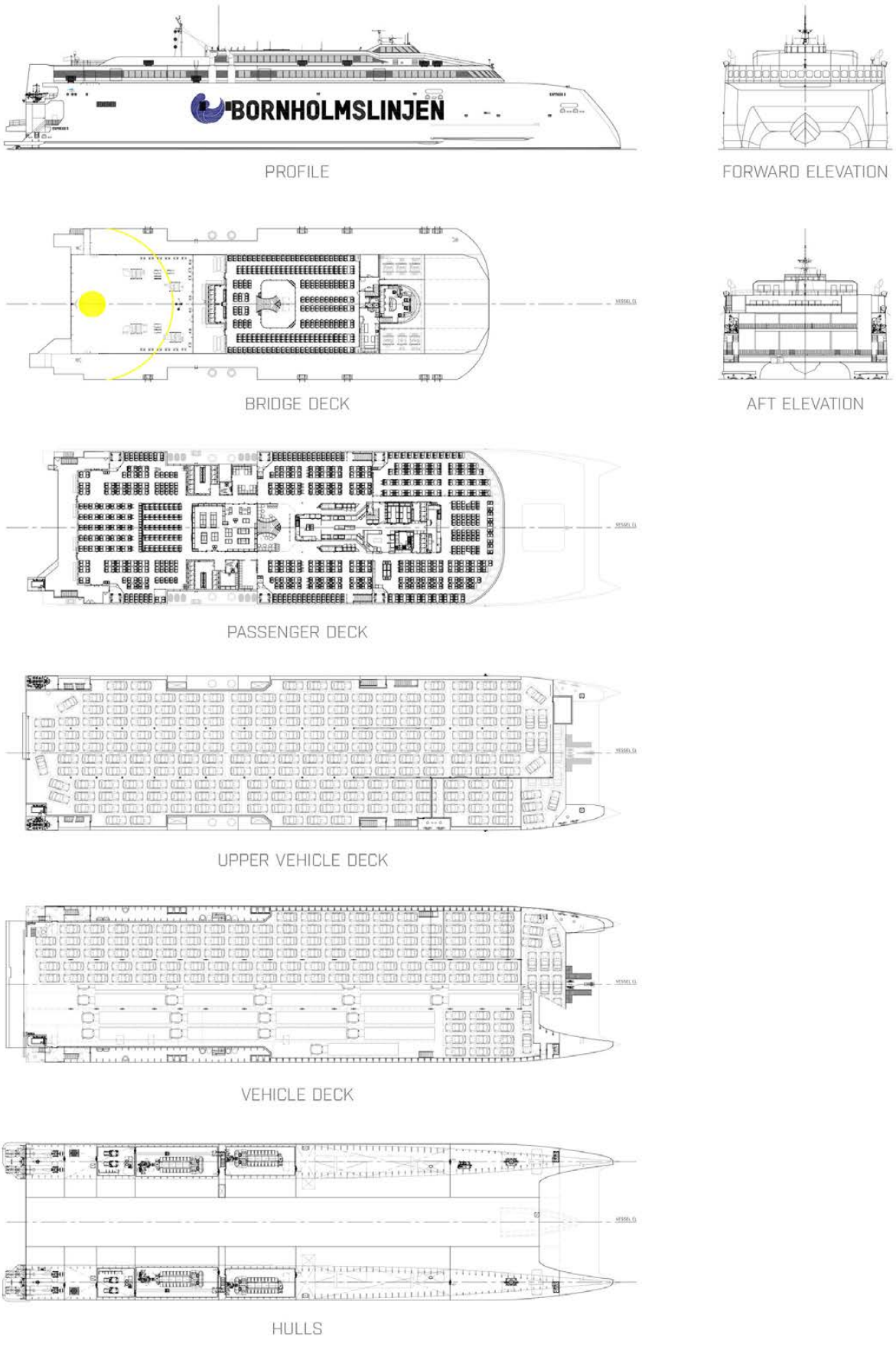
Austal Australia and Gotland sign MoU to Develop Design for 130 m High-speed Catamaran

Austal Australia and the Gotland Company of Sweden have signed a Memorandum of Understanding (MoU) for the design of Gotland Company's upcoming catamaran.

Gotland Horizon X is a 130 m long high-speed catamaran which will be able to operate on hydrogen and other fossil-free fuels, and will be used in the traffic between the Swedish mainland and the island of Gotland, transporting 1650 passengers and 450 vehicles at speeds up to 35 kn.

Under the MoU, the parties intend to enter a design agreement whereby Austal and the Gotland Company will develop the design for the high-speed catamaran with a multi-fuel solution which allows it to also operate on fossil-free fuels, including hydrogen.

An impression of *Gotland Horizon X*
(Image courtesy Gotland)



The general arrangement of *Express 5* recently delivered by Austal Phillipines to Molslinjen of Denmark (Drawing courtesy Austal)

Austal's Chief Executive Officer, Paddy Gregg, said "This agreement with the Gotland Company confirms that Austal is ready to finalise the design, ready for construction, of a new 130 m, hydrogen-powered high-speed catamaran which is yet another pathway forward to net zero emissions.

"Austal has developed vessel designs optimised for various fuel and propulsion technologies, including hydrogen and electricity, which offer a real choice to operators of high-speed craft. We look forward to working with the Gotland Company to finalise an exciting new design of the highest standards," he added.

Håkan Johansson, CEO of Gotland Company, said "This is an important step in our climate journey. We are working on developing our future ships, and in 2022 we presented the second ship model in our Horizon series: *Gotland Horizon X*. The vessel will be a very good addition to the traffic between the Swedish mainland and Gotland. She will be used foremost during the summer months and make the trip to and from Gotland in under three hours.

Warship Alliance Contract Extension

In March the Commonwealth Government awarded a contract extension to the Warship Asset Management Agreement (WAMA) partners, securing the future of critical ship management capability. The WAMA is an alliance of BAE Systems Australia, Saab Australia, Naval Ship Management and the Commonwealth Government, and sustains hundreds of skilled shipbuilding jobs at Henderson in Western Australia supporting a strong local supply chain.

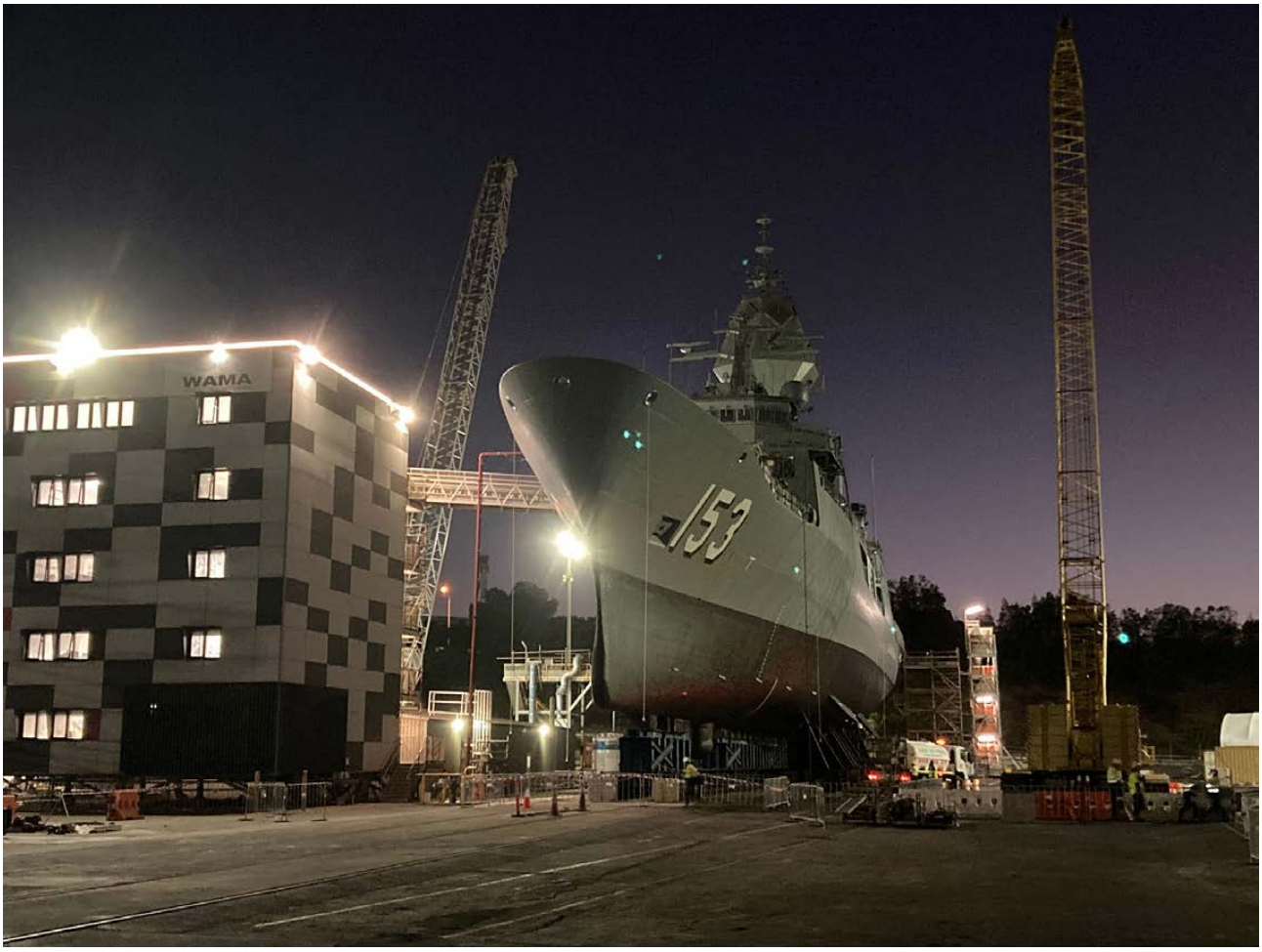
The timing of the Transition Capability Assurance Program (TransCAP) will align with BAE Systems' plans to modernise its Henderson site so that complex capability upgrades can be delivered more efficiently.

BAE Systems Australia—Maritime Sutainment Delivery Director, Greg Laxton, said "We're excited to continue our work with the WAMA delivering through-life support and asset management of the Anzac Class.

"We will later move to deliver the TransCAP which will include providing greater missile capability for the ships.

"We have developed a critical ship-management capability at Henderson, which has delivered significant ship-to-ship efficiencies. We're investing in the local facilities, bringing innovation from the Hunter-class frigate program and the digital shipyard at Osborne to Henderson."

Saab Australia's Managing Director, Andy Keough CSC, said "As the nation's sovereign combat management system provider for the Royal Australian Navy's surface fleet, Saab Australia is delighted to continue its long-term role as the combat systems integrator for Australia's Anzac-class frigates, delivering cutting-edge capability and in-service support under the WAMA contract."



HMAS *Stuart* successfully returned to the water on 22 February, having undocked after 101 weeks of production work in the BAE Systems Henderson shipyard in Western Australia. Coordinated through the Anzac System Program Office and the Warship Asset Management Agreement (WAMA) Alliance, *Stuart* is the sixth of the eight Anzac class frigates to undertake the Anzac Mid-life Capability Assurance Program (AMCAP), with another 20 weeks of work before she returns to sea
(RAN photograph)

Babcock's General Manager—Warships Australia, Gavin Stewart, said "Babcock, through its Australian warship division Naval Ship Management, welcomes the extension of the WAMA. We look forward to building on the over 10 years of experience already provided in safely delivering the sustainment needs of the Royal Australian Navy for the Anzac-class frigate.

"Our close partnerships with local industry in both Henderson and Sydney and the promotion of sovereign engagement, combined with the dedication and skills of our people, enables us to reliably provide this national maritime sustainment solution for the RAN."

The contract extension will cover the final 12 months of the current Anzac Mid-life Capability Program (AMCAP) which is due to finish in 2024 following work on HMAS *Ballarat* and HMAS *Parramatta*.

It will also cover the start of the Transition Capability Assurance Program (TransCAP) which will see work on HMA Ships *Anzac*, *Warramunga* and *Arunta* to ensure they continue to serve and protect Australia.

RAN and AMSA sign MoU

The Royal Australian Navy and Australian Maritime Safety Authority (AMSA) have strengthened the relationship between military and civilian maritime jurisdictions to support safety at sea and delivery of naval capability.

Chief of Navy, VADM Mark Hammond AM, RAN and Chief Executive Officer AMSA, Mick Kinley, signed a Memorandum of Understanding (MoU) which provides the process to move vessels from Australia's civilian regulation authority (known as Flag administration) to operate under a Defence Flag administration.

VADM Hammond said that the MoU provided greater agility for Defence and partner agencies to quickly respond to a variety of needs and contingencies in the maritime environment.

"Australia is a three-ocean island trading nation. Our seaborne supply chains and undersea infrastructure are the lifeblood of our economy—this underpins our way of life as a maritime nation.

"This MoU is important, as it allows Australia to better harness its resources in advancing the national interest in our maritime region.

"The agreement will support both Defence and AMSA to uphold Australia's international obligations for vessel Flag administration, while enhancing Defence's maritime response options in times of national necessity or crisis."

Mr Kinley said that the MoU was another great example of Australian Government organisations partnering for the benefit of the nation.

"We have a close and strong working relationship with Defence and this MoU will enable us to strengthen our maritime responses and operations across a range of situations," Mr Kinley said.

"The MoU helps the civilian and military regulators to have a mutual understanding of the safety, seaworthiness and environmental compliance of ships with changing jurisdictions to ensure none of these issues are compromised.

"Vessels operating under Defence's Flag administration

Head of Navy Engineering, RADM Kath Richards, AM, CSC, RAN, Chief of Navy, VADM Mark Hammond AM, RAN, Chief Executive Officer AMSA, Mick Kinley and Executive Director Operations AMSA, Michael Drake, at the signing of the Memorandum of Understanding in Russell Offices, Canberra
(RAN photograph)

have obligations under the United Nations Convention on the Law of the Sea (UNCLOS) and can gain access to the necessary ports, oceans and waterways to deliver missions for the Australian Government.

"This MoU will enable a quick extension of this regime to civilian maritime vessels when the need arises," Mr Kinley said.

The Pacific Support Vessel, ADV *Reliant*, is an example of what this MoU will enable. ADV *Reliant* was procured from the commercial market via a rapid acquisition process. It was quickly transferred from civilian to Defence Flag administration, enabling its timely and flexible employment in support of Australia's Pacific partners.

First Ocius Bluebottle Uncrewed Surface Vessels for the ADF

On 6 March the Minister for Defence Industry, The Hon. Pat Conroy MP, and Assistant Minister for Defence, The Hon. Matt Thistlethwaite MP, welcomed the arrival of the first Ocius BlueBottle Uncrewed Surface Vessels (USVs) for the Australian Defence Force.

The Royal Australian Navy and Defence industry have worked together through a Defence Innovation Hub initiative to develop the Ocius BlueBottle USV, with two of the five vessels received.

"As a trading nation, surrounded by oceans, a sustained maritime security presence is essential for assuring our national economy," Minister Conroy said.

Commander Australian Fleet RADM Chris Smith and CDRE Darron Kavanagh inspecting the BlueBottle
(Photo courtesy Department of Defence)

"Autonomous capabilities and innovative technologies, such as the Ocius BlueBottle Uncrewed Surface Vessels, will assist our Navy in supporting Australian interests."

"Powered by the wind, waves and the sun, the Ocius BlueBottle can autonomously monitor designated areas for extended lengths of time."

Assistant Minister Thistlethwaite said that the Ocius BlueBottle capability would strengthen our Navy's ability to protect Australia's trade routes, shipping, and marine resources to help secure Australia's ongoing economic prosperity and national security.

"Uncrewed Surface Vessels will also provide the Navy with a platform for continuous experimentation, including support to other autonomous surface and sub-surface systems," Assistant Minister Thistlethwaite said.

"The remaining three Ocius BlueBottle USVs are expected to be delivered by July 2023."

Ocius Technology Ltd is an Australian Sydney-based engineering company developing and delivering autonomous solutions for maritime surveillance.

New Head of Navy Engineering

On 24 March RADM Rachel Durbin CSC RAN succeeded RADM Kath Richards AM CSC RAN as Head of Navy Engineering at a ceremony in Canberra. At the same ceremony, RADM Durbin, as outgoing Director General Engineering for Navy, handed over that task to Joseph Cole.

Outgoing Head of Navy Engineering, RADM Kath Richards, (left) hands the weight of command to incoming Head of Navy Engineering, RADM Rachel Durbin, during a transfer of authority ceremony at Campbell Park in Canberra
(RAN photograph)

Outgoing Director General Engineering for Navy, RADM Rachel Durbin CSC RAN, hands the weight to Mr Joseph Cole at a transfer of authority ceremony at Campbell Park in Canberra
(RAN photograph)

Austal Australia and Saildrone enter Teaming Agreement

Austal Australia and Saildrone Inc. have entered an exclusive Teaming Agreement to jointly identify opportunities to collaborate on the manufacture of the 20 m Saildrone Surveyor, in Australia, for deployments in the Indo-Pacific region.

Saildrone is a world leader in long-endurance, uncrewed surface vehicles (USVs), having amassed nearly 1 million miles and 25 000 days at sea with its 120-strong fleet. Saildrone Inc is based in the United States of America but will be establishing Saildrone Australia in 2023 to cater to the commercial and government sector in Australia and the broader Indo-Pacific region.

The company entered a strategic partnership with Austal USA in August 2022 to construct Saildrone Surveyor USVs at Austal USA's shipyard in Mobile, Alabama. This new Teaming Agreement in Australia builds upon the successful partnership in the United States.

Austal's Chief Executive Officer, Paddy Gregg, said that the Teaming Agreement was a logical move and an excellent opportunity for Austal Australia and Saildrone to collaborate.

"This Agreement allows us to bring Saildrone Surveyor manufacturing to Australia, building in parallel with Austal USA. This increases our ability to rapidly scale to meet the demands we anticipate in the Indo-Pacific region. This industry-leading technology complements our work in the Patrol Boat Autonomy Trial and strengthens our capabilities overall in the autonomous naval vessel market," Mr Gregg said.

Saildrone Inc.'s Founder and Chief Executive Officer, Richard Jenkins, is an Australian National, having grown up in the southwest of Western Australia. Mr Jenkins went to school mainly in the UK and moved to America in 2009 to start the business. "It is fantastic to be bringing technology, innovation and investment back to Australia, and specifically to my home city of Perth," said Mr Jenkins.

The Saildrone Surveyor USV is 20 m long and designed specifically for deep-ocean mapping and Intelligence, Surveillance, and Reconnaissance (ISR) applications, above and below the surface. The Surveyor is autonomous and uncrewed, offering extreme endurance, reliability, and cost-effective operations.

An impression of Surveyor, a 20 m long uncrewed surface vehicle designed by Saildrone
(Image courtesy Saildrone)

Windflex-27 CTVs from Incat Crowther

Irish crew-transfer vessel (CTV) owner and operator Farra Marine has expanded its fleet of CTVs after ordering a further seven vessels from Singapore-based Penguin Shipyard International. The new CTVs—part of the WindFlex-27 series—will, when complete, see Farra Marine boast a fleet of 14 CTVs servicing the UK and European offshore wind industry. By early 2024, 13 of the 14 CTVs in Farra Marine's fleet will be Incat Crowther-designed, Penguin-built vessels.

The new WindFlex-27s have been customised to meet Farra Marine's special operational requirements, following discussions between Farra Marine CEO, Martin Rice, Incat Crowther and Penguin. The WindFlex-27 features a high deadweight capacity (50 t), plush seating for up to 24 pax and Incat Crowther's Resilient Bow Technology, which ensures safe and efficient operations in up to 2 m significant wave height. The system ensures safe passenger transfers in up to 1.75 m significant wave height.

For the 2023 series, the WindFlex-27 will be powered by IMO Tier III Volvo Penta D16 main engines, which represents a significant step forward in emissions reduction.

The vessel's main deck features a spacious passenger lounge, a wet room and ample toilet facilities. There are three large protected cargo zones forward of the deckhouse.

The upper deckhouse features the wheelhouse, a crew mess and pantry, and a bathroom. The hull below the main deck is fitted with sleeping quarters for four crew, including two bathrooms.

Mr Rice said that the seven newly-redesigned vessels are the result of a close collaborative relationship with Incat Crowther and Penguin. "When we were selecting a supplier to help expand our fleet, it was important to partner with companies which had the capability and expertise to deliver, as well as one who was willing to genuinely listen to our unique needs and requirements. Incat Crowther and Penguin jointly met our every requirement. The result of this collaboration is seven new vessels which are truly tailored to our operations in European waters," Mr Rice said.

"During a period of rapid growth for Farra Marine, I've enjoyed working with Incat Crowther and Penguin to build up our fleet," Mr Rice added. "With the addition of our new vessels, we will offer our clients a truly bespoke service and remain ahead of the game here in Europe.

Starboard bow of *Farra Orla*
(Photo courtesy Incat Crowther)

Farra Aiofe on station
(Photo courtesy Incat Crowther)

Incat Crowther's Managing Director—Europe, Ed Dudson, said that the collaborative design process was a sign of the strong partnership between Incat Crowther, Penguin and Farra Marine. "We are extremely proud of our long-term relationship with Farra Marine and Penguin. This project has been built on Incat Crowther's proven co-design capabilities where our clients' needs and requirements are at the centre of our process," said Mr Dudson.

The seven new CTVs are expected to be delivered in 2023 and early 2024.

Principal particulars of the Windflex-27 vessels are

Length OA	27.10 m
Length WL	24.90 m
Beam OA	9.00 m
Depth	3.85 m
Draft (hull)	1.76 m
Passengers	24
Crew	4
Fuel oil	2×13 000 L
	2×22 375 L
Fresh water	3500 L
Sullage	2500 L
Main engines	4×Volvo Penta D16 IMO Tier III each 625 kW @ 1900 rpm
Propulsion	4×Hamilton HM521 waterjets
Generators	2×Kohler 45EFOZDJ
Speed (service)	27 kn
(maximum)	30 kn
Construction	Marine-grade aluminium
Flag	United Kingdom
Class/Survey	BV I + HULL MACH, WIND FARM SERVICE SHIP SDS — SO, SEA AREA 3

38 m Ferries from Incat Crowther

Italian ferry operator Liberty Lines has expanded its order of 38 m hybrid monohull passenger ferries from Incat Crowther, with three additional vessels added to the original order of nine. Each of the twelve new vessels will offer a flexible hybrid drive train and will have the ability to enter and leave ports at speeds up to 8 kn in zero-emission mode.

The expansion of the project comes following Incat Crowther's proven digital design process delivered a forward-thinking design solution for the Trapani-based operator. With construction underway at Astilleros Armon's shipyard in Spain, delivery of the vessels is expected to take place between 2023 and 2026.

Each vessel will be capable of a speed of 30 kn and can accommodate 251 passengers in safety and comfort.

The main deck of each vessel features seating for 166 passengers, five bathrooms and a kiosk/bar amidships. The upper deck seats a further 85 passengers with an additional two toilets. Large luggage racks are situated throughout the vessel's two passenger cabins, in addition to overhead luggage bins.

Commenting on the new vessels, Chief Executive Officer at Liberty Lines, Gennaro Carlo Cotella, said that the acquisitions were part of the company's net-zero strategy. "With this project, we are making a sustainable investment in the renewal of our fleet, with the purpose of continuing to offer high-quality services to our stakeholders and minimise environmental impact in order to achieve an emission-free future."

The ships will be equipped with Rolls-Royce integrated MTU hybrid propulsion systems, each comprising two 16V4000M65L engines, two gearboxes, two e-motors and electric systems, two variable-speed gensets, a battery system, switchboard, electrical power-management system and an MTU hybrid automation system.

The advanced hybrid system will call upon different operating modes as required. In all-electric mode, the vessels will have no emissions to a speed of 8 kn. In hybrid mode, they can reach a high cruising speed when travelling across the sea, whilst simultaneously charging the batteries by the two main engines and deactivating the gensets for hotel load. During longer stops, the batteries are charged by means of the shore-power supply.

Starboard bow of Liberty Lines' 38 m ferry
(Image courtesy Incat Crowther)

Incat Crowther's CEO, Brett Crowther, said that the additional order was a sign of the growing demand for low-emission ferries. "This project requires our team of marine designers to integrate new and cutting-edge technology into bespoke designs for our client, while ensuring that we meet all regulatory requirements," said Mr Crowther. "Our work with Liberty Lines is yet another example of the ability of Incat Crowther to design and deliver tailored and innovative low-emission high-speed ferries for operators all around the world. We're seeing growing demand for low and zero-emission passenger ferries, and our proven digital design process means that Incat Crowther is perfectly placed to help operators both reduce emissions and increase operational efficiency as the world transitions to a net zero future".

Principal particulars of the new vessels are

Length OA	39.5 m
Length WL	38.3 m
Beam OA	8.3 m
Depth	4.0 m
Draft (hull)	1.8 m
Passengers	251
Crew	7
Fuel oil	20 000 L
Fresh water	1500 L
Sullage	2000 L
Main engines	2×MTU 16V4000 M65L each 2560 kW @ 1800 rpm
Propulsion	2×fixed-pitch propellers
Speed (service)	28 kn
(maximum)	30 kn
Construction	Marine-grade aluminium
Flag	Italy
Class/Survey	RINa C✠HSC A MON, PASSENGER SHIP, ✠AUT-CCS, PMR-ITA

Kilimanjaro VIII from Incat Crowther

Kilimanjaro VIII, a new 53 m passenger ferry designed by Incat Crowther and built by Hobart-based shipyard Richardson Devine Marine, has been handed over for delivery after undergoing sea trials in Hobart, Tasmania. *Kilimanjaro VIII* is the eleventh Incat Crowther-designed vessel for Azam Marine and the eighth built by Richardson Devine Marine. The vessel is larger than its predecessor, *Kilimanjaro VII*, and is capable of transporting up to 620 passengers at speeds in excess of 30 kn.

The main deck has an internal capacity of 340 as well as a large kiosk area and five bathrooms.

The mid-deck cabin seats 56 VIP passengers, 16 Royal-class passengers in fully lie-flat seats, and an additional 200 economy passengers as well as four bathrooms. Aft of the man-deck cabin, the vessel's luggage room houses up to 10 t of luggage and cargo, whilst IMO HSC code-compliant stability enhances her safety credentials. *Kilimanjaro VIII* has been designed for streamlined and efficient boarding, featuring Azam Marine's signature parallel boarding system, which sees five ramps per side load passengers and cargo in segregated flows. This proven system increases operational efficiency and safety by ensuring that passenger classes and luggage trolleys remain separated during boarding.

Starboard side of *Kilimanjaro VIII*
(Photo courtesy Incat Crowther)

Commenting on the project, Incat Crowther's CEO, Brett Crowther, said "It's great to see *Kilimanjaro VIII* perform so well on trials and lifted onto the ship for delivery. This project represents another milestone in our long and successful collaboration with Azam Marine and Richardson Devine Marine, and we've thoroughly enjoyed working with Azam to evolve and expand their fleet. The delivery of *Kilimanjaro VIII* in Tanzania will re-affirm Azam Marine's position as the country's leading passenger ferry service".

Kilimanjaro VIII represents a modern progression of the fleet's style, with an edginess to her lines and a long, sleek profile. Combined with the introduction of a reverse-bow hull configuration, the vessel will offer passengers a state-of-the-art ride. *Kilimanjaro VIII* has been handed over Azam Marine and is en route to Tanzania, where she will enter service shortly after delivery.

Principal particulars of *Kilimanjaro VIII* are

Length OA	53.0 m
Length WL	51.0 m
Beam OA	12.5 m
Depth	4.35 m
Draft (hull)	1.50 m
Passengers	620
Crew	10
Fuel oil	18 600 L
Fuel oil	4000 L
Fresh water	2000 L
Sullage	3000 L
Main engines	2×Cummins QSK95-M each 2983 kW @ 1800 rpm
Propulsion	2×Kamewa S80-4 waterjets
Generators	2×Cummins 6-CP 136DM/5
Harbour Generator	Onan 17.5 MDKR/12503
Speed (service)	34 kn
(maximum)	37 kn
Construction	Marine-grade aluminium
Flag	Tanzania
Class/Survey	DNV and NSCV Class 1C

Tuhi Rapa from Incat Crowther

Auckland-based tourism operator Explore Group has expanded its fleet of passenger and tourism vessels with the launch of *Tuhi Rapa*. The Incat Crowther 29, built by Australian shipyard Aluminium Marine, can transport up to 300 passengers and has been plying the waters of Auckland Harbour and the Bay of Islands since her maiden voyage in late 2022.

Tailored specifically to Explore Group's needs, *Tuhi Rapa*—which will act as both a passenger ferry as well as a wildlife sightseeing cruise vessel—features a range of design elements to help increase operational efficiency including the addition of midship boarding doors on the main deck. *Tuhi Rapa*'s main deck features spacious indoor seating for 123 passengers, a large bar and kiosk, three toilets, outdoor seating for 8 more passengers and an overhead bicycle store. The mid deck includes outdoor seating for 37 passengers as well as indoor seating for 65 additional passengers, a bathroom and the vessel's wheelhouse. There is also a viewing platform and seats for 67 passengers on the roof deck.

Explore Group's Managing Director, William Goodfellow, told media in Auckland that the design of *Tuhi Rapa* had been tailored for both tourists and local commuters. "*Tuhi Rapa* has enough space to carry bikes as well as large outdoor spaces and windows for cruising and wildlife viewing in local conditions and came just in time for our busy summer holidays," said Mr Goodfellow. "We love the design and operability of *Tuhi Rapa*. Having owned and operated more than 20 vessels, we can safely say that *Tuhi Rapa*'s versatility means that she stands head and shoulders above anything else," he added.

Incat Crowther's Technical Manager, Dan Mace, said that Incat Crowther's proven design process was crucial in creating *Tuhi Rapa*. "The design of *Tuhi Rapa* is based on our proven Incat Crowther 29 catamaran; however, we worked with Aluminium Marine to tailor *Tuhi Rapa* specifically

to the needs of Explore Group. The result is a flexible, operationally-efficient and safe passenger ferry which also doubles as a tourism catamaran," said Mr Mace. "Having worked with Explore Group previously, we knew that some of the finer details in the design were incredibly important. It's great to see *Tuhi Rapa* on the water and we've thoroughly enjoyed working on yet another successful project," he said.

Tuhi Rapa was named in consultation with Ngāi Tai ki Tāmaki, the original inhabitants and iwi of Auckland, as part of their ongoing partnership with Explore Group. You can read more about Tuhi Rapa and Explore Group at: www.exploregroup.co.nz.

Principal particulars of *Tuhi Rapa* are

Length OA		29.3 m
Length WL		29.3 m
Beam OA		8.00 m
Depth		2.50 m
Draft	(hull)	1.20 m
	(propellers)	1.55 m
Passengers		300
Crew		5
Fuel oil		4000 L
Fresh water		700 L
Sullage		700 L
Main engines		2×Yanmar 6AYM-WGT each 679 kW @ 1938 rpm
Propulsion		2×propellers
Generators		2×Isuzu 4 cylinder 60 kVA
Speed	(maximum)	28 kn
Construction		Marine-grade aluminium
Flag		New Zealand
Class/Survey		NSCV Class 1C

Stewart Marler

Cruising in NSW

The summer season continued through late February with visits to Sydney by *Celebrity Eclipse, Viking Neptune, Pacific Adventure, Island Princess, Arcadia, Viking Mars, Ovation of the Seas, Carnival Splendor, Majestic Princess, Silver Whisper, MSC Poesia, Asuka II* and *Regatta.*

The season wound down through autumn, with return visits in March by many of these vessels plus visits by *Queen Victoria, Viking Orion, Norwegian Spirit, Seabourn Sojourn, Seabourn Odyssey, Queen Mary 2, Noordam, MSC Magnifica,* and *Europa.*

April saw return visits by some of these vessels and added visits by *Grand Princess* and *Coral Princess,* while May saw only return visits.

Carnival Splendor and *Pacific Adventure* are scheduled for cruises over the winter months. The arrival of *Coral Princess* on 20 September and *Celebrity Solstice* on 19 October will signal the start of the next summer season.

Cruise vessels operating out of Sydney continue to call at Eden, NSW, with vessels berthing at the Eden Cruise Wharf and passengers going ashore to visit local sights and shops. *Viking Neptune, Celebrity Eclipse, Norwegian Spirit* (three times)*, Pacific Adventure* (twice)*, Seabourn Odyssey, Grand Princess* and *Majestic Princess* all visited between mid-February and mid-April.

Phil Helmore

Port bow of *Tuhi Rapa*
(Photo courtesy Incat Crowther)

Cunard's *Queen Mary 2* at anchor in Athol Bight, Sydney on 11 March 2023. She moved to the Overseas Passenger Terminal later that day after the departure of *Ovation of the Seas*
(Photo John Jeremy)

The RANI Australian Maritime Warfare Centre and Thales are testing and evaluating Steber Unmanned Surface Vehicles (USVs) for use in mine-sweeping operations. The USVs will be operating inside and outside Sydney Harbour but will be controlled remotely from a forward operating position at HMAS *Watson* overlooking the test area. This activity is an important step in proving the capability of the USVs before they reach full operational capability
(RAN photograoh)

INDUSTRY NEWS

Austal's New Artificial Intelligence Toolset

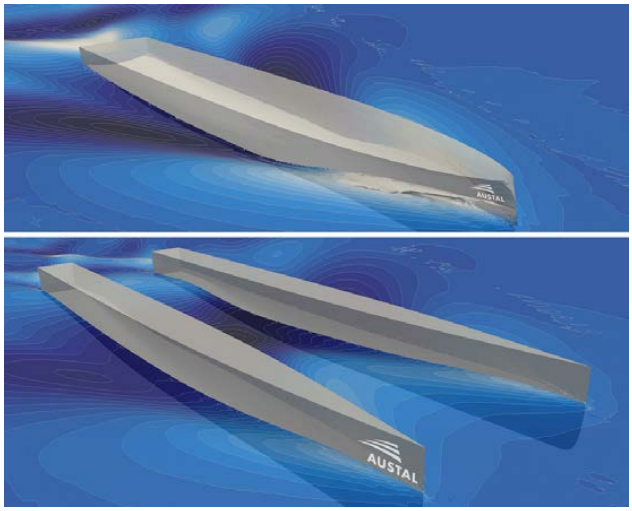
Austal's new artificial intelligence (AI) toolset, DeepMorpher, is helping the company's Australia-based designers explore broader design spaces whilst significantly reducing resource requirements for complex hull-optimisation routines.

Quickly-evolving market environments require an innovative approach to provide optimum solutions for emerging trends, including autonomy, decarbonisation, and new naval capabilities. DeepMorpher was developed by Austal Australia to achieve greater efficiencies and productivity in design and engineering.

Max Haase, Development Hydrodynamics Specialist at Austal Australia and co-author of a newly published research article *DeepMorpher: Deep Learning-based Design Space Dimensionality Reduction for Shape Optimisation*", said "DeepMorpher allows us to efficiently investigate and optimise (conceptually) different hullforms beyond those in our traditional product range. It reduces our reliance on domain expertise and enables greater focus on maximising outcomes based on key customer requirements.

"Artificial intelligence and machine learning have broadened and accelerated our optimisation process, delivering greater options, more quickly, for our customers. With the support of high-performance computing provider DUG Technology, we can reduce the timeframe for hullform optimisation in conjunction with computational fluid dynamics by an order of magnitude," he added.

While DeepMorpher has been developed primarily for optimising ship hullforms, it can also be used for arbitrary shape optimisation including many other maritime, aerospace or engineering applications.



Austal's DeepMorpher artificial intelligence tool assists in optimising monohull and multi-hull solutions with maximum hullform efficiency
(Image courtesy Austal)

CEO and MD of Australian Naval Infrastructure Reappointed

Andrew Seaton has been reappointed as Managing Director and Chief Executive Officer of Australian Naval Infrastructure Pty Ltd (ANI) for a five-year term.

Mr Seaton has been ANI's Managing Director and Chief Executive Officer since 2020. During this period, he has led the organisation through the planning and construction of infrastructure in support of key naval shipbuilding projects.

Mr Seaton has extensive engineering, financial, commercial, and major project management experience.

Mr Seaton's reappointment will ensure continuity of leadership during an important time in which ANI will deliver critical shipbuilding infrastructure, including designing and building the future nuclear-powered submarine construction yard at Osborne, South Australia.

Bureau Veritas and the RAN ANCF

Following a review of DEF(AUST) 5000 Maritime Materiel Requirements Set (MRS) the Department of Defence has asked Bureau Veritas to help rewrite the entire framework and create the new Australia's Naval Classification Framework (ANCF).

Bureau Veritas was selected after a competitive tender led by CDRE Colin Dagg, former RAN Director General Engineering (Navy), who retired in 2021 after more than four decades in the RAN only to be brought back in to run the ANCF project. "Bureau Veritas really understands what we're trying to do," CDRE Dagg said. "They comprehend that this is a classification to support navy vessels, and their understanding of how rules can drive design and construction to meet our sovereign requirements is crucial. They are helping us write a framework which is specifically for Australia, not just Bureau Veritas rules or another set of IACS rules applied to Australia."

Leveraging know-how and experience, Bureau Veritas is helping the RAN create a framework understood by the industry as well as Defence. "Many of their experts have lived and worked on ships operating in complex engineering and technical areas such as mining and offshore pipelines, so they bring vital expertise to the project," CDRE Dagg said. "They are helping us think innovatively about the process and how to achieve our goals." The ANCF is to be implemented in three "tranches." Tranche 1 has already begun and covers necessary preliminary activities to support a successful implementation strategy. Tranche 2, slated to start in July 2022, migrates existing RAN vessels to the new naval classification framework. Tranche 3 is scheduled to commence in January 2025 and take effect in January 2027. It ensures that all future naval vessels are designed, built and maintained under a complete naval classification framework.

ABB Azipod® Propulsion to Power Spanish Navy's Flagship

ABB has secured a breakthrough contract with the Spanish state-owned Navantia shipbuilding company to retrofit the Spanish Navy flagship, *Juan Carlos I*, with an electrical propulsion system based on dual ABB Azipod® units. Due for completion in 2025, the project is the first of its kind on a naval ship. Following the commissioning, *Juan Carlos I* will benefit from enhanced efficiency and maneuverability to support its varied and demanding naval operations.

The contract follows a study undertaken by ABB in 2020 to determine the feasibility of installing new propulsors on the ship. The study identified ABB Azipod® as a solution to meet the vessel's requirements for reliability, efficiency, manoeuvrability and safety.

"We are proud to see our Azipod® propulsion system chosen for this project," said Sindre Satre, Business Line Manager, Coast Guard and Navy, ABB Marine & Ports. "We already have a long track record with highly-efficient solutions on the commercial market and now see that our technologies are becoming increasingly viable also for naval vessels."

ABB's scope of supply for *Juan Carlos I* comprises two Azipod® propulsors and medium-voltage drives, with support and maintenance available locally from the ABB service centre in Spain and worldwide via ABB's global service network.

While the order represents the first retrofit of an ABB Azipod® propulsion system aboard a naval vessel, the solution has been maximising ship performance in the naval patrol segment for several years. In 2019, the Norwegian Coast Guard icebreaker KV *Svalbard* became the first Azipod®-powered vessel to reach the North Pole, where the system's manoeuvrability and icebreaking capabilities proved critical.

Across its 30-plus years in operation, Azipod® propulsion has recorded an availability rate of 99.8 percent and has been shown to cut fuel consumption by up to 20 percent when compared with traditional shaftline propulsion systems. The solution's high manoeuvrability eliminates the need for tugs in harbour operations and maximises safety, while its pioneering design minimises vibrations, saves space on board and facilitates maintenance as well as future refits.

The Spanish Navy flagship, *Juan Carlos I*, is to be fitted with new propulsors manufactured by ABB (US Navy photograph)

Austal USA Opens San Diego Ship Repair Facility

On 13 February Austal USA celebrated the opening of the company's new San Diego waterfront ship repair facility during an afternoon reception which brought together military and community leaders, elected officials and representatives from across the ship repair industry.

The shipyard, located adjacent to Naval Base San Diego, will provide full-service repair, maintenance and modernisation services for small surface combatants, unmanned and autonomous vessels, and auxiliary ships.

An impression of Austal USA's new San Deigo facility (Image courtesy Austal USA)

Since finalising an agreement for the property over a year ago, Austal USA has invested over $US100 million in facility upgrades and a new floating dry dock to transform the facility. The 6 ha site now provides 205 m of improved San Diego Bay shoreline, 7432 m^2 of covered working space, and has been equipped with new pier fenders and moorings, modernised shore-power conversions, and enhanced security.

Austal USA was then executing its first task in its new facility, the post-shakedown availability of the future USS *Canberra* (LCS 30). With the company's new floating dry dock on schedule to be fully operational by Northern Hemisphere summer 2023, Austal USA will have the capability to execute more extensive depot maintenance on littoral combat ships, frigates, and other similar-sized surface combatants and auxiliaries.

With repair and service capabilities previously established in Mobile, AL. and Singapore, recent expansions into steel shipbuilding, and a technology centre in Charlottesville, VA., the San Diego shipyard opening continues Austal USA's growth as a full-service defence provider.

Rolls Royce Reactors for SSN AUKUS

Rolls-Royce Submarines has been contracted to provide reactors for Australia's nuclear-powered submarines, as part of the AUKUS trilateral agreement between Australia, the UK and the US.

Rolls-Royce Submarines, based in Derby, UK, currently employs more than 4000 people and designs, manufactures and provides in-service support to the pressurised water reactors which power every boat in the Royal Navy's submarine fleet.

"We are delighted to be asked to play our part in delivering this element of the AUKUS Agreement and are well prepared for support through our nuclear expertise and engineering excellence. For over 60 years we have provided the power to the Royal Navy's nuclear submarines and we are proud to be playing a critical role in helping Australia acquire their own nuclear propulsion submarine capability," Steve Carlier, President—Rolls-Royce Submarines said.

Rolls-Royce is currently supporting the existing Astute-class and Dreadnought-class submarine build programmes with the delivery of reactor plant and associated components. Additionally, it provides frontline support across the world for reactor plant equipment from its Operations Centre in Derby and supports the submarines when in the Barrow-in-Furness shipyard and the naval bases at Devonport and Faslane.

Thales and Orbis link up to Support RAN

Thales Australia and Orbis Sibro have entered into an agreement to collaborate on the advancement of maritime sustainment operations in support of the Royal Australian Navy (RAN) at Fleet Base East, Garden Island, Sydney.

Under this agreement, Thales Australia and Orbis Inc. will focus on a range of initiatives including technological innovation and shipyard infrastructure optimisation, as well as further developing the naval sustainment industrial base and workforce.

To accelerate capability advancement at Fleet Base East, the companies have recently completed preliminary feasibility studies and extensive reviews of Australia's existing naval sustainment and support operations, workforce development and optimisation, as well as upskilling and mentoring programs.

"This partnership will help deliver greater integration of platform and infrastructure through digitisation and automation of the maritime sustainment environment, which is necessary to increase the readiness, availability and performance of RAN fleets and assets," Max Kufner, Vice President, Above Water Systems, Thales Australian & New Zealand said.

"Orbis's origin and roots are in the United States' Navy's submarine program. As the requirements for integration and interoperability grew, Orbis leveraged and applied the knowledge, experience, and expertise developed through its submarine experience to broader Navy-wide challenges, including global supply chain, shore infrastructure, and other sustainment eco-system challenges. Partnering with Thales to lead critical elements of the Commonwealth of Australia's Plan Galileo is as much an obligation as it is an opportunity," Greg Thomas, Vice President, Submarine Initiatives, Orbis Inc, said.

The two companies will help strengthen the naval support and maintenance ecosystem in the region, whilst assuring fleet readiness, availability and interoperability of Australian and allied partner current and future maritime capabilities.

EDUCATION NEWS

UNSW Canberra

Semester 1 is nearing its end and the four courses being taught have progressed well. These are namely: ZHSS3750 Building the Fleet, ZEIT3750 Naval Architecture Practice, Hydrostatics and Stability, ZEIT4750 Ship Design Project A, and ZEIT4752 Ship Propulsion and Marine Engineering.

At the end of March, Dr Prasanta Sahoo's 12-month appointment with us ended. Prasanta's contributions in helping us establish our program during his time with us are greatly appreciated and I expect him to remain a valued associate of our enterprise going forward.

In the month of April, we were busy with running the inaugural fourth year field trips. The first of these was a trip to AMC (including resistance and seakeeping test experience and tours of other AMC facilities) with industry visits in Hobart to Incat Tasmania, Richardson Devine Marine, and Taylor Bros.

Aboard the AMC Carriage integrating UNSW Canberra and AMC Students
(Photo courtesy Warren Smith)

Donning hard hats for an extensive tour at Incat Tasmania
(Photo courtesy Warren Smith)

Our hosts at AMC, including staff and students, and those in industry are graciously thanked. A second trip comprised a three-day training cruise out of HMAS *Creswell* conducted on MV *Sycamore*. Similar gracious thankyous are extended to the Master, Chief Engineer, crew, sustainment office and liaison officer of *Sycamore*. We look forward with keen anticipation to both these trips being conducted annually. They provided fantastic insights.

In early May, a trip with our third year students took us to Sydney, for the second time, for an inclining experiment at the Sydney Heritage Fleet and other industry visits to Garden Island Dockyard, Lloyds Register and One2Three Naval Architects. This trip followed a laboratory session where a model was inclined to establish clear understanding of the principles involved.

In the lab for the model inclining experiment at UNSW Canberra
(Photo courtesy Warren Smith)

In May, we also welcome to our teaching team on a full-time basis Sean McCracken. Sean is an ex-RAN marine engineer who comes to the university most recently from Border Force. He will work across our naval architecture and mechanical engineering disciplines.

As always, we welcome enquiry and comment. Please do not hesitate to contact me (w.smith@unsw.edu.au) or David Lyons (david.lyons@unsw.edu.au) or us both (navarch@adfa.edu.au) via email, or either of us by other channels, if you have any questions or would like to contribute to or to join our enterprise. We would welcome talking to prospective students, both undergraduate and postgraduate, and those that might be interested in exploring academic opportunity.

A/Prof. Warren Smith
Naval Architecture Program Coordinator
School of Engineering and IT
UNSW Canberra

THE AUSTRALIAN NAVAL ARCHITECT

Contributions from RINA members for *The Australian Naval Architect* are most welcome

Material can be sent by email or hard copy. Contributions sent by email can be in any common word-processor format, but please use a minimum of formatting — it all has to be removed or simplified before layout.

Photographs and figures should be sent as separate files (not embedded) with a minimum resolution of 200 dpi. A resolution of 300 dpi is preferred.

AMSA

Survey Matters

Survey Matters is AMSA's e-Newsletter relating to domestic commercial vessel (DCV) survey and is published approximately six times per year. You can request placement on the mailing list by emailing DCV Survey <dcvsurvey@amsa.gov.au>. The e-Newsletters are now also available online at

https://www.amsa.gov.au/news-community/newsletters#collapseArea612

Items included in the April 2023 e-Newsletter included:

- Careers at AMSA
- Audits and application assessments
- Draft Instruction to Surveyors now available—10 yearly internal inspections
- Periodic lightship check—comparison of departure conditions is not acceptable
- Vessel repairs
- Polyurethane sealant in timber vessels
- Load line conditions of assignment
- Minor fixes can save major costs later

The article on *Periodic Lightship Check—Comparison of Departure Conditions is Not Acceptable* is reproduced below.

Phil Helmore

Periodic Lightship Check—Comparison of Departure Conditions is Not Acceptable

Recently an accredited surveyor recommended a periodic lightship check after measuring the vessel's departure condition and comparing this with the departure values shown in the stability book. The surveyor concluded that there had been no (0%) change in vessel lightship from this measurement and recommended that the vessel's certificate be renewed.

AMSA identified this during assessment of the application and required a lightship measurement to be conducted on the vessel. The lightship comparison correctly identified that the vessel's lightship displacement had in fact changed by almost 8 t. The vessel was re-inclined and the VCG had increased significantly.

Comparison of departure conditions is not an acceptable method to assess a vessel's lightship displacement or determine whether any modifications have occurred.

As shown by this case, a comparison of departure conditions does not provide evidence that a vessel has not been modified. Whilst a vessel's loaded displacement may remain constant, other changes may still have occurred, such as replacement of lead ballast with additional tanks, awnings etc.

For example, in the case of the vessel *Returner*, the Coroner's Report states:

> 103. The AMSA/DoT investigators concluded that if the vessel's weight (checked through the freeboard) was the sole or deciding factor used to determine whether further testing of stability was required, a false conclusion may have been reached. It appears that this is what did occur.

Applications recommended with this kind of method may be refused by an AMSA delegate and lead to investigation by AMSA's surveyor audit team.

Survey Matters, April 2023

The future HMS *Glasgow*, the first Type 26 frigate to be built for the Royal Navy shortly after her launching last December. Australia's Hunter-class frigates are based on this design
(MoD(N) photograph)

MEMBERSHIP

Australian Division Council

The Council of the Australian Division of RINA met on the afternoon of Tuesday 21 March 2023 by Zoom-conference under the chairmanship of our President, Jim Black, in Perth with links to Airlie Beach, Gold Coast, Sydney, Canberra, Melbourne, Hobart, Adelaide and Perth.

Among the items discussed were:

Lower Secondary Brochure

Council is well advanced in the development of a brochure to advise of the breadth of work which may be undertaken by maritime engineers, encourage prospective naval architecture students to take STEM subjects, and to advise them of where they could study to undertake their degree.

Council Membership

Council endorsed the outcome of the Council election process, under which no election was necessary and resulting in Karl Slater effectively replacing Walid Amin who was ineligible for re-election.

Following the resignation from Council of Vice President Belinda Tayler, the President, Treasurer and I are working to fill the resulting vacancies. Anyone interested in either or both positions should contact the President or me.

Government Initiatives

Council agreed to actions regarding contact with Defence to reinforce the importance of our profession to the implementation of the Naval Shipbuilding Program including the nuclear-powered submarine project.

Promotion of the Profession

In keeping with the long-term view expressed in relation to government initiatives and STEM studies, Council initiated moves to investigate maritime and marine subjects being presented in secondary schools with a view to involvement in those programs.

Engineer Registration in Queensland and Victoria

Council received a report on progress made with submission and assessment of applications for approval/re-approval as an assessment entity to facilitate the mandatory registration of RINA members in these jurisdictions.

Indo-Pacific IMC 2023

Council received a progress report on arrangements for the Conference in Sydney on 7–9 November.

The draft minutes of the meeting have been circulated to Council members and are available to other members by request.

It should be noted that the Division's Annual General Meeting was held one week after the Council meeting. I would like to express Council's appreciation to those members who took time out of their evening to attend this meeting which is an essential part of our governance and meeting the statutory requirements applying to the Division.

Finally, on a personal note, I would like to express my appreciation to any members who might have had a role in, or conveyed congratulations on, my Award in the Australia Day Honours list. The Award augurs well for the recognition by Australians of the importance of our Institution and profession to many aspects of the industry, commerce, defence and economy of our country.

Rob Gehling AO
Secretary
rinaaustraliandivision@iinet.net.au
0403 221 631

Changed contact Details?

Have you changed your contact details within the last three months? If so, then now would be a good time to advise RINA of the change.

Please advise RINA London, *and* the Australian Division, *and* your local section:

RINA London		hq@rina.org.uk
Australian Div.		rinaaustraliandivision@iinet.net.au
Section	ACT	rinaact@gmail.com
	NSW	rinansw@gmail.com
	Qld	rinaqlddiv@gmail.com
	SA/NT	rinasantdiv@gmail.com
	Tas	tassec@rina.org.u
	Vic	vicsec@rina.org.uk
	WA	wa@rina.org.uk

Phil Helmore

VALE

Arthur King

It is with sadness that *The ANA* records the passing of Arthur King on 2 January 2023.

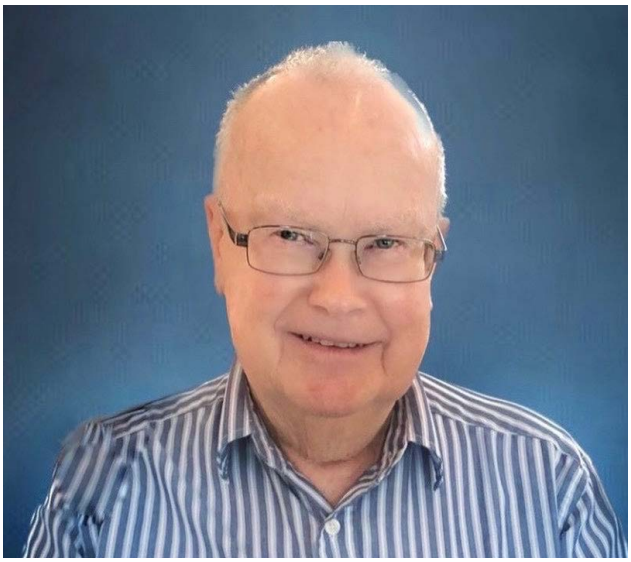
Arthur was born In Sydney on 6 October 1944 and grew up in Balmain where his life revolved around St John's Anglican Church and the Snapper Island Corps of the Sea Cadets.

He attended Birchgrove Public School and then Homebush Boys High School. From an early age he was fascinated by ships. When he was around 12 years of age he created a scale model of each of the ships in the Royal Australian Navy from balsa.

Following high school he enrolled in the shipwright's course at Sydney Technical College and was apprenticed as a shipwright at HMA Naval Dockyard, Garden Island. His talent was soon recognised and he was awarded Apprentice of the Year in his final year.

He then studied part time for the degree of Bachelor of Science (Engineering) in Naval Architecture at the University of NSW, whilst working as a shipwright at Garden Island. He graduated in 1971 in the top 10% of his cohort and shared the award from the Royal Institution of Naval Architects (Australian Division) for best performance in the final year of Naval Architecture.

He was subsequently offered a scholarship to complete his Master's Degree in Science in Naval Architecture at the University College London in 1971 but failed to meet the requirements of the first year of study. He returned to Canberra to work for the Department of Defence (Navy) until his early retirement in 1994. His chief focus was the design and construction of the new Collins-class submarines, and he was part of the design team sent by the Australian Government to Sweden to participate in a 12-month tender process for the construction of the submarines.



Arthur King
(Photo courtesy Terry King)

An avid reader, he amassed a significant collection of reference books related to all aspects of naval architecture and design and the history of naval vessels during both World Wars. He was a Member of the Canberra Chapter of the Naval Historical Society of Australia, serving at times as President and Secretary. He bequeathed his collection of books to the Naval Historical Society of Australia.

In retirement he moved to the Gold Coast to be close to his aging mother, and died in Pindara Private Hospital in Benowa, Queensland.

Call the Hands, Newsletter of the Naval Historical Society of Australia, April 2023
[*Reproduced with permission*—Ed.]

THE INTERNET

RINA Webcasts

RINA has set up a YouTube channel and RINA webcasts can be viewed there. The RINA YouTube channel is at

https://www.youtube.com/channel/UChb1sfHbWfQmG-iwpp_QGJg/videos

Bookmark this website and keep your eye on it!

Video recordings of presentations should be sent to Rusne Ramonaite <rramonaite@rina.org.uk> at RINA HQ for uploading.

Click on Playlists in the menu bar. Branch and Section presentations are shown fourth from the left in the top line. Click on *View full Playlist* to see the list (best for a recent presentation), or click on the search function to the right of About in the menu bar (for an older presentation), type the title of the presentation you are looking for (or at least the first few words thereof) and press Enter.

ACT Section Webcast

The ACT Section webcast recorded and uploaded within the last three months is:

- *The Effect of Submergence on the Wave Attenuation Performance of an Artificial Reef,* presented by John Lynch of CASG's SEA5000 Branch, as a webinar hosted by RINA using the Zoom software platform on 1 November 2022.

Jordan Rayson

[*RINA HQ has had a resignation of one of their web gurus, and they are busy trying to get back up to speed with loading presentations to the YouTube channel*—Ed.]

Further recordings will be added to the RINA YouTube channel as they occur.

NAVAL ARCHITECTS ON THE MOVE

The recent moves of which we are aware are as follows:

Sammar Abbas has moved on within ASC and has taken up the position of Senior Principal, Asset Management in Perth.

Matthew Addison moved on from Mermaid Marine Australia in 2014 and, after some time at Rivtow Marine, AST Oceanics, Solstad Offshore and Serco, has taken up the position of Ship Manager with Luerssen Australia in Henderson, WA.

Alistair Allen has moved on and has founded DAME Technologies and taken up the position of Executive Director in Melbourne.

Matthew Allen has moved on from Subcon and has taken up the position of Business Development Manager with MMA Offshore Limited in Perth.

Michael Andrewartha has moved on from VEEM, continues as Senior Engineer with Electro.Aero, and has also recently co-founded Electro Nautic and taken up the position of Chief Technology Officer in Perth.

Tristan Andrewartha has moved on within Knud E. Hansen and has taken up the position of Senior Naval Architect in Copenhagen, Denmark.

Nathan Atkinson has moved on from London Offshore Consultants and has taken up the position of MWS Projects Manager with ABL Group in Perth.

James Bell has moved on from the Royal Australian Navy and has taken up the position of Warranty and Support Engineer with Serco in Launceston.

Joshua Bolin has moved on from C-Job Naval Architects in The Netherlands and has taken up the position of Senior Naval Architect with Thales in Sydney.

Lauchlan Clarke has moved on from Jacobs Engineering and has taken up the position of Senior Advisor Vessel Safety with the Australian Maritime Safety Authority in Canberra.

Chris da Roza has moved on from Thales Australia and has taken up the position of Lead Naval Architect with Atlantic & Peninsula Australia in Sydney.

Ahmed Elhanafi has moved on from the Directorate of Naval Engineering and has taken up the position of Senior Project Engineer with Delmar & Vryhof in Perth.

Adela Greenbaum has moved on from Navy Enterprise Resource Planning and has taken up the position of Deputy Director Policy with the Navy Materiel Seaworthiness Assurance Agency of the Department of Defence in Canberra.

Pranjal Gupta moved on from Unisys in 2020 to take up the position of Director of Technology Services with Inferno Tech in Sydney where he continues, and has also recently co-founded DataXLR8.ai, a company making artificial intelligence (AI) accessible and affordable by providing tailored solutions.

Braden Holgate has moved on and, after some time at The Occasional Brewer and Full Stack Developer, has taken up the position of Junior Software Engineer with Immersive in Wellington, New Zealand.

Torsten Lau has graduated from the Australian Maritime College with his bachelor's degree in naval architecture and has taken up a position in the autonomous vessels team with Gibbs & Cox Australia in Canberra.

Ho Young Daniel Lim has moved on from the Capability Acquisition and Sustainment Group of the Department of Defence in Canberra and has taken up a position with Navantia Australia in Melbourne.

Max McCann has moved on from McConaghy Boats and is heading back to the USA to take up a position as Naval Architect with Maritime Applied Physics Corporation in Brunswick, ME.

Jesse Millar has moved on from Deloitte, setting up his own business, PJ Group Consulting, and is contracting to Defence. Under his current contract, he provided engineering support to establish the Defence Maritime Assurance (DMAP) Panel to support the streamlined procurement of commercial vessels into Defence. He has now focussed on operationalising the panel, and the procurement of various vessels which may initially include light landing craft, dive-support vessels, tugs and, potentially, vessels for other government agencies.

Richard Milne has moved on within the Directorate of Naval Engineering, Department of Defence, and has taken up the position of Naval Architecture Centre of Expertise Director in Canberra.

Brett Morris has moved on from Naval Group Australia, having spent 18 months in Cherbourg, France, and has returned to Australia where he has taken up the position of Principal Systems Engineer with Shoal Group in Adelaide.

Jeremy Nolan moved on from Birdon Group in 2021 and took up the position of Naval Architect with the Stability, Hydrodynamics and Support Craft Cell with the Directorate of Navy Engineering, Department of Defence, in Canberra. He has since been promoted to become the Cell Lead.

Shannon Phillips has joined the Directorate of Navy Engineering, Department of Defence in Canberra under the Navy Civilian Engineer Development Program (CEDP).

Alex Walter has moved on from Saab Australia and has taken up the position of Business Development Lead—Marine with Babcock Australia & New Zealand in Adelaide.

Tamasin Welch has moved on from the Navy Civilian Engineer Development Program (CEDP) to take up the position of Program Liaison Officer with the Maritime Mine Warfare Patrol and Geospatial Capability Domain, Directorate of Navy Engineering, Department of Defence, in Canberra.

This column is intended to keep everyone (and, in particular, the friends you only see occasionally) updated on where you have moved to. It consequently relies on input from everyone. Please advise the editors when you up-anchor and move on to bigger, better or brighter things, or if you know of a move anyone else has made in the last three months. It would also help if you would advise Robin Gehling when your mailing address changes.

Phil Helmore
Martin Grimm

FROM THE ARCHIVES

Supporting Shipbuilding Mobilisation

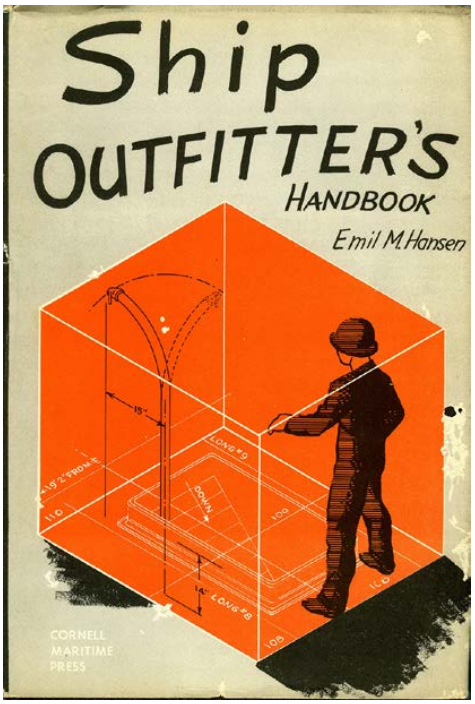
John Jeremy

Amongst the remarkable stories of achievement during World War II is that of the mobilisation of North American naval and merchant ship construction facilities and workforce. The production rates achieved were outstanding. Between 1941 and 1945 naval shipbuilders delivered (in addition to a large number of major combatant ships) some 343 destroyers, 1014 destroyer escorts, frigates and patrol vessels, 221 submarines and many transports, landing craft, troopships and tankers.

Whilst that output was impressive, the achievements of the builders of Liberty and Victory cargo ships, in shipyards set up for the purpose, are more widely known. Between 1941 and the end of the war 2710 Liberty ships and 534 Victory ships were completed, often in almost unbelievably short times. Urgently required to replace tonnage lost to German submarines, they were simple ships built to standard designs. The introduction of welding resulted in some well-known catastrophic failures, but the prodigious output of the new shipbuilders made a major contribution to the war effort.

The workforces assembled to build these thousands of ships were very large. Some 650 000 people were engaged in the construction of the Liberty and Victory ships alone. Of course, most had little knowledge of ships, let alone the necessary skills to build them. In support of the training of these people, by 1943 Cornell Maritime Press of New York had published some 37 books on maritime subjects ranging from *Practical Principles of Naval Architecture* to a *Ship Welding Handbook* and even one volume entitled *How to Abandon Ship*.

One of these books has recently surfaced in my library. *Ship Outfitter's Handbook*, by Emil M. Hansen, was published in 1943. It addresses a wide range of topics including types of drawings and drawing conventions, shipbuilding terms, the layout of ships, ship structure, how to read ship outfitting drawings, ship outfitting jobs and practices, tools, tests and shipyard safety.



Ship Outfitter's Handbook was published in 1943 by Cornell Maritime Press

The author described the book's purpose in his Preface.

"This book is written primarily for the new man in the shipyard who has been on the job a short time and is still doing much of his work in the dark.

"Building a ship is a thoroughly complicated task. The new man is easily confused by the endless details of construction, the enormous number of compartments, the highly intricate facts in every one of the many blueprints.

"However, the new man who sets out to be a ship outfitter should not have too much trouble if he remembers that a certain amount of study beforehand will clarify even the most difficult operation.

"And when you do study, the important thing is to keep your mind on what you are doing rather than on what you would like to do. This simple prescription will help you grasp the facts and explanations presented here as nothing else can."

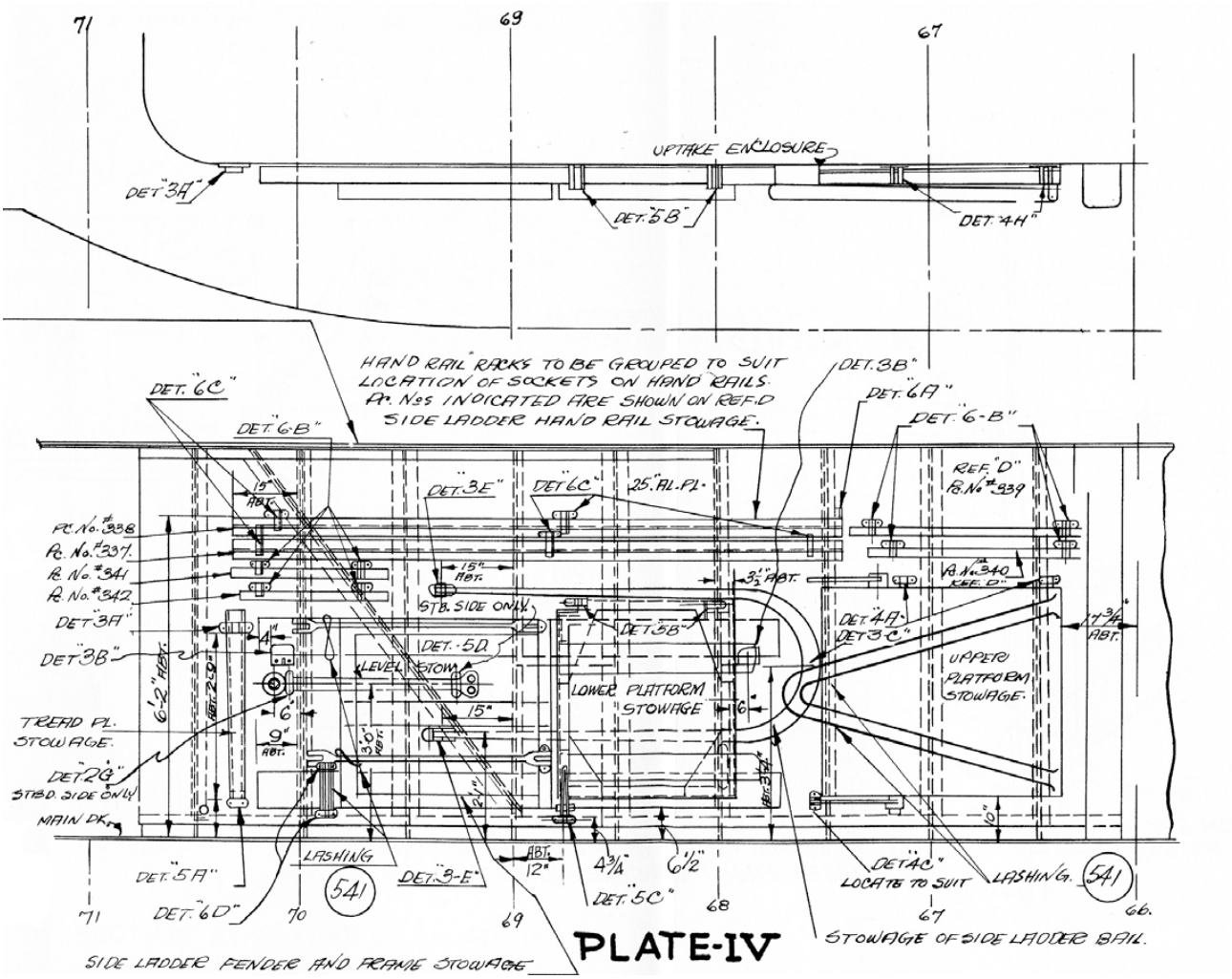
There are many challenges to be faced when rapidly mobilising an industry for war. The training of a new workforce is but one of them, but vital to the success of an enterprise.

In the coming years, with a highly ambitious program of naval construction, Australia faces similar challenges in peace. Today's ships and submarines are vastly more complex than those of World War II and I can't help thinking that a series of books like *Ship Outfitter's Handbook* could prove very helpful.

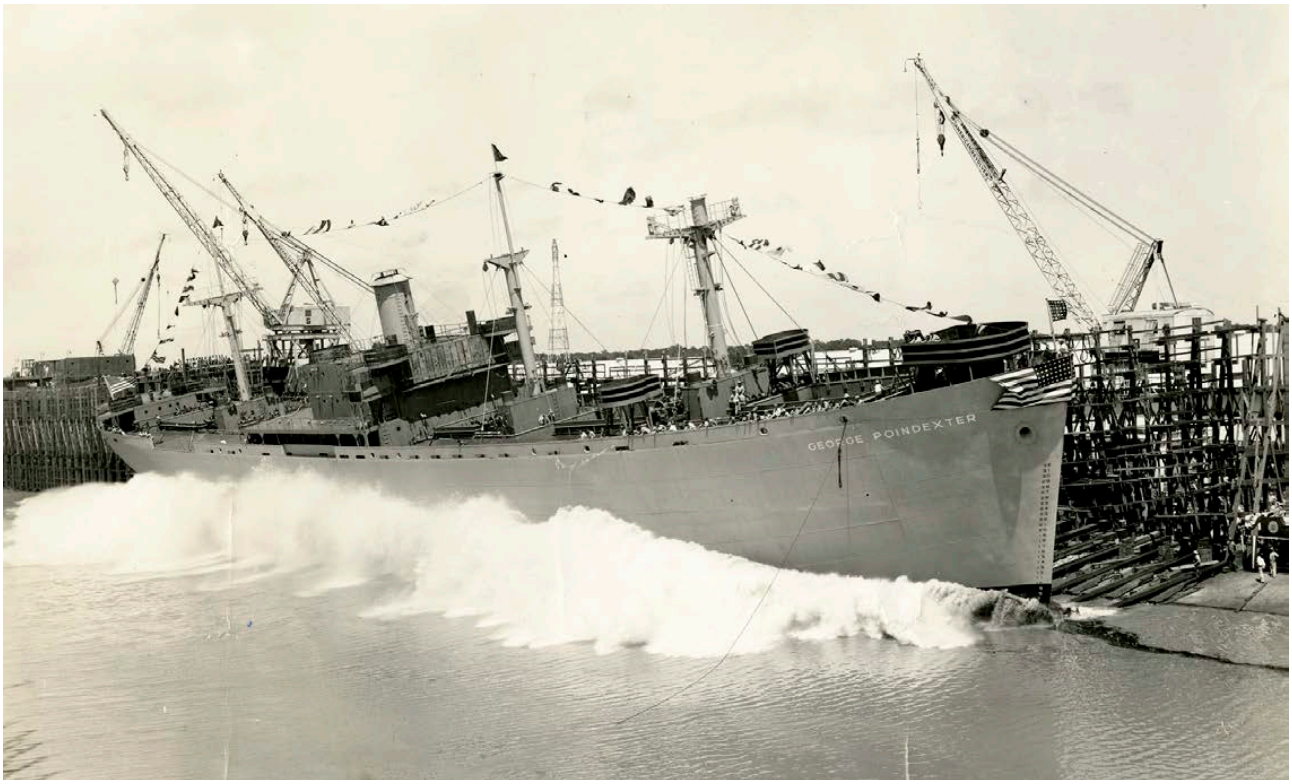
USS *English*, photographed in October 1962, was one of 58 Alan M. Sumner-class destroyers completed between 1943 and 1945.

The 2200 t destroyer was built by the Federal Shipbuilding and Drydock Company in New Jersey and was completed on 4 May 1944.

USS *English* was built in only 6.5 months. After a long life in the US Navy and the navy of Taiwan she was sunk as a target in 2003 (US Navy photograph)



One of the illustrations from *Ship Outfitter's Handbook* showing stowage arrangements for a side ladder (accommodation ladder)



George Poindexter, built in Milwaukee, Wisconsin and launched on 17 April 1943, was one of 2710 Liberty ships built during World War II. She was completed on 18 May 1943 and survived to be finally scrapped in Tacoma in 1967 (Photo from www.www2online.org website)

Recently completed by Austal in WA, ADV *Cape Naturaliste* during her transit to homeport in Darwin, Northern Territory (RAN photograph)