THE AUSTRALIAN NAVAL ARCHITECT

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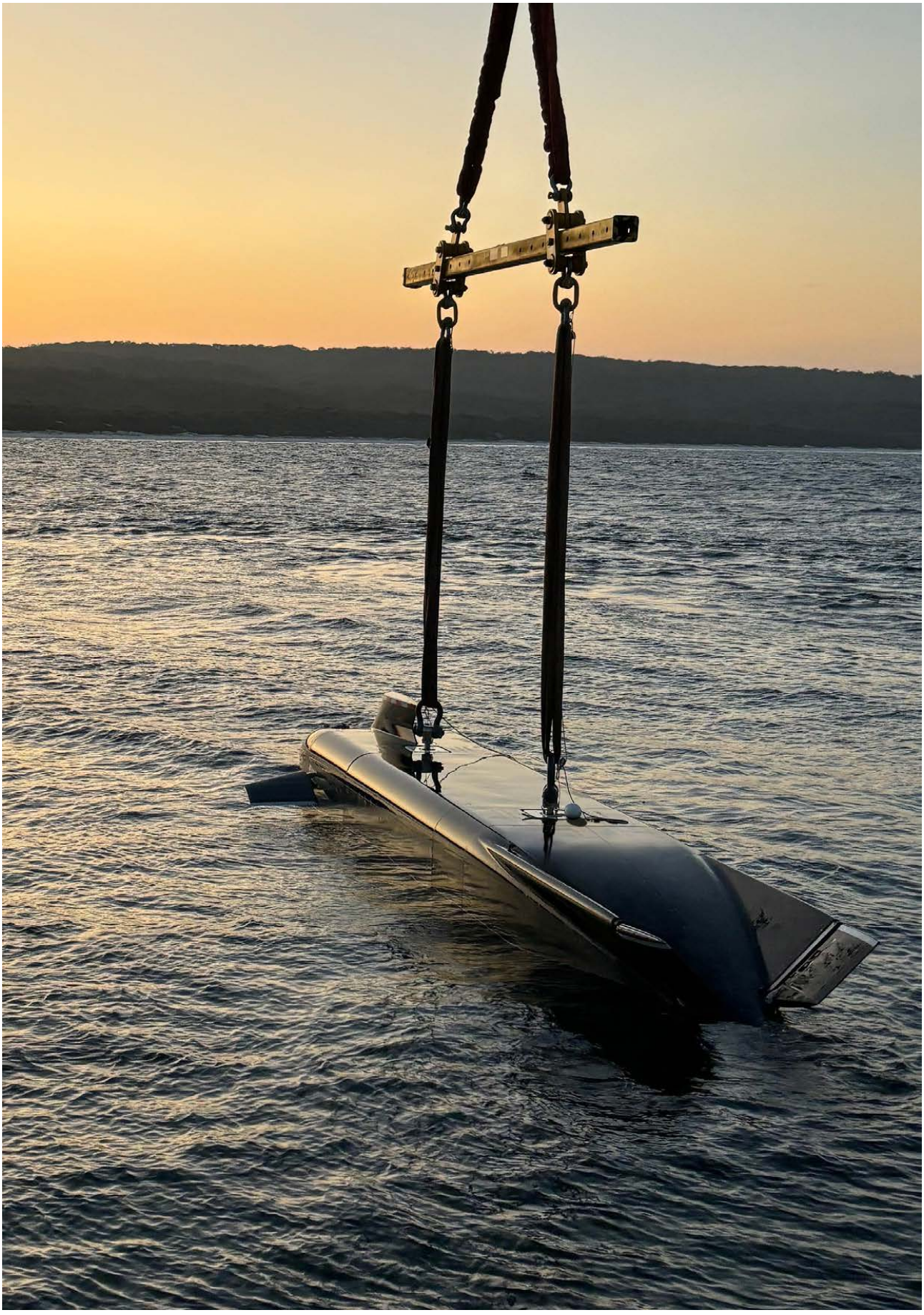

Australia's first developed extra large autonomous undersea vehicle (XLAUV), *Ghost Shark*, is being jointly developed and funded by a partnership between Defence and Anduril Australia, and will will provide the Navy with a stealthy, long-range autonomous undersea warfare capability
(RAN photograph)

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Cover Photo:

The new Sydney port operations vessel *Burra* in firefighting mode
(Photo courtesy Incat Crowther)

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RINA Australian Division
on the
World Wide Web
www.rina.org.uk/publications

From the Division President

Jonathan Binns

To all our Australian RINA members and everyone reading this freely-distributed journal, welcome to the May edition of your favourite, informative and most relevant publication on naval architecture in Australia. I have just finished reading the proof of this edition and there is a lot in this publication. As always, this is largely due to the amazing work of John Jeremy and Phil Helmore, to whom we are deeply indebted. John's editorial on digital technology heading full speed into data science and AI and Phil's From the Crows Nest of up-to-date news items are valuable reads. The reports from the sections really do stand out to me in this edition. Please do read through these reports to see which presentations you can review online and keep an eye out for upcoming presentations to attend to get the latest developments in the maritime industry.

You would have read in the February 2024 edition that Jim Black has stepped down from the Presidency and that I have agreed to take over as President. This was voted on by Council in December and my term commenced after the AGM held on 19 March. I would like to thank Jim Black as my predecessor for the excellent work that he did in the position and for his long-term service to the Division, such as his work with Kim Klaka in 1997 editing the first couple of issues of this, our esteemed journal. The Division is truly in a sound and prosperous position thanks to the work of the whole of the Division ably led most recently by Jim.

For those who attended the AGM you would have seen that we have retiring members of Council Emma Tongue from WA, Martin Grimm from ACT and the retirement after his maximum term of Adrian Broadbent from NSW. Additionally we say farewell to Gordon MacDonald as Immediate Past President and Karl Slater resigned following his transfer to the UK. The composition of Council for the new year is now set with Tim Speer being nominated to replace Emma, Tamasin Welch replacing Martin and Peter Blackwood in place of Adrian. Bruce McRae and Martin Grimm have agreed to fill the two vacancies for elected Council members. An election is currently underway within Division Council for the new Vice President.

As the new President of the Australian Division I am stepping into the shoes of the incredible range of people which have come before me. I hope I will be able to add something to the role. But it is really what comes after me that I hope will have the greatest impact. We have some great opportunities ahead of us. Opportunities which have been built over the last 70 years, specifically in Australia. Looking at the website for RINA's History of the Division, "In 1954, a number of Australian members of the Institution of Naval Architects proposed that a Branch of the Institution should be formed in that country. Accordingly, the Australian Branch of the Institution of Naval Architects was formally constituted." From these beginnings, our Australian RINA members have created a strong base from which we can, and must, grow.

To me naval architecture, indeed the whole of engineering, is all about opportunities. I joined RINA as a student when I started the naval architecture years of the BE degree at UNSW in 1993 and, since then, I have been on the committees for Tasmania and Victoria and on the Australian Division Council. I look forward to representing the Division on the Institution's Council.

I have taught naval architects for Australia and the world since 2001, and have worked as a research engineer in naval architecture on three continents, three America's Cups, for fast ferries, FLNG concepts and even an indoor surfing arena. I now find myself in the thick of naval architecture research for Australia working with a dedicated team of defence research scientists. I have had many opportunities, but the best achievements are always to help other professional engineers to realise their opportunities. The last 70 years, the first 25 being as the Australian Branch and latterly a Division, have set us up to create these opportunities.

Looking back to the RINA Charter of 1910, RINA could pursue its objects as it:

- promotes the bringing together of the results of the practical and scientific experience of all those concerned with the design, construction and operation of ships and other marine artefacts; the value of these results being enhanced by their publication, examination and discussion by the Institution;
- encourages and promotes the carrying out of experiments and other enquiries intended to assist the advancement of knowledge in the science, technology and management of shipbuilding, marine technology and shipping;
- arranges for the discussion of scientific advances, new inventions and materials having an application to marine technology; and
- investigates and gives guidance on those matters of professional importance relating to naval architects, their education and training which are properly the concern of a professional institution.

To my reading, these are all about creating opportunities! Those opportunities cover many of the areas covered in my professional career. While the current emphasis is in the naval area, through AUKUS submarines and the recently revised naval shipbuilding program, the backbone of the Australian maritime industry is in commercial vessels including high-speed craft and the offshore industry, not to mention recreational vessels. The Division looks to ensure the full and proper application of maritime engineers' skills and experience to all these areas.

Please do join your local committee, please do contribute to the activities of your local sections and indeed those of the Division and the wider Institution such as on its technical committees.

Jonathan Binns
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Editorial

As I have been around for quite some time—it is almost 65 years since I began my apprenticeship in the drawing office—I am sometimes asked what technical development in the last half century or so has had the greatest impact on the productivity of the shipbuilding and ship repair industries. My answer is, without hesitation, the development of the digital computer.

Quite early in my career I became involved with planning, and around 1965 managed to get approval to spend what was then quite a lot of money for an hour on IBM's 7044 computer on St Kilda Road in Melbourne for a critical path analysis of a small network. I flew to Melbourne with my box of punched cards in great anticipation. That job was more of a learning experience than anything more productive, but within five years we were processing networks of over 10 000 activities with full resource analysis. During the 1970s computer use grew enormously. Accounting applications were the highest priority at the time but we engineers and naval architects were able to make use of the mainframe computer after hours. Planimeters and integrators soon became museum pieces.

In the 1970s the traditional role of the mould loft came under challenge as the fairing of lines, plate part nesting and other functions were gradually taken over by computers. The powerful machines (very small by today's standards) then processed suites of programs enabling applications like quality control, progress monitoring, material ordering and control as well as planning to make use of common databases of information. The pressure was on to improve the quality of data—gigo (garbage in, garbage out) was a real problem.

By the 1980s computer aided drafting was improving productivity in the drawing offices. As CAD applications improved, the need for expensive full-size mock-ups of complex spaces (especially for submarines) declined. It soon became possible for machines like lathes and plate cutting machines to be remotely controlled by computer—across the world if necessary.

The 1990s brought us CALS (Computer-aided Acquisition and Logistic Support) which promised the removal of tonnes of paper from ships. Handbooks, drawings and parts lists could all be accessed by computer from anywhere in the world. Spares needed on a ship in, say, the Persian Gulf could be made in the ship's workshop with machines driven by a computer in North America.

One substantial benefit of computers in production was the prospect of much greater accuracy in part definition. Components of ships, from machinery seatings to complete hull modules could be built in dispersed locations with a high likelihood that they would actually fit together when assembled. Time spent making corrections at the ship declined. Improved CAD programs helped ensure that interferences between machinery, pipes and cables could be reduced to a minimum. No longer did trades need to rush into compartments to claim space for services before it was all gone. The old, trusty words 'arrange at ship' began to disappear.

In this century the capability of the computer systems at our disposal has continued to improve. Today we have digital twins which provide us (all going well) with an electronic duplicate of the ship which we have built with considerable advantages to be gained in logistic support and modification through life. Training of ship's crews in very realistic simulations becomes possible.

When, perhaps, we may think that we have reached some kind of pinnacle in our use of computers, a new expression has entered our language—artificial intelligence or AI. The public perception of AI seems largely driven by perceived problems, real as they may be. But think of the potential advantages. I am well out of my depth now, but imagine the possibilities. Just ask a computer to design a system to perform a particular function in a ship and the computer does it with full knowledge of the required standards from materials to shock clearances without further intervention. Perhaps we are already there.

John Jeremy

USS *Mobile*, HMAS *Warramunga* and FS *Vendemiaire* conduct a trilateral maritime cooperative activity in April (RAN photograph)

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 refreshments and 18:30 for the presentation, finishing by 20:00. Guests are welcome.

The program of meetings remaining for 2024 (with exceptions noted) is as follows:

5 Jun Thomas Frank, Principal Engineer, Ausbright Electrical Solutions
IT Earthing Systems and the Evolution of Insulation Monitoring Devices

3 Jul Peter Thurling, Senior Project Manager, Gibbs & Cox Australia, and Elettra Ganoulis, Naval Architect and Project Manager, One2three Naval Architects
The New AIMS Research Vessel

7 Aug IMarEST TBA

4 Sep Sean Langman, Managing Director, Noakes Group, and John Butler, Principal, John Butler Design
Docking James Craig *on the Floating Dock*
Royal Prince Edward Yacht Club

2 Oct Levi Catton, Managing Director, Gibbs & Cox Australia
Autonomous Vessels

5 Dec SMIX Bash 2024

Tasmanian Section Technical Presentations

Technical presentations are generally arranged as in person venues in either Launceston or Hobart, with a video link between them and large screens at each location, and streamed live, starting at 17:30 for refreshments and 18:00 for the presentation, and finishing by 19:30. Guests are welcome.

The program of meetings remaining for 2024 is as follows:

11 Jun Hobart Phil Durbin, Finite Elements (Australia)
Deep Sea Challenger*: Finite Element Analysis and Other Considerations when the Pressure Comes on!*

9 Jul Launceston
Gregor Macfarlane and Thomas Rehrmann, Australian Maritime College
The AMC Towing Tank: Four Decades Solving Hydrodynamic Problems for the Maritime Industry

13 Aug Hobart TBA

17 Sep Launceston
Stephen Turnock, University of Southampton
Routes to Zero Carbon Shipping

8 Oct Hobart Graeme Elphinstone, Elphinstone Engineering
Antarctic Expedition Programs

Warship 2024 Conference

Sponsored by BMT and Supported by the RINA Australian Division, the Royal Institution of Naval Architects is once again hosting the highly popular Warship International Conference, with the 2024 instalment to be held on 18–19 June 2024 at the Adelaide Convention Centre, North Terrace, Adelaide.

The increasingly-complex warship design requires effective engineering assistance, design configuration control, supply chain and inventory management to meet operational requirements. With the introduction of autonomy and disruptive developments such as quantum technologies, could future operating concepts evolve leading to a step change in design requirements? With vessel design lives between 25 and 50 years, naval architects need to consider the effects of current and future technological and operational developments now.

Early-bird pricing closed on 1 February.

	From 1 March 2024
RINA Member	£900
RINA Non-Member	£1000
Concession (retired/students etc.)	£400
Authors	£200
Additional authors	£800

Registration is available on the conference website (Click on Book Now):

https://rina.org.uk/events/events-programme/warship-2024-future-surface-combatants/

Cancellations received in writing up to two weeks before the event takes place will be subject to administration charge of £200. Cancellations received after this time cannot be accepted and are subject to the full event fee. Delegates may be substituted; however, this must be sent in writing and confirmed with the RINA Events Team. It may be necessary for reasons beyond our control to alter the content and timing of the program. In the unlikely event that RINA cancels the event for any reason, our liability is limited to the return of the registration fee.

The conference will present technical developments in the design, construction and support of surface ships including, but not limited to, the following topics:

- Future navy surface fleet mix
- Design for constructability and supportability
- Facilities and shipbuilding
- Automation in ship design and construction
- Digital engineering
- Use of offboard autonomy—partially or fully autonomous ships
- Disruptive technologies

The call for papers was issued last year, and abstract submission closed on 1 November 2023.

For further information, contact the conference secretariat at <events@rina.org.uk>.

IODS 2024

The Indian Ocean Defence & Security (IODS) conference and exhibition will return to Perth in 2024 on 24–26 July.

This rapidly growing event, presented by AMDA Foundation in partnership with the Western Australian Government, through the Department of Jobs, Tourism, Science and Innovation and Defence West, will feature a specialist conference program, international industry exhibition and networking opportunities.

Senior government, defence and industry representatives from around the world will come together at IODS 2024 to discuss the theme *Where AUKUS Meets the Quad* with confirmed speakers including:

- Australia's Chief of Navy, VADM Mark Hammond AO RAN
- Former US Chief of Naval Operations, ADM Gary Roughead, US Navy (Ret.)
- United Kingdom's First Sea Lord, ADM Sir Ben Key KCB CBE ADC

Don't miss this important event: Indian Ocean Defence & Security, 24–26 July 2024, Perth Convention and Exhibition Centre.

For more information and to join the IODS 2024 mailing list, visit iods.com.au

Indo Pacific 2025

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 three-day event is a platform for engagement and incorporates an international industry exhibition, specialist conference program featuring presentations and symposia from leading maritime institutions and networking opportunities. Indo Pacific is strongly supported by the Royal Australian Navy, the Australian Department of Defence and the NSW State Government.

AMDA Foundation in conjunction with the Royal Australian Navy has committed to the future dates of the Indo Pacific International Maritime Expositions. 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.

Planning has begun for the International Maritime Conference 2025, organised by the Royal Institution of Naval Architects, the Institute of Marine Engineering, Science and Technology and Engineers Australia, and will be held at the International Convention Centre Sydney on 4–6 November.

NEWS FROM THE SECTIONS

ACT

Annual General Meeting

The ACT Section held its AGM on the evening of 9 April as an online meeting with Warren Smith as MC and 11 in attendance. Warren Smith continues as Chairman. Cameron Whitten takes over the Vice Chairman role from Trevor Dove while Jeremy Nolan takes over the Secretary role from Jordan Rayson. Lily Webster remains as Assistant Secretary while Lachlan Clarke remains as Treasurer. Tamasin Welsh takes over from Martin Grimm as Nominee to the Australian Division Council. Ray Duggan, Martin Grimm and David Lyons continue as committee members while Trevor Dove and Alistair Smith have stepped down from the committee.

The new committee comprises

Chair	Warren Smith
Deputy Chair	Cameron Whitten
Secretary	Jeremy Nolan
Assistant Secretary	Lily Webster
Treasurer	Lachlan Clarke
Nominee to ADC	Tamasin Welch
Member	Ray Duggan
	Martin Grimm
	David Lyons

Martin Grimm

Digitalisation in the Context of Autonomous Shipping

Julius Moeller, Advisor Navigation Safety and Digitalisation, Australian Maritime Safety Authority, gave a presentation on *Digitalisation in the Context of Autonomous Shipping* to a meeting at UNSW Canberra at ADFA, with the Chair of the ACT Section, Warren Smith, as MC on 2 April, and streamed live. The presentation was attended by 12 with a further 15 participating online.

The maritime industry plays a crucial role in global trade and commerce, and the utilisation of contemporary technologies is contributing increasingly to safe and efficient shipping operations. As a consequence, there has been a great demand within the industry to introduce and enhance the next generation of technologies in the process of a digital transformation. This has been acknowledged by the International Maritime Organization (IMO) in several documents. A popular example of IMO legislation related to digitalisation is the introduction of the e-Navigation strategy for improving the safety and efficiency of shipping operations as early as 2008. Building on these advancements, the industry is now also witnessing a transition towards autonomous shipping. This paradigm shift aims to improve operational efficiency, safety, and environmental sustainability.

This presentation provided an overview of the current developments at both national and international levels and presented AMSA's activities in this space.

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

The Presenter

Julius Moeller is an Advisor for Navigation Safety and Digitalisation at the Australian Maritime Safety Authority (AMSA). His expertise lies in global digitalisation, cybersecurity, and maritime communications. With a background in computer science and research in maritime digitalisation, Julius has contributed to international maritime standards and guidelines through various technical committees associated with IHO, IMO, and IALA. After completing his PhD in Germany, he relocated to Australia to work for AMSA, where he focusses on designing, implementing, standardising, and validating maritime IT solutions to enhance navigation safety.

Warship Environment Protection

John Polglaze, Director of PGM Environment, gave a presentation on *Warship Environment Protection: Avoiding Utopian Aspiration in Favour of Rational, Balanced, Objective Pursuit* to a meeting at UNSW Canberra at ADFA, with the Deputy Chair of the ACT Section, Cameron Whitten, as MC on 30 April, and streamed live. The presentation was attended by 12 with a further 12 participating online.

Many navies seek perceived benefit from proclaiming the intent to acquire 'fully environmentally compliant' warships, but such statements indicate minimal understanding of what compliance entails, or realisation of the emasculation of ships' operational effectiveness inherent to such ambition. Inescapable technical realities void any possibility of achieving this aspiration in all but limited circumstances.

Compliance with marine environmental protection obligations can be exceptionally onerous for warships and, in many cases, nonsensical to pursue and impossible to achieve. Compliance is becoming ever more divergent from the standard caveat of "not impairing the operations or operational capabilities of such ships". Some requirements can be accommodated, offering benefits in terms of operational effectiveness and sustainment. Many, however, cannot be sensibly addressed without severe penalty in combat capability, survivability and through-life costs. Strict application of merchant ship risk remedies to warships can result in inappropriate design responses to ill-defined, inconsequential or non-existent risks, and myopic adherence to IMO prescripts can sometimes result in perverse outcomes which actually amplify risks to the environment. Navies need to be smarter in characterising and managing environmental risks, and innovative in generating fit-for-purpose technical solutions.

The presentation was not recorded.

The Presenter

John Polglaze, the Director of PGM Environment, has over 25 years' experience as a maritime environmental consultant. This follows a 19 year full-time naval career with service in submarines and surface ships, and he maintains his commission as a Captain in the Australian Naval Reserve. As well as work for the IMO, other maritime regulators and commercial ports and shipping, he has worked in warship environmental compliance for over 30 years. He has contributed to a notable proportion of current Australian navy environmental management policies and procedures and related engineering policy, and his warship acquisition experience spans an array of capabilities, including patrol

vessels, combat support ships, small and large amphibious platforms, frigates and destroyers, as well as nuclear-powered and conventional submarines.

Jeremy Nolan

Queensland

Bureau Veritas 3D Digital Plan Approval

Olivier Degrand, Technical Software Manager with Bureau Veritas, gave a presentation on *Bureau Veritas 3D Digital Plan Approval* to a joint meeting with the Institute of Marine Engineering Science and Technology in the Boardroom at Bureau Veritas, 340 Adelaide St, Brisbane, on 2 February and streamed live. The presentation was attended by 8 with a further 19 participating online.

Bureau Veritas now has a 3D approval process in place and naval architects are interested to investigate the new methods of approvals. The advances in 3D modelling software and their use in design offices give rise to a need for a streamlined 3D approval process rather than converting all models to 2D plans and submitting them. Although 2D plans are still required for construction, it is not necessarily best for the approval process. With 3D model approvals, naval architects and class surveyors can communicate much more efficiently, identify gaps, and make improvements if necessary. This requires interacting platforms where design offices and class surveyors can exchange and view designs.

The presenters explained the advances in the plan approval process in BV, and gave details of their surveyors, office locations, and type of surveys which they cover in Australia.

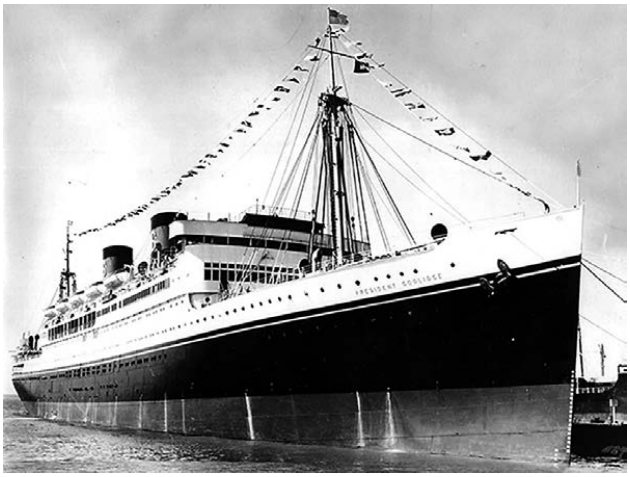
The presentation was not recorded.

Jalal Rafieshahraki

SS *President Coolidge*: Sinking and the Shipwreck

Carl Linkenbagh, a Senior Systems Engineer working within the Department of Defence on maritime projects, gave a presentation on *SS* President Coolidge*: Sinking and the Shipwreck* to a meeting at the View Hotel, Brisbane, on 30 April, and streamed live. The presentation was attended by 5 with a further 8 participating online.

SS *President Coolidge* was a passenger ship built for the Dollar Steamship Company (later American President Lines) by Newport News Shipbuilding. Entering service in 1931, the ship was homeported in San Francisco and used on the Trans-Pacific route to China, the Philippines and Japan via Honolulu. At 22 000 GT and 200 m in length with a turbo-electric propulsion system and luxurious art deco fittings, she represented the best of American passenger ship design of the time.



SS *President Coolidge*
(Photo from ocealinersmagazine.com website)

Requisitioned as a troopship in 1941 following the outbreak of WW2, the ship was lost in Espiritu Santo (Vanuatu) on 26 October 1942 when she struck a friendly minefield at the entrance to the Segond Channel. Today, the ship is one of the largest ships accessible to recreational divers. Diving the wreck is a spectacular awe-inspiring experience. This presentation provided an overview of the fascinating story of the ship, how and why she was lost, her condition today and some direct observations on what it is like to dive the wreck. For further details and photos, see *The ANA*, November 2023, Pages 10–15.

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

The final moments of *President Coolidge*
(Photo courtesy US Naval History and Heritage Command)

The Presenter

Carl Linkenbagh is a Senior Systems Engineer who specialises in maritime systems. His career started in 1999 as a Marine Technician in the Royal Australian Navy on amphibious ships and guided-missile frigates and, for the last 10 years, he has worked as a consultant on a variety of maritime projects for the Departments of Defence and Home Affairs. He holds master's degrees in Systems Engineering and Project Management from UNSW Canberra. Carl relocated to Brisbane in late 2023 after one Canberra winter too many and in his spare time he drives heritage steam locomotives, rides road and mountain bikes and is a qualified technical diver and proud member of Global Underwater Explorers with a passion for historic shipwreck exploration.

Tom Ryan

Tasmania

RINA at AMC Careers Fair

The Australian Maritime College held its annual careers fair on Wednesday 13 March. There were over 40 companies represented and it was a very busy event with many students meeting with potential employers. It was also a very useful networking event for those in the industry who attended, with over 80 participants.

The Tasmanian Section of RINA had a stand which was crewed by Martin Renilson and Michael Woodward. The stand was visited by quite a few students, many of whom were interested in knowing how to become chartered through RINA. Others weren't really aware of RINA, so we took the opportunity to let them know what we do, and encourage them to attend the technical presentations.

Designing for Australia's Future Blue Economy

On 13 March RINA members and friends attended a double-headed presentation on *Designing for Australia's Future Blue Economy*, covering two Blue Economy Cooperative Research Centre projects. Details follow.

A Code of Practice for Aquaculture Vessels

Andrew Harris of BMT gave a presentation on *A Code of Practice for Aquaculture Vessels* to a meeting at the Australian Maritime College in Launceston, Zoomed to the Royal Yacht Club of Tasmania in Hobart, and streamed live to the wider fraternity on 13 March. The presentation was attended by 29 in Launceston, 4 in Hobart, and a further 19 participating online.

This presentation covered the recently-completed two-year project to develop *A Code of Practice for Aquaculture Vessels* on behalf of the original author, Dr Saeed Mohajernasab, formerly of AMC. This subject was of particular relevance for the Tasmanian audience, with the prevalence of the local salmon-farming industry. The presentation described how the work had been undertaken in three phases:

(1) a literature survey of existing codes, standards, conventions, and statutory legislation, including an assessment of their relevance to the design and operation of aquaculture vessels;

(2) a series of interviews with aquaculture operators in Australia and globally; and

(3) drafting the Code of Practice, with iterations of stakeholder reviews and comments.

The completed code aims to provide operators and purchasers with a convenient guide to addressing aquaculture risk across the range of applicable standards, classification and statutory legislation. Future work is being discussed to establish the body which will adopt and maintain the draft code, as a non-mandatory best-practice document. The assistance and support of the Australian Maritime Safety Authority was gratefully acknowledged.

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

The Feasibility of Utilising Hydrogen as a Fuel for Australian Vessels

Hongjun Fan, Postdoctoral Research Fellow at the Australian Maritime College, gave a presentation on *The Feasibility of Utilising Hydrogen as a Fuel for Australian Vessels* to a meeting at the Australian Maritime College in Launceston, Zoomed to the Royal Yacht Club of Tasmania in Hobart, and streamed live to the wider fraternity on 13 March. The presentation was attended by 29 in Launceston, 4 in Hobart, and a further 19 participating online.

To decarbonise the Australian maritime sector, this presentation examined the viability of adopting hydrogen as a marine fuel. Firstly, an assessment was provided on hydrogen's potential sustainability, energy security, and affordability in Australia. An analysis of Australia's domestic vessel fleet structure was conducted, alongside a discussion on how hydrogen can aid in emissions reduction within the fleet. The current state of maritime hydrogen technologies was reviewed, encompassing hydrogen fuel cells, internal combustion engines, hydrogen storage methods, and bunkering technologies.

A case study was presented involving the utilisation of hydrogen on an offshore wind-farm crew-transfer vessel, for which a portable high-pressure storage system and fuel-cell power system were devised. Safety concerns regarding hydrogen leakage were addressed through CFD simulations, with proposed risk-mitigation measures. The technical feasibility study for the vessel identified challenges in storing sufficient energy onboard using current commercially-available compressed hydrogen cylinders. However, effective management of the portable tank supply chain could potentially mitigate this issue through quick tank swapping. The economic feasibility study revealed that the total cost of ownership for hydrogen systems was approximately three times that of diesel systems for the time being.

Finally, emerging technologies such as hydrogen internal combustion engines, cryogenic liquid hydrogen storage, and metal hydride hydrogen storage were discussed, suggesting promising advancements for onboard hydrogen use.

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

Hongjun Fan making his presentation at the AMC
(Photo courtesy Martin Renilson)

The *Blythe Star* Tragedy

Michael Stoddart, Researcher, Maritime Museum of Tasmania, gave a presentation on *The* Blythe Star *Tragedy* to a meeting at the Royal Yacht Club of Tasmania in Hobart, Zoomed to the Australian Maritime College in Launceston, and streamed live to the wider fraternity on 9 April. The presentation was attended by 8 in Hobart, 6 in Launceston, and a further 10 participating online.

In October 1973 the freighter MV *Blythe Star* departed from Hobart for King Island with a cargo of fertiliser and beer. The hold was completely filled and outside, on top of the hatch covers, 54 t of palleted fertiliser completed the 351 t cargo. Twelve hours after departure, the ship was logged by Maatsuyker Island at 0515 in the morning. Three hours later, *Blythe Star* sank in good weather and a calm sea. The

crew of ten made it into a life raft but were aghast to learn that the Captain had neither sent out an SOS nor grabbed the portable radio before jumping into the life raft.

MV *Blythe Star*
(Photo from CSIRO website)

Nobody at home knew anything was amiss until 30 hours after the ship's ETA at Grassy, King Island, had passed, at which time the Marine Operations Centre in Canberra started a search-and-rescue mission. The biggest such operation in Australian history failed to find any trace of the raft. After drifting around the Southern Ocean for eight days, and coming close to a fleet of fishing boats, only to see them turn away, the raft was blown ashore at Deep Glen Bay on the Forestier Peninsula. A few days into their ordeal, the second Engineer died and was buried at sea. Within a few hours of making landfall, the Chief Engineer died, followed a few hours later by the Chief Officer.

After three days of attempted escapes from the bay, the three youngest crewmen knew that if they did not manage to climb the sheer rocky face and find help, then all seven remaining crew would die. Two days of climbing and bush-bashing were rewarded with finding a road and the arrival of a logging truck which took them to Dunalley, from where the Hobart police were alerted. A helicopter rescued the four remaining crewmen from Deep Glen Bay.

This presentation described the ship's last journey, its laissez-faire management, and the farcical Court of Marine Inquiry into the loss which ultimately arrived at a conclusion which satisfied no-one.

The presentation was not recorded.

The vote of thanks was proposed, and the "thank you" bottle of Devil's Corner Pinot presented, by Chris Davies.

(L to R) Nipuna Rajapaksha, Michael Stoddart, Chris Davies, Michael O'Connor, Gang Zhao, John Polmear
(Photo courtesy Paul Chapman)

The Presenter

Michael Stoddart is a former Chief Scientist of Australia's Antarctic Program, and is currently a researcher at the Maritime Museum of Tasmania.

Richard Boult

Victoria

Lessons from Medium-USV Trials

Jacob Bailey, Lead Project Engineer for Austal's Patrol Boat Autonomy Trial (PBAT), gave a presentation on *Lessons from Medium-USV Trials: Building Trust in Platform Autonomy* streamed live via Zoom on 21 March. The presentation was attended by 21 participating online.

Jacob began his presentation by describing what platform autonomy is and how it expands in complexity between small to large unmanned surface vessels (USVs). He then introduced the attendees to medium-to-large USVs (M-LUSVs) which formed the focus of the presentation since their capabilities cannot be met by smaller USVs. The presentation highlighted challenges associated with M-LUSVs such as complexity, cost, availability and reliability.

Jacob then discussed how the PBAT program was developed to demonstrate the capability of M-LUSVs to the Royal Australian Navy. Within the program, platform and navigational autonomy were tested for remote operation, autonomous operation, and extended operation which involves traversing up and down the west coast of Australia. During his presentation, Jacob discussed some of the challenges with autonomy, including building reliability and developing trust. The presentation was well received and generated significant questions and discussion.

The presentation was recorded and may be available soon (pending approval) on the RINA YouTube channel.

Sentinel (ex-HMAS *Maitland*) in the Patrol Boat Autonomy Trial
(Photo courtesy Austal)

The Presenter

Jacob started his professional career over six years ago at Austal as a graduate engineer and has spent his career contributing to the marine industry with a passion for novel technology that advances the field. He has been responsible for various roles across new-build and R&D projects from large 118 m commercial trimarans to 60 m patrol boats for the Royal Australian Navy.

Jacob is the lead project engineer for Austal's Patrol Boat Autonomy Trial. This project has navigated the technical

and regulatory challenges with retrofitting and certifying an existing 56 m patrol vessel from manned to unmanned. PBAT has been retrofitted with a navigational autonomy system to comply with COLREGs and a platform autonomy system to operate key systems to enable extended endurance without crew intervention.

Navigating the Seas of Innovation

Nirman Jayarathne, Innovation Group Lead, Navantia Australia, gave a presentation on *Navigating the Seas of Innovation* at the Mission to Seafarers in Docklands and streamed live via Zoom on 17 April. The presentation was attended by 7, with a further 20 participating online.

Nirman began his presentation by discussing the 'waves of innovation' which have occurred over the past 240 years and used this to illustrate how much technology *will* change over the lifespan of a ship being designed today. He then went on to define innovation as 'engineering development towards commercial deployment of a new product'. The emphasis here was that creativity can produce new ideas, but they only count as innovation once they achieve commercial deployment.

Nirman posed the question "Who can innovate?". He proposed, somewhat contentiously (though drawing on the research of others), that 'recognised expertise' is required for purposeful creativity. He explained that novel or creative ideas can come from anyone, but the quality which leads to useful innovations is far more likely to come from people with expertise.

Nirman explained how research has shown that teams where everyone thinks in similar ways are less successful at innovating. These teams are said to have a high level of interconnection. He proposed that "for faster breakthroughs in maritime innovation, cross-functional, multi-disciplinary teams with intermediate levels of interconnection should be created." To demonstrate this, Nirman explained how the Ukraine has become very successful at developing new maritime drones very quickly in their war with Russia, due to a wide range of people with different skill sets having joined the Ukraine military since the conflict began.

Nirman explained the difference between people who are 'adaptors' versus those who are 'innovators'. In summary, adaptors seek to do things better, whereas innovators seek to do things differently. To be realistic, in engineering professions we probably need a mix of both. As an example of adaptors, Nirman spoke about the ship design spiral. The spiral will continually improve on a design, but it is not agile enough to allow for real innovation. In addition, the pressure of deadlines will stifle creativity.

Nirman spoke about different tools which are useful for naval architect innovators. He listed mathematical problem-solving, Quintilian's Seven Questions, teleological decomposition, accelerated radical innovation (ARI), Osborn-Parnes Creative Problem-Solving Process, MUDA, TRIZ, brainstorming, Amazon Method, SCAMPER Method, multitasking, synectic, and design-by-analogy.

Nirman wrapped up his presentation by emphasising that innovation is often perceived as being through complex and advanced systems but, really, we should strive for simplicity. As an example, with the proliferation of unmanned vessels, the simpler we can keep them, the more reliable they will be.

Finally, there was a discussion about artificial intelligence (AI), prompted by how he had used Google Gemini to create the image used in the flier promoting the talk. We were left with the tantalising thought that, in the future, rather than using prompts for AI to create images, we may be using prompts from which an AI-driven shipyard will autonomously build a ship.

The presentation provoked a good number of questions and discussion at the end.

The presentation was recorded and may be available soon (pending approval) on the RINA YouTube channel.

AI-generated maritime innovation
(Image courtesy Nirman Jayarathne)

The Presenter

Nirman is a naval architect with 18 years of experience in various roles in the maritime industry, including ship management, commercial and naval ship design, marine surveying, lecturing, commercial and defence research, and leading innovation projects. He completed his PhD in ship-to-ship interaction in 2018 at the Australian Maritime College. Currently, as the Innovation Group Lead at Navantia Australia, he is responsible for driving the development of new and innovative technologies and solutions for the naval defence sector. His research interest focuses on the application of AI for naval ship and system designs and ship hydrodynamics. He has led teams which developed a novel uncrewed landing craft (ULC) concept and uncrewed-RHIB projects at Navantia Australia.

Tom Dearling

Tom Dearling (L) and Nirman Jayarathne
(Photo courtesy Johnson Joseph)

New South Wales

Annual General Meeting

The NSW Section held its twenty-sixth AGM on the evening of 6 March, following the March technical presentation in the Kirribilli Room at the Royal Sydney Yacht Squadron, attended by 17 with Belinda Tayler in the chair.

Belinda in her third Chair's Report, touched on some of the highlights of 2023, which included nine joint technical meetings with the IMarEST (ACT & NSW Branch), with attendances varying between 149 (in person plus online) for Tom Charter's presentation on *Electric-drive Technology for Tugs—The Future is Now,* and 22 for Sean Langman's presentation on *Finite Element Analysis: Computed Prediction vs Reality.* SMIX Bash 2023 was successful and was attended by about 200, including a number of intra and interstate guests.

Adrian Broadbent presented the Treasurer's Report. The SMSA venue in the Sydney CBD had, as usual, been our major cost for the year. However, with a close watch on the outgoings, we had managed to operate within our budget and have a reasonable float in the Section account at 29 February 2024. SMIX Bash is funded separately through the Social account; accounts for 2023 have been paid and the proceeds of the raffle have been donated to the Sydney Heritage Fleet, resulting in a small surplus which was shared with the IMarEST; the account currently has a healthy balance, enabling preliminary arrangements for SMIX Bash 2024 to be made.

There have been a number of changes to positions on the NSW Section Committee for 2024, although all members signified that they would be happy to serve on the committee for one further term. As a result, the committee for 2024 is as follows:

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

Committee Meeting

The NSW Section Committee met on 9 April and, other than routine matters, discussed:

- SMIX Bash
- 2023: All transaction have now been completed and the donation to the Sydney Heritage Fleet and 50% share of the surplus to IMarEST have been paid.
- 2024: SHF has confirmed our booking for 5 December on board *James Craig,* and planning is under way.
- TM Program: Technical presentation for 17 April confirmed as live stream only; all other RINA presentations booked for 2024, with one postponed to March 2025, and one IMarEST presentation to be arranged for August.
- NSW Section Nominee to AD Council: The nominee does not have to be a member of the Section Committee (but ideal if this is so); email circulated to members for expressions of interest, and two replies under consideration.
- AD Council Report: Jonathan Binns now President of the Australian Division, and has proposed a workshop to help set future goals for RINA in Australia.

The next meeting of the NSW Section Committee is scheduled for 4 June.

Latest Developments in Ship Docking Facilities and Equipment

Michael Bakker, Sales Manager Oceania, Synchrolift, gave a presentation on *Latest Developments in Ship Docking Facilities and Equipment* to a joint meeting with the IMarEST on 6 March in the Kirribilli Room at the Royal Sydney Yacht Squadron, Kirribilli. The presentation was attended by 13 with a further 11 participating online.

Syncrolift is a Norwegian-based company specialising in creating innovative solutions for dry docking of ships in a safe and efficient manner. With Syncrolift shiplifts and transfer systems, multiple vessels can be berthed ashore simultaneously for easy access, efficient repair, and maintenance works in an environmentally-safe work area and away from the waterside. Solutions are tailored to suit specific shipyard demands and requirements.

Syncrolift has the capability to provide solutions for dry docking of vessels up to 30 000 t. Particularly-relevant for the RAN, this would suit dry docking of the Canberra-class LHDs, the Supply-class AORs, the UK Astute-class submarines, and the future AUKUS SSN nuclear-powered submarines.

This presentation outlined the history of lifting platform technology for ship docking and some of the current developments in Australia and overseas. A comparison of articulated vs rigid or hybrid platforms was discussed with emphasis on the latest safety features, particularly for docking nuclear submarines. Developments for docking support equipment include the various transfer systems, ship positioning systems and underwater equipment handling systems.

The presentation was not recorded.

The vote of thanks was proposed by Adrian Broadbent, and the "thank you" bottle of wine subsequently delivered via an eGift card.

The Presenter

Michael completed his bachelor's degree in naval architecture and marine engineering and started in 1992 at a naval architecture firm as junior draftsman and worked at a small shipyard, manufacturing sailing yachts and workboats as project manager. He then moved to Damen Shipyards in 1998, eventually moving to Cape Town in 2008 with his family to work as Managing Director of the local shipyard.

In 2010 Michael left Damen and started setting up a new shipyard, Nautic Africa, designing and building high-quality and high-performance work and patrol boats. In 2015 Michael and his family emigrated to Australia, where he worked for Austal Ships and Silver Yachts, assisting both yards in successful delivery of various shipbuilding and facility projects.

Michael founded Versatile Marine in 2018, offering his know-how to clients in the maritime industry as an independent contractor. He worked in various roles in business development, project management, design and engineering for clients such as BMT, BAE and Cullys, and acquired several sales agencies for major OEMs such as Syncrolift, Hydromaster and Wavefoil.

Currently Michael is leading the sales activities for Syncrolift in Australia and New Zealand

Inadequate Knowledge Transfer Causes Maintenance Issues on Imported Ships

Dauson Swied, Senior Engineer, Baker & Provan, gave a presentation on *Inadequate Knowledge Transfer Causes Maintenance Issues on Imported Ships* to a joint meeting with the IMarEST on 3 April in the Henry Carmichael Theatre at the Sydney Mechanics School of Arts in the Sydney CBD. The presentation was attended by 15 with a further 16 participating online.

Dauson began his presentation with an introduction to Baker & Provan, a heavy machining and heavy fabrication company established in 1946 with branches in Sydney, Perth, and Cooma, offering assembly, on-site and workshop maintenance, repair, and overhaul services. Baker & Provan is ISO9001 quality accredited and has been a Defence services supplier for 30 years. They have the capability to design and build cranes for marine applications. Baker & Provan is the OEM for the boat davit on the Anzac-class frigates and the multipurpose crane on the Huon-class minehunters and provide the maintenance services. Being the in-country agent for Industrias Ferri SA, they also provide maintenance services on various cranes on LHD, AOR, and DDG vessels.

Most of the RAN's major fleet ships have been designed and built overseas, and their subsequent maintenance in Australia has suffered due to inadequate transfer of knowledge and localisation during construction and delivery. These include material specifications, hydraulic fittings, fasteners, etc. Several examples were detailed.

Recommendations were made to the technical community based on Baker & Provan's experience from maintenance jobs, such as adopting a common standard for hydraulic systems, and a recommendation for establishing a framework/guideline for knowledge transfer and localisation when importing ships and equipment.

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 Greg Hellessey.

The Presenter

Dauson graduated from UNSW Sydney in 2014 and joined One2three Naval Architects, where he did structural design and stability analysis on various ships including the Manly fast ferries, Thames Clippers, Emerald-class ferries, and most iconically, *White Rabbit*, an 84 m trimaran superyacht. He moved to London in September 2017 to study for a master's degree and travel. He completed his coursework in gas turbine engines, advanced vibration engineering, and stress analysis, and graduated from Imperial College London with a master's degree in advanced mechanical engineering. He joined Baker & Provan in September 2020 and started as Project Engineer managing overhauls of the boat davits on the Anzac-class frigates and multi-purpose cranes on the Huon-class minehunters. He developed and implemented several processes to improve the quality of work and managed to reduce the duration to overhaul the minehunter cranes from five months to three months. Now he is the Senior Engineer overseeing engineering design and changes.

Dauson Swied (L) and Greg Hellessey
(Photo Phil Helmore)

Towards Zero Carbon Shipping

Jan de Kat, Regulatory Affairs Manager, Mærsk McKinney Møller Centre for Zero Carbon Shipping, Copenhagen, gave a presentation on *Towards Zero Carbon Shipping* as a webinar (i.e. streamed live only) on 17 April. The presentation was attended by 16 online.

The presentation began with an introduction to the Maersk McKinney Møller Center for Zero Carbon Shipping, providing a brief overview of its mission, organisational setup and activities. The following topics were discussed in detail from a technical and regulatory perspective: GHG emissions from shipping and latest IMO strategy, ship energy efficiency, and alternative fuels. Energy efficiency topics touched on technical and operational measures such as minimising propulsion power and fuel consumption across the operational profile, reduction of onboard power demand, and onboard carbon capture. As of 2023, ships over 5000 GT must monitor and report their carbon-intensity indicator (CII); compliance presents some challenges for certain ships and trades, which were discussed.

Reaching (close to) zero GHG emissions for shipping will not be possible without the wide production and uptake of 'green' fuels, i.e. fuels with a zero or close-to-zero carbon intensity from a lifecycle (well to wake) perspective. Recent

newbuilding orders already show a relatively large number of ships being ordered which are capable of running on LNG/methane or methanol. The green marine fuel contenders are bio- (or e-)methane, e-methanol, e-ammonia, and biofuel. Each fuel option has its pros and cons. Green hydrogen forms the basis for many of these fuels, but by itself may not be suitable as a fuel for deep-sea shipping. Methane slip is an issue of concern for LNG as a fuel, and this applies also to the greener methane options; abatement technologies will be needed. For ammonia, a key issue is safety in view of its high toxicity; examples were provided of recent HAZID studies outlining hazards and risk mitigation measures related to its onboard use.

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

The Presenter

Jan works as Regulatory Affairs Manager at the Maersk McKinney Møller Centre for Zero Carbon Shipping in Copenhagen. He is a consultant to the IMO as part of the GreenVoyage 2050 program. Prior to joining the MMM Centre, he was employed as Director at ABS in Copenhagen, dealing with energy efficiency and vessel performance, sustainability and IMO environmental regulations. He started working in Copenhagen in 2007, when he joined A.P. Møller-Maersk as Senior Director and Head of Innovation, focussing on fuel efficiency and reducing environmental impact in design and operation of containerships and tankers. Before moving to Denmark he worked at MARIN, Wageningen, The Netherlands, on ship and platform hydrodynamics, dynamic stability and ship safety matters, with the last seven years as Technical Director/Head of Research and Development. Jan received his PhD and MSc degrees in Naval Architecture from the University of California at Berkeley, and his BE degree from the University of New South Wales in Sydney.

Pollution Prevention in a Defence Context

Jonathan Branch, Principal Consultant and Director, Invicta Maritime Solutions, gave a presentation on *Pollution Prevention in a Defence Context: Could an International Naval Ship Pollution Prevention Code be Feasible?* to a joint meeting with the IMarEST on 1 May in the Henry Carmichael Theatre at the Sydney Mechanics School of Arts in the Sydney CBD. The presentation was attended by 8 with an a further 7 participating online.

As responsible owners, navies are moving towards seeking compliance with International Maritime Organisation pollution-prevention conventions such as MARPOL, but are navies obligated beyond their social licence? In Australia, national maritime legislation is unambiguous: naval ships are excluded from the civilian maritime international conventions, but is it really that simple?

This presentation explored the complexity of international conventions and national legislation which make it anything but simple. A structure was proposed which has been developed as part of the Australian Naval Classification Rules, providing a consistent application of international conventions to naval ships and an outline for justifying an operational capability imperative when this is not appropriate. The focus was on the Australian context, but explored how this approach could be applied internationally.

The presentation also considered other sovereign nations to see whether a Naval Ships Pollution Prevention (NAVPOL) Code would be feasible. The potential benefits are clear: an internationally-endorsed code would provide clarity in purchasing decisions from shipbuilders and enable a consistent approach for managing pollution risks for naval ships entering sovereign waters.

The presentation was recorded and may be available soon (pending approval) on the RINA YouTube channel.

The vote of thanks was proposed, and the thank you" bottle of wine presented, by Geoffrey Fawcett.

The Presenter

Jonathan's professional career over the last 25 years began in a dockyard in Glasgow, followed by providing consultancy services in London, before transferring to Sydney as the Naval Business Manager for Lloyd's Register within Australasia. Since setting up Invicta Maritime Solutions in 2018, he has been contracting to Defence providing expertise in safety assurance, regulation, and governance.

He is currently supporting the Australian Naval Classification Authority and is the Technical Transition Lead, as well as being responsible for the Australian Naval Classification Rules environmental protection chapter.

Phil Helmore

Jonathan Branch (L) and Geofrey Fawcett
(Photo Phil Helmore)

CLASSIFICATION SOCIETY NEWS

ABS Releases Industry-first Advisory on Methanol Bunkering

With the publication of *ABS Methanol Bunkering: Technical and Operational Advisory*, ABS is expanding its industry-leading suite of guidance on methanol as a marine fuel. A key component of the methanol value chain and the overall scalability of the fuel will be the ability to bunker methanol, either by truck-to-ship, ship-to-ship or land storage tank/terminal-to-ship. The new advisory provides the maritime industry with insight into the challenges of bunkering methanol and strategies to address them.

"As the class provider for the world's largest methanol-fuelled vessel and with numerous methanol-based projects underway, ABS has unrivalled insight into the adoption of methanol as a marine fuel. Numbers of methanol fuelled vessels are growing rapidly and ABS is focussed on supporting its safe adoption by the industry, which is why we are proud to offer this publication to support owners, operators and yards with bunkering challenges related to operations, design and training," said John McDonald, ABS President and COO.

The publication provides guidance regarding the technical and operational challenges of the supplier to the receiving vessel, including critical design issues, regulatory compliance, safe practices, areas of operational processes to consider, training, and safety aspects.

Download a copy of *ABS Methanol Bunkering: Technical and Operational Advisory* at https://ww2.eagle.org/en/publication-flip/methanol-bunkering.html.

More information on ABS services for methanol as a marine fuel is available at https://ww2.eagle.org/en/Products-and-Services/sustainability/methanol-value-chain.html.

ABS News, 22 April 2024

DNV Awards Certificates for Fortescue's Dual-fuelled Ammonia-powered Vessel

DNV presented Australian green technology, energy and metals company, Fortescue, with class and statutory certificates for its dual-fuelled ammonia-powered vessel *Green Pioneer* at a ceremony held during Singapore Maritime Week. This marked the culmination of a project which began in 2021, when DNV was engaged by Fortescue to work on the feasibility study and Fuel Ready (Ammonia) notation for the vessel's conversion.

DNV's Technology Qualification process provided the framework for the qualification and assurance of the engine modifications, where industry rules were yet to be developed. Additionally, DNV's Gas Fuelled Ammonia notation, an industry first, set out the requirements for the ship's fuel system, fuel bunkering connection and piping through to the fuel consumers.

With no IMO regulations covering the specific use of ammonia, DNV and Fortescue utilised the SOLAS provision for Alternative Design Arrangements (ADA) with the backing of the Maritime and Port Authority of Singapore, particularly around fire and evacuation risks.

Commenting after the ceremony, Dino Otranto, Fortescue Metals CEO, said "Fortescue's *Green Pioneer* proves to the world that the shipping industry can, and must, innovate to stop burning fossil fuels. We know 2024 is a pivotal year for global shipping and will have an enormous impact on ammonia's use as a marine fuel in this decade and beyond. The shipping industry must adopt early use of 'real zero' long-term solutions such as green ammonia."

"When Fortescue embarked on this cutting-edge project, it was vital that we worked with organisations like DNV who shared our vision for pioneering solutions to drive decarbonisation in the industry. DNV has brought a high level of competence, focus and agility to this project. Their solution-focussed and 'can-do' attitude without compromising their core roles of safety and quality, was immense," he continued.

At the presentation of the certificates, Cristina Saenz de Santa Maria, DNV's Regional Manager South East Asia, Pacific & India, Maritime, noted "Fortescue's commitment to decarbonisation aligns perfectly with DNV's vision, and we are honoured to be part of this pioneering project. Our global teams have worked closely with Fortescue over the last two years, from the engine-bed testing stage through to commissioning and trials, to help realise this milestone. We look forward to continuing this partnership and supporting Fortescue as we both strive to create a greener future for shipping."

In 2022, Fortescue successfully converted a four-stroke engine to run on ammonia in combination with diesel at its land-based testing facility in Perth, Western Australia. Conversion work later began on *Green Pioneer* at the Seatrium yard in Singapore to convert the vessel's engines to run on ammonia in combination with conventional fuels.

Fortescue's *Green Pioneer* completed the world's first ammonia bunkering trial safely at an ammonia facility on Jurong Island, in the Port of Singapore, in March 2024, following which the vessel received flag approval from the Singapore Registry of Ships (SRS) and the Gas Fuelled Ammonia notation from DNV.

DNV News, 19 April 2024

LR to Class Hydrogen-powered Ferries

Two hydrogen-powered passenger ferries ordered by Norwegian transport company Torghatten Nord are set for Lloyd's Register (LR) class following Approval in Principle (AiP) awarded in August 2022. Designed by the The Norwegian Ship Design Company to operate in the challenging waters of the Vestfjordstrekninga Fjord in the Arctic Circle, the two vessels will be built at Norwegian shipyard, Myklebust Verft.

At 117 m long with a 120 car capacity, the duo will be the world's largest hydrogen-powered ships, operating on green hydrogen at least 85% of the time. Operating at an average speed of 17 kn in often challenging conditions, the vessels will navigate the 278 km Vestfjordstrekninga ferry route connecting Bodø, the islands of Røst and Værøy, and Moskenes.

A hydrogen storage unit onboard the vessel will feed gas to the fuel cells, creating electricity to propel the vessels and

power their auxiliary systems, reducing CO_2 emissions on the route by around 26 900 t each year.

The alternative-fuel newbuilds with biodiesel backup, bring together LR as the class society, owner Torghatten Nord, The Norwegian Ship Design Company, Myklebust Verft shipyard, systems integrator SEAM, and hydrogen supplier GreenH. The Norwegian Maritime Authority will flag the two vessels.

The hydrogen-powered ferries join another set of LR-classed vessels currently being built in Norway; two construction support offshore vessels (CSOVs) are being built at Vard Langsten shipyard and will enter service late in 2025 or early 2026.

Nick Brown, LR's CEO, said "These flagship hydrogen-powered ferries represent a significant milestone for Norway as it furthers its continuing commitment to clean hydrogen infrastructure. We see significant interest in green hydrogen as a maritime fuel, especially for short-sea shipping, and look forward to working with our Norwegian customers—Torghatten Nord, Myklebust Verft and The Norwegian Ship Design Company—to ensure that this innovative project is progressed with safety, reliability and sustainability at its core."

Marius Hansen, Managing Director, Torghatten Nord, said "We are delighted to be working with Myklebust Verft on this project as, together with our partners, we set the standard for a completely new class of ship which reduces emissions and supports sustainable operations. This project is a significant boost for the Norwegian technology and shipyard environment and we are proud to make it happen in Norway."

Torghatten Nord's hydrogen-powered ferries
(Image from LR website)

Leiv Sindre Muren, CEO, Myklebust Verft, said "We are delighted that Myklebust Verft has been selected to build these innovative, large-scale hydrogen-powered ferries, showcasing Norway's level of expertise and ambition and augmenting its maritime hydrogen power infrastructure. We look forward to developing our relationship with Lloyd's Register as we partner on these complex newbuilds."

Alf Tore Sørheim, Acting Director General of Shipping and Navigation, Norwegian Maritime Authority, said "Signing contracts for zero-emission vessels is a significant milestone. The Norwegian Maritime Authority is pleased to see Norwegian shipping companies taking responsibility and driving forward new technologies for reducing emissions, and that they have competent partners to assist them in this endeavour. We look forward to collaborating with LR, the shipping company, and suppliers towards the certification and commissioning of the vessels."

Gjermund Johannessen, CEO, The Norwegian Ship Design Company, said "We are excited to finally start building the two hydrogen ferries for Torghatten Nord and look forward to continuing our good collaboration with Torghatten Nord and Myklebust Verft. These hydrogen-powered ferries are unmatched by any other ferries in the world today, with the largest hydrogen installations in a ship ever by a substantial margin. We have developed a unique hydrogen concept using hydrogen's physical properties for achieving optimal safety. We believe hydrogen will play an important role for zero-emission short-sea shipping. Through close and fruitful collaboration with Torghatten Nord and their technical team from tender and during all development stages, the project is now more than ready to welcome the well-respected shipyard Myklebust Verft onto the project."

LR News, 18 April 2024

FROM THE CROWS NEST

RAN Bluebottles Exercising off Eden

The Royal Australian Navy now has five of Ocius Technology's bluebottles in service (BBs 701 through 705) and has recently signed a contract with Ocius to have two more delivered by the end of June 2024.

In early March the RAN trailered BBs 701, 702 and 703 to Eden, NSW, and launched them from the launching ramp at Quarantine Bay (inside Twofold Bay) for a five-day exercise. The vessels spent most of the first day exercising by themselves in the vicinity of South Head (i.e. the south headland of Twofold Bay where Boyd's Tower stands). On subsequent days the RAN brought in other assets including ships, planes and drones for joint exercises with the Bluebottles, ranging around Twofold Bay and offshore.

Phil Helmore

Bluebottle 703 being launched at Quarantine Bay, Eden, on 4 March
(Photo courtesy Johanna Innes)

Bluebottle Variants

There are now three variants of Ocius Technology's Bluebottles, each with different capabilities.

Beth Class

- Sail folds down for zero windage and Tactical Range Advantage
- Wave power plus solar and wind
- Keel winch for ASW
- Launch from a boat ramp
- 30,000+ n miles unescorted in Australia
- AMSA approved

Bathy Class

- Diesel hybrid
- Transit renewable energy
- 30 days on station doing hydrography
- Bathymetry to 600 m

Shipmate™ Class

- Three mode USV; patent registered
- Loiter/stealth mode: solar and wave energy
- Hull speed mode: 6–8 kn hybrid diesel
- Foiling speed mode: 17–40 kn hybrid diesel
- Scalable 2.8 m to 11 m

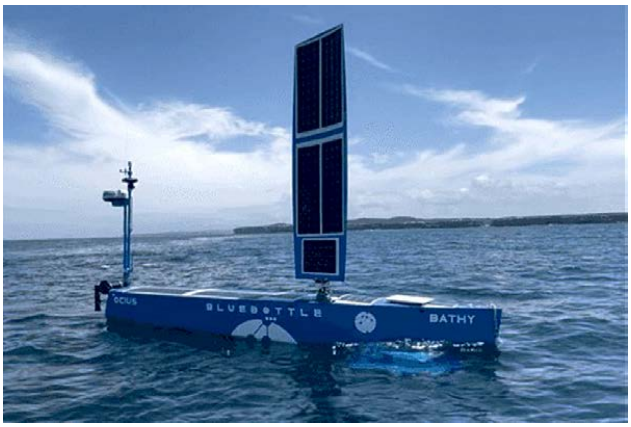
Bluebottles Spreading Far and Wide

Ocius Technology's Bluebottles are being deployed around Australia and, indeed the world, on a range of activities, including

- The Royal New Zealand Navy recently completed a two-week trial of BB *Bellona* on Auckland Harbour and the Hauraki Gulf;
- Ocius is supplying two BBs, *Bluey* and *Brizo,* to undertake seven 21-day voyages off Fremantle between November 2023 and June 2024, to help MMA Offshore deliver the first maritime remote and autonomous systems upskilling voyages for Royal Australian Navy personnel;
- diesel hybrid BB *Bathy* recently completed multi-beam echo sounder (MBES) bathymetry trials off the NSW coast and has been shipped to WA for trials with an oil and gas company; and
- Ocius approached the USA market by attending the Sea-Air-Space Expo in Washington in April on the Austrade Team Australia stand. Simultaneously they shipped BBs *Beth* and *Bonnie* to the USA for trials at the Xponential USV exercises on 22–25 April off San Diego.

Ocius Technology News, January/February 2024

Bellona on Auckland Harbour
(Photo from Ocius Technology website)



Bathy off the NSW coast
(Photo from Ocius Technology website)

Onboard CO_2 Capture

Shipping companies are experimenting with onboard carbon-capture systems, but they face difficult trade-offs on energy and space for regular cargo.

The 240 m container ship *Sounion Trader* recently completed a test of an onboard carbon-capture system as it cruised

around the Persian Gulf. It is one of a small but growing number of ships trying to reduce their climate footprint by capturing and storing their carbon dioxide emissions onboard—but finding space for tonnes of CO_2 is a challenge.

"You're miniaturising a system which was designed for huge power plants," said Roujia Wen at Seabound, the UK-based start-up behind the *Sounion Trader's* test run.

Shipping is responsible for around 3 per cent of global CO_2 emissions. To reduce that, shippers are using cleaner fuels, lubricating hulls with bubbles to improve fuel efficiency, and even turning back to sails. But near-term options to reach the industry's pledge of net-zero emissions by 2050 are limited.

Another possibility is capturing ships' emissions and storing them onboard, but it faces major obstacles. One is supplying the energy to recharge the chemical sorbents used to absorb CO_2. Tristan Smith at University College London said that some existing systems increase fuel use by one-third just to catch half of CO_2 emissions. The systems, and the carbon they capture, also take up room on board which would normally be used for valuable cargo.

"Space is an issue," said Jasper Ros at TNO, a research organisation in the Netherlands. "Especially when you're talking about long voyages."

Each tonne of combusted fuel forms around 3 t of CO_2, said George Mallouppas at the Cyprus Marine & Maritime Institute. When it is captured and stored, the added mass can affect a ship's stability and reduce its fuel efficiency.

New Scientist website, 16 February 2024

WSR *Bluebird K7* Returns to Coniston

Bluebird K7 is a jet-engined hydroplane in which Britain's Donald Campbell set seven successive world water speed records between 1955 and 1967. *K7* was the first successful jet-powered hydroplane, and was considered revolutionary when launched in January 1955. Campbell and *K7* added almost 100 mph (160 km/h) to the water speed record, taking it from Stanley Sayres and Elmer Leninschmidt's 1955 existing mark of 178 mph (286 km/h) in *Slo-Mo-Shun IV* to just over 276 miles per hour (444 km/h). Donald Campbell was killed in an accident when the much-modified *K7* somersaulted on Coniston Water on 4 January 1967 whilst aiming for his eighth water speed record at over 300 mph (480 km/h).

The wreckage of the vessel lay on the lake bed until it was re-located by engineer Bill Smith, and he and his dive team raised it on 8 March 2001, with Mr Campbell's body recovered on 28 May 2001.

On 7 December 2006, Gina Campbell, Donald's daughter, formally gifted the recovered wreckage of *Bluebird K7* to the Ruskin Museum in Coniston on behalf of the Campbell Family Heritage Trust. In agreement with the Trust and the museum, Bill Smith was to organise the restoration of the boat at no cost to the museum. There followed a lengthy restoration of the vessel in Bill Smith's Tyneside workshop in North Shields, and the restored vessel ran again on Loch Fad in Scotland in August 2018, completing a series of test runs on the loch and reaching a maximum speed of 157 mph (253 km/h).

However, since January 2020, the occasion of the fifty-third anniversary of Donald Campbell's death, relations between the Bluebird Project and the Ruskin Museum gradually broke down over ownership, maintenance and possible future outings. On 24 February 2023 the Ruskin Museum served legal papers on Bill Smith and Bluebird Project to ensure that the rebuilt *Bluebird K7* was handed to its owners.

Following the legal battle, *K7* was handed to the Ruskin Museum, but without the Orpheus engine and other new components. She was transported on 9 March 2024 from North Shields to Coniston, where she was welcomed by crowds of well-wishers. She will now become the centrepiece of the museum's Bluebird Wing which was built specially to house her.

Bill, Gillian and Robert Smith farewelling *Bluebird K7* in North Shields
(Photo from Longbow website)

Bluebird K7 arriving back in Coniston
(Photo from Longbow website)

The Ruskin Museum has chosen WEC Group as engineering partners who will subsequently maintain *Bluebird K7*, and three Orpheus engines have been donated to the museum. The museum has announced that they have plans to run *Bluebird K7* on Coniston Water in 2026.

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).

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 was back on the water at Blowering Dam on the weekend of 11–12 May. However, windy conditions allowed only one run on the Saturday which had to be aborted. The team are now planning to be back at Blowering in July.

Phil Helmore
Martin Grimm

WSR *Longbow*

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

Dave Aldred went to Coniston for *Bluebird K7*'s homecoming, but has not been completely idle when it comes to *Longbow*. In amongst all the wind and rain he managed to get a sunny day to pull the boat out of his garage on her trailer and place the mould for the driver's cockpit/capsule. Their composites design engineer, Paul Martin, wanted some measurements in relation to the cockpit with it positioned in the hull for his calculations. This mould is not the final shape or size. However, it has allowed them to have a hands-on three dimensional starting point for a cockpit in the hull which they can then play about with under Paul's guidance to come up with a satisfactory design solution. Until the design of the cockpit/capsule is finalised, they are rather in limbo as so much else is built around that area of the boat. For example, the location of the air intakes and fuel tanks and, not least, the steering arrangement.

Cockpit mould placed in *Longbow*
(Photo from Longbow website)

Cockpit mould and jet outlets on *Longbow*
(Photo from Longbow website)

The steering arrangement on *Longbow* has not yet been decided—they have many choices: hydraulic, fly-by-wire, Teleflex or rack-and-pinion driving a single cable, push-pull rods and levers, or wire ropes to a quadrant. All have their pros and cons, but the wire ropes and quadrant give the driver the best 'feel' of what the rudder is doing.

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.

SP80
(Image from SP80 website)

The boat has been having a refit over the (northern) winter months and some structural issues were detected, so the team has not yet sailed this year. However, they are doing everything they can to resolve the issues and return to the water as quickly as possible. At the same time, they are taking advantage of this longer-than-expected time on land to improve their systems, procedures, foils, kite wings and even the shape of the hulls.

From initial trials, they decided to modify the shape of the central hull (which contains the pilots' cockpit) to improve the performance of the boat during acceleration.

Adding an extension to the (upside-down) centre hull
(Photo from SP80 website)

During the last sailing campaign at Leucate, France, they were able to test their first tailor-made wing (25 m^2) to validate the take-off procedure and refine their needs for future kites. Since then, they have tested new ideas on a miniature version (10 m^2) of the wing, allowing them to finalise the next design from the beach, with much simpler logistics than navigation. The new 40 m^2 wing is expected soon.

For more details, visit https://sp80.ch/

SP80 10 m^2 kite deployed
(Photo from SP80 website)

Sail GP Series 4

The Australia SailGP Team has now won the coveted SailGP Trophy three times, winning it in Seasons 1, 2 and 3.

Series 4 kicked off in Los Angeles, USA, on 22–23 July 2023, with Australia, Great Britain, Canada, Denmark, France, Germany (a newcomer), New Zealand, Spain, Switzerland and USA all competing.

Subsequent events have been held in Saint Tropez (France) 9–10 September, Taranto (Italy) 23–24September and Andalucia-Cadiz (Spain) 14–15 October, Dubai (UAE) 9–10 December, Abu Dhabi (UAE) 13–14 January, Sydney 24–25 February, Auckland 23–24 March and Bermuda 4–5 May.

Australia lost the season lead in Christchurch after hitting a race mark and being handed a devastating eight-point penalty to its season total. In Bermuda Australia had two wins and a second place, and results currently show New Zealand at the top of the table with 77 points., Australia 2 with 67 and Spain 3 with 65.

There are three venues remaining to complete the series, as follows:

Halifax	1–2 June
New York	22–23 June
San Francisco	13–14 July

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

Phil Helmore

The United States' SailGP entry's dramatic pre-racing capsize during the third fleet race of the practice day In Bermuda when the US team was on the reach to Mark 1. The top of the wing inverted—or bent the wrong way—resulting in the F50 suddenly flipping over and five of six crew-members falling overboard
(Photo courtesy SailGP)

GENERAL NEWS

AUKUS Build and Sustainment Partners Announced

On 22 March the Government announced Australia's Sovereign Submarine Build Partner and Sovereign Submarine Sustainment Partner.

The Government has selected ASC Pty Ltd and BAE Systems to build Australia's SSN-AUKUS submarines. These world-leading companies will work closely together to establish the foundations of the complex project and will initially form a collaborative arrangement which will lead to the establishment of a long-term incorporated Joint Venture within Australia.

This Joint Venture establishes an enduring partnership between ASC and BAE Systems to bring together and leverage the unique and complementary capabilities, skills, expertise and resources of the two partners to deliver Australia's SSN-AUKUS submarines.

ASC has been at the centre of Australia's sovereign submarine program for decades as Australia's prime sovereign submarine sustainment partner, and the builder of our Collins-class submarines.

Its experience in submarine construction, testing, commissioning and certification, including physical integration of US combat systems, make ASC a reliable, tested and capable partner.

BAE Systems is the United Kingdom's long-term submarine build partner and brings over 60 years of nuclear-powered submarine building experience, world-class industrial capability and intellectual property to this partnership.

BAE's involvement ensures an integral connection between the SSN-AUKUS design led by BAE Systems in the UK, where Australian experts are already working alongside their peers, and the SSN-AUKUS build strategy in Australia.

ASC and BAE—and once established, the Joint Venture—will operate collaboratively within a wider enterprise and be accountable and responsible for the delivery of our SSN-AUKUS submarines, as well as ensuring safety, security, and regulatory compliance throughout the build program.

The Commonwealth will hold sovereign protection rights in relation to the governance of the Joint Venture to preserve the national interest in the build program.

Sovereign Submarine Sustainment Partner

The Government has selected ASC Pty Ltd for the sustainment of nuclear-powered submarines, commencing with the Virginia class and followed by SSN-AUKUS.

This decision recognises ASC's long history and expertise in the sustainment of submarines in Australia, in addition to its established workforce and supply-chain network.

Building on ASC's current role and capability in sustaining Australia's Collins-class submarines, ASC's sustainment capability for nuclear-powered submarines will be uplifted in the lead up to Australia acquiring its first Virginia-class submarine from the United States in the early 2030s. It will include significant workforce growth and the development of skills, knowledge and experience required to sustain Virginia-class submarines.

The passage of the *National Defense Authorization Act* (NDAA) in December 2023 through the United States Congress represented important progress towards enabling the next steps in realising Australia's conventionally-armed nuclear-powered submarine capability. With the passage of this Act, exemptions were established that will authorise Australian workers to sustain US submarines—an activity never before enabled under US legislation.

With the NDAA passed, there will be opportunities to embed Australian workers from ASC in the Pearl Harbor Naval Shipyard to train on sustainment of US conventionally-armed nuclear-powered submarines. ASC will also provide sustainment support to visiting US and UK submarines at HMAS *Stirling* in the lead up to the establishment of Submarine Rotational Force–West from 2027.

Importantly, ASC's growing role in nuclear-powered submarine sustainment will be integrated with the existing Collins-class submarine enterprise and sustainment arrangements, providing the opportunity to strengthen our sovereign capability while Australian workers learn new skills for the future. This plan secures our current and future submarine capabilities.

The task ahead is significant and will require ASC's deep engagement with Australian industry. ASC and the Australian Submarine Agency will further refine upcoming opportunities for Australian industry to become involved in the sustainment program as planning matures. ASC will also develop robust industry partnerships with UK and US businesses to gain the technical skills, know-how and capacity to sustain nuclear-powered submarines.

Delivering on AUKUS

The work to deliver Australia's conventionally-armed,nuclear-powered submarines is already well underway, and key land acquisition and infrastructure upgrades have already commenced, all to ensure that we are able to begin construction of Australia's first SSN-AUKUS before the end of this decade.

Additionally, work has already begun to develop the skills to maintain our nuclear-powered submarines with increased visits of US and UK SSNs ahead of the arrival of Australia's own sovereign Virginia-class submarines.

Australia's commitment to meeting the highest safety, security and nuclear non-proliferation standards in supporting our acquisition of conventionally-armed nuclear-powered submarine capability will be a central element of the work undertaken by both our build and sustainment partners.

The establishment of the Australian Naval Nuclear Power Safety Regulator, with legislation currently before the Australian Parliament, will be another important step in building and ensuring an environment of nuclear safety and security.

AUKUS and Industry

The Government will continue collaboration with AUKUS partners and industry, including ASC and BAE Systems, to develop Australian supply chains and facilitate industry participation in the United Kingdom and United States supply chains. Part of this coordination is the development of an efficient vendor qualification process.

To this end, in January the Defence Industry Vendor Qualification Program was launched. With the assistance of AUKUS partners, the program is reducing barriers and streamlining-process as the entry of Australian products into UK and US supply chains is accelerated. Once qualified, Australian companies will be well-positioned to contribute to international supply chains, working with UK and US industrial partners.

In its initial wave, the program is working with 26 companies to qualify supplies across four product families to meet US supply chain requirements. The next wave will expand the program to qualify suppliers into both the US and UK supply chains and will commence in mid-2024.

Workforce

The Government has announced new initiatives through the Skills and Training Academy to develop Australia's workforce to build and sustain our nuclear-powered submarines.

These pilot programs will be delivered in close consultation with Australia's Sovereign Submarine Build Partner, Sovereign Submarine Sustainment Partner and the shipbuilding industry and include:

- Non-destructive Testing Traineeships to grow the testing technician workforce.
- Development of Australia's welding and fabrication pipeline, including:
    - The Welding Aptitude Testing Initiative, providing entry-level workers and mid-career skilled workers opportunities to test their skills and explore welding careers in shipbuilding.
    - A welding bridging initiative for new entrants, existing workers and advanced apprentices in adjacent industries to uplift their skills to fill welding roles in shipbuilding and the nuclear-powered submarine program.
- International placements for a 'train the trainer' pilot.
    - Opportunities for Australia's VET teacher workforce to conduct short-term placements in the US to enable them to build an understanding of AUKUS trilateral training requirements and methods, and support students with understanding nuclear-powered submarine career pathways.

The Defence Industry Pathways Program will also expand to include pathways into the nuclear-powered submarine program.

Through an international placements program under the Skills and Training Academy, Australian trainers will be placed within the US nuclear-powered submarine training system to learn skills to bring back to Australia. In order to support the building of the workforce in support of Submarine Rotational Force–West, this will include personnel from the South Metropolitan TAFE in Western Australia.

International Placements

Australia is working closely with the AUKUS partners to build the pathways for international placements as part of the upskilling of Australia's domestic industrial workforce.

Following the recent passage by the United States of the *National Defense Authorization Act* (NDAA), Australian industry has benefited from an easing of restrictions which has enabled unprecedented training opportunities in US shipyards, which will enhance the skills and qualifications of Australian workers.

Partnering with US and UK industry will be an important element of Australia's sovereign build and sustainment partners growing the specialist skills and capacity required to build and sustain nuclear-powered submarines, leveraging their decades of expertise.

AUKUS partners are committed to ensuring that all activities to build Australia's future submarine workforce are undertaken in a manner which is consistent with the highest standards for nuclear non-proliferation.

All work by Australian personnel in the UK and US will remain consistent with Australia's domestic and international legal obligations, including with respect to nuclear non-proliferation.

Boost for Defence Trade Cooperation

Tangible steps have been made by the United States Government to further streamline export control licensing requirements for AUKUS trilateral partners. A licence-free environment between Australia, the United Kingdom and the United States will revolutionise collaboration and enable unprecedented levels of scientific, technological and industrial cooperation and co-development.

As part of the license-free environment, the United States Department of Commerce has announced that that Australia and the United Kingdom are being provided with a national exemption from the Export Administration Regulations. This will reduce the burden associated with US export licences for dual-use goods to Australia, valued at almost $US2 billion.

The decision by the United States Department of Commerce to establish a licence-free dual-use export environment amongst and between AUKUS partners is another significant step towards establishing a seamless environment for innovation, cooperation and collaboration.

It follows the passage of the National Defense Authorization Act for Fiscal Year 2024 in December 2023 which established a full national exemption for Australia and the United Kingdom from United States export-control licensing requirements for military end-use items.

This US action is complemented by the Defence Trade Controls Amendment Act 2024 which passed through the Australian Parliament in March 2024. The Act provides a reciprocal national exemption for the United States and United Kingdom from Australia's export control permit requirements.

The AUKUS trilateral partners will soon take another significant step forward in our commitment to streamline

defence trade, cooperation and collaboration.

Australia will release amendments to the Defence Trade Controls Regulation 2013 and Customs (Prohibited Exports) Regulations 1958 for public consultation. The proposed amendments to the regulations will give effect to specific elements of the Defence Trade Controls Amendment Act 2024.

In September 2024, the national exemption for the United States and the United Kingdom from Australia's export control legislation will come into effect.

The United States Department of State will also release the International Traffic in Arms Regulations for public consultation, which will give effect to the exemption for Australia and the United Kingdom from the United States' International Traffic in Arms Regulations.

The United Kingdom will also release its Open General Export Licence in September 2024 to give effect to the exemption for Australia and the United States.

These exemptions will remove the licensing requirements for most military goods and technology items exported, re-exported or transferred (in-country) to or within the three AUKUS partners.

This new licence-free environment will support the industry, higher education, and research sectors in all three nations to cooperate with lower technology-transfer barriers and costs of trade.

The AUKUS nations are committed to working with industry partners, and higher education and research sectors to ensure that the exemptions, taken together, deliver real benefits, unlock opportunities and promote outcomes which support our shared interest.

Nuclear Submarines in Western Australia

The UK Ministry of Defence commented in April that, building on the success of earlier SSN visits to Australia since the Optimal Pathway announcement, AUKUS partners welcomed a visit by USS *Annapolis* to HMAS *Stirling* in March 2024. This latest visit is part of a trilateral commitment to more frequent SSN visits to HMAS *Stirling* under the Optimal Pathway. This, and future such visits from UK and US SSNs, will contribute to building Australia's capacity to support a rotational presence of UK and US SSNs under Submarine Rotational Force–West (SRF–West) from as early as 2027, and Australia's future sovereign SSN capability.

The most significant maintenance activity to be conducted on an SSN in Australia, to date, is scheduled to occur in the second half of 2024. The maintenance activity, supported by a Submarine Tender, will be critical to building Australia's ability to safely and securely sustain US SSNs in preparation for the establishment of SRF–West. In anticipation of this forthcoming activity, 37 Royal Australian Navy sailors reported to the USS *Emory S. Land* in Guam in late January 2024, to begin training and to gain the necessary skills and qualifications. Australian industry personnel will also be involved in supporting this activity to continue to grow the submarine sustainment workforce and supply chain. UK Royal Navy officers will observe the activity to enable integration of UK maintenance requirements for future UK SSN port visits and future UK rotational presence as part of SRF–West. This will be the first time that Australian personnel will actively participate in the maintenance of a US SSN in Australia, enabled by the provisions in the National Defense Authorization Act for Fiscal Year 2024.

Newport News Shipbuilding (NNS) delivered the Virginia-class submarine *New Jersey* (SSN 796) to the US Navy on 25 April 2024. *New Jersey* is the 11th Virginia-class submarine delivered by NNS, and the 23rd built as part of the teaming agreement with General Dynamics Electric Boat
(Photo courtesy Newport News Shipbuilding)

In December 2023, the United States and Australia finalised a Foreign Military Sales (FMS) case to procure submarine training devices to support the establishment of SRF–West. As part of the FMS case, the first contracts were awarded in April by the United States for submarine training simulators. These will be used to train Royal Australian Navy personnel on the Virginia-class platform in advance of Australia operating its own sovereign Virginia-class SSNs, and supporting visiting and rotational US Virginia-class SSNs through SRF–West. The FMS case will also enable the training of Australian Defence and industry personnel in the United States. In March 2024, a cohort of 20 Australian industry personnel completed a successful three-month placement at Pearl Harbor Naval Shipyard and Intermediate Maintenance Facility.

Incat to Commence Design Study for New Electric-hybrid Ferry in Partnership with DFDS

On 24 April Incat Tasmania announced a new partnership with the Danish Shipping and Logistics Company DFDS to complete a design study for the construction of a cutting-edge electric-hybrid ferry.

The 72 m ferry, which will have the option to convert to fully electric, is suited to a number of ferry routes across Europe.

Incat's CEO, Stephen Casey, said that the Tasmanian shipbuilder is ideally placed to design and build this next generation of ships for the world market.

"Since launching the design of our series-produced electric ships last November there has been significant interest from many ferry operators, and we're excited to work with DFDS on their projects," Mr Casey said. "The Incat 72 m series is offered in a fully-electric model which is suited to many ferry networks around the world."

"Incat's industry-leading design and construction capabilities, and our commitment to sustainability, make us the logical choice for ferry operators who want a vessel of the highest quality whilst minimising their environmental footprint."

"We know that battery-electric or electric-hybrid propulsion coupled with lightweight aluminium on shorter sea routes will be the ideal choice to cut emissions, and it's great to see major operators such as DFDS sharing in our goal to shape the future of decarbonisation in maritime transport."

"Incat pioneered the development of large vehicle-carrying catamarans in the 1990s, and now we're ready to work with ferry operators around the world to showcase what the future of maritime transport looks like."

"Incat has specialised in lightweight aluminium vessel design and construction for the past four decades. Aluminium ferries, being approximately half the weight of their steel counterparts, require less power when operated at similar speeds and deadweight. This results in significant energy savings and emissions reductions."

Incat is based in Tasmania where the State generates 100 per cent of its energy needs from renewables, and the energy consumed in the construction of Incat vessels comes from 100 per cent renewable sources—a combination of hydro, wind and solar. Tasmania has achieved Net Zero emissions for the past seven years in a row, making Incat the only shipyard in Australia, and part of only a handful in the world, able to produce zero-emission ships in a state that has already achieved net-zero.

Incat is world renowned for its quality shipbuilding, undertaking all its manufacturing on shore in Australia and servicing a global market. Incat was recently announced as one of Australia's Best Managed Companies for 2023 as part of Deloitte Private's Best Managed Companies Program.

Australia's First Extra Large Autonomous Undersea Vehicle Prototype Ready

Australia is developing an autonomous undersea capability through the *Ghost Shark* Program. Ghost Shark is being jointly developed and funded by a partnership between Defence and Anduril Australia, and will become Mission Zero for the Advanced Strategic Capabilities Accelerator (ASCA).

Only Defence's highest priorities are used to select ASCA missions and there must be an identified pathway for the innovation to transition to capability.

Ten Australian companies have partnered with Anduril Australia to be ready for the manufacture of *Ghost Shark*, and there are 42 Australian companies who stand to benefit in the supply chain.

Ghost Shark will provide the Navy with a stealthy, long-range autonomous undersea warfare capability which can conduct persistent intelligence, surveillance, reconnaissance and strike missions. It will also enhance the Navy's ability to operate with allies and partners.

Ghost Shark will form part of the Government's investment of up to $7.2 billion for the development and acquisition of subsea warfare capabilities and new autonomous and uncrewed maritime vehicles. The Government is spending more than $10 billion on autonomous and uncrewed systems, including armed systems, as part of a comprehensive plan to provide the ADF with capabilities it needs to meet strategic circumstances.

The Navy will also explore the potential for synergies between Navy's XLAUV program and future trilateral collaboration through AUKUS Advanced Capabilities.

Ghost Shark is being jointly developed and funded by a partnership between Defence and Anduril Australia, and will become Mission Zero for the Advanced Strategic Capabilities Accelerator (RAN photograph)

Austal Australia Completes Sea Trials for RAN's Patrol Boat Autonomy Trial

On 23 April Austal announced that the collaborative Patrol Boat Autonomy Trial (PBAT) project has successfully completed Sea Acceptance Trials (including Endurance Trials) of the remote and autonomously operated vessel, *Sentinel*.

The trials consisted of a series of remote and autonomous navigation events conducted off the Western Australian coastline during March and April 2024; utilising Greenroom Robotics' Advanced Maritime Autonomy (GAMA) software to reliably navigate the de-commissioned Armidale-class patrol boat. Throughout the trials, a limited number of project team members, observers and a crew from International Maritime Services (IMS) were on board, ensuring a swift response in case of any unforeseen deviations or necessary manual interventions.

Funded by the Commonwealth of Australia, PBAT is a collaboration between Austal Australia, Greenroom Robotics, Trusted Autonomous Systems and the Royal Australian Navy's Warfare Innovation Navy (WIN) Branch to establish robotic, automated and autonomous elements on a former Navy patrol boat to provide a proof-of-concept demonstrator, for optionally crewed or autonomous operations. The trial has also explored the legal and regulatory pathways and requirements for operating an autonomous vessel.

In 2022, Austal Australia took possession of the decommissioned HMAS *Maitland* from the Commonwealth of Australia, renamed the vessel *Sentinel* and commenced planning, modification, testing and evaluation of autonomous and remotely-operated systems for the Patrol Boat Autonomy Trial (PBAT). At 57 m LOA, *Sentinel* is (by a significant extent) the largest vessel in Australia to be operated remotely and autonomously.

Sentinel was extensively modified to enable remote and autonomous operations, including modifications to navigation, communications, bilges, CCTV, and electrical systems. Sensors and computer units were also added by Greenroom Robotics to inform and host the Autonomous Control System, GAMA.

Austal's Chief Executive Officer, Paddy Gregg, said that the completion of the sea trials marks a significant milestone in the Patrol Boat Autonomy Trial, successfully demonstrating the capability of the locally developed autonomous systems and their integration within a full-size Australian-made naval vessel.

The PBAT team comprising Austal, Greenroom Robotics, TAS and Navy WIN Branch have worked exceptionally hard and achieved the objectives of the trial—to demonstrate the autonomous technology successfully within a complex regulatory and operating environment.

"Looking ahead, we are excited about the potential opportunities to work with Navy to further advance the autonomous technology demonstrated during the trial; on projects such as the Large Optionally Crewed Surface Vessels (LOSV), recently announced by the Australian Government as part of the Surface Combatant Fleet Review," Mr Gregg said.

Greenroom Robotics Chief Technology Officer, Harry Hubbert, said "PBAT has been a very successful collaborative project between Austal, Greenroom, TASDCRC and the RAN; the insights from all parties has been instrumental in steering us toward success. Together we've harnessed collective expertise to deliver this ground-breaking project, setting the stage for a future brimming with maritime capability. This collaborative effort not only has the potential to enhance current operations and platforms, but also paves the way for unprecedented advancements on the horizon."

TAS Chief Executive Officer, Glen Schafer, said "Trusted Autonomous Systems are extremely impressed and proud of the achievements of the PBAT project. Autonomous and automated features on a vessel of this size in addition to the regulatory considerations are complex. It is a clear demonstration of the significant innovation possible through investment in sovereign industry".

CDRE Michael Turner, the Navy's Director General Warfare Innovation Navy, said "PBAT stands out not only for its demonstration of autonomous technology and its practical application to operational vessels, but also for the spirit of collaboration that underpinned its success."

Austal Delivers 19th Guardian-class Patrol Boat

On 8 March Austal Australia announced the delivery of the 19th Guardian-class Patrol Boat (GCPB) to the Australian Department of Defence.

The vessel, RFNS *Puamau*, was then gifted by the Australian Government to the Republic of Fiji Navy at a handover ceremony held at HMAS *Stirling* in Western Australia, attended by the Prime Minister of Fiji, the Hon. Sitiveni Rabuka and Australia's Minister for Defence Industry and Minister for International Development and the Pacific, the Hon. Pat Conroy MP.

Austal's Chief Executive Officer, Paddy Gregg, said that RFNS *Puamau* was the second Guardian-class patrol boat to be delivered to the Republic of Fiji under the Pacific Patrol Boat Replacement Project (SEA3036-1).

"The Pacific Patrol Boat Replacement Project is a successful program which continues to highlight Western Australia's naval shipbuilding capability, effective defence industry collaboration and the vital, ongoing support delivered by the Royal Australian Navy's Sea Training Group with every Guardian-class Patrol Boat," Mr Gregg said.

RFNS *Puamau* is the 19th Guardian-class Patrol Boat to be delivered by Austal to the Australian Department of Defence under the Pacific Patrol Boat Replacement Project (Photo Republic of Fiji Navy)

"*Puamau*, and her sister ship *Savenaca*, are great examples of Australian naval shipbuilding capability, which draws upon the skills and expertise of not only the Austal team, but hundreds of supply-chain partners, and the training support of the Royal Australian Navy in Western Australia.

"*Savenaca* has already proven to be an invaluable addition to the Republic of Fiji Navy, undertaking successful missions throughout Fiji's territorial waters since 2020, including combined maritime patrol and interoperability training with the Royal Australian Navy, in 2022."

Austal Delivers *Cape Fourcroy*

On 24 April Austal announced that the first of two Cape-class patrol boats for the Royal Australian Navy, the Australian Defence Vessel (ADV) *Cape Fourcroy*, has been delivered from the company's Henderson shipyard in Western Australia.

The two 58 m patrol vessels are to be chartered by the Commonwealth of Australia on behalf of the Royal Australian Navy, which awarded the $63 million contract to Austal in December 2015.

Austal's Chief Executive Officer, Paddy Gregg, said that the delivery highlights Austal's proven capability to design and build defence vessels—a record that has seen the company build 72 patrol boats for domestic and international markets before this delivery.

Austal currently has an order book of 20 patrol vessels to be delivered over the next four years and has successfully competed in a number of overseas markets. Austal is currently proposing variations of its Bay-class, Cape-class and Guardian-class patrol boats for customers in the Middle East and Asia and expects this activity to bring further construction work to Australia.

Austal Launches Seventh Evolved Cape-class Patrol Boat

At the end of April Austal Australia launched the future ADV *Cape Solander*, the seventh Evolved Cape-class patrol boat which the company is building for the Royal Australian Navy.

Cape Solander at her launching in April
(Photo courtesy Austal)

Like her earlier sisters, the vessel has an aluminium hull, a length of 58 m, and accommodation for 32 crew members and other personnel. Armament will include two pintle-mounted 12.7 mm machine guns.

Delivery of the future *Cape Solander* is scheduled for later this year.

The RAN will use the Evolved Cape-class patrol boats in constabulary operations, primarily to the North of Australia, enforcing Australian sovereign immigration and fisheries laws. They will be maintained at the Regional Maintenance Centre North East in Cairns.

Lite Cat 2 from Seatransport

Lite Cat 2 is a 60 m long, 20 m wide catamaran ro-pax ferry designed by Seatransport and built by PTKAS in Indonesia for Sealease and Philippines Lite Ferries. The vessel was designed, built and surveyed under LR Special Services Craft rules. The project suffered some delays during the pandemic, but was completed during 2022. The hull is of steel construction, while the superstructure is aluminium. She has two ro-ro ramps capable of easy loading and offloading of trucks and cars.

Lite Ferries of Philippines, a long-time customer of Seatransport, snapped up the vessel, but requested some modifications made for its Cebu-Tubigon route, including an increase in truck spaces due to higher demand, longer ramps and a significant increase in passenger numbers, bumped to 450 pax. Seatransport and PTKAS took up the

ADV *Cape Fourcroy* was recently delivered to the Commonwealth by Austal Australia
(Photo courtesy Austal)

challenge, added a truck lane and an extra accommodation deck. Ensuring structural strength and compliance with statutory requirements in these new loading and passenger configurations was a memorable task.

Lite Cat 2 is currently the flagship in Lite Ferries fleet with widely-spaced and comfortable seats, including business class, tourist class and an economy class accommodation area.

Port bow of *Lite Cat 2*
(Photo courtesy CIRI Productions)

Stern ramp on *Lite Cat 2*
(Photo courtesy CIRI Productions)

Mirrabooka and *Yarabinjara* from Seatransport

Mirrabooka and *Yarabinjara* are two 44.9 m long, 16.5 m beam catamaran ro-pax ferries currently under construction for SeaLink. Their steel hulls were fabricated at PT BatamEC Shipyard in Batam, Indonesia, and they are being completed at Polaris Marine Dockyards (formerly Harwood Marine) in Harwood, NSW.

Mirrabooka and *Yarabinjara* under construction at Polaris Marine Dockyards, Harwood
(Photo courtesy Chris Briggs)

The ferries were designed by Seatransport to LR Special Services Craft rules. They have a steel hulls and aluminium superstructures. They have long bow ramps and aft to fit with the shore structure for fast ro-ro vehicle transfer. Accommodating 199 passengers with a service speed of 12 kn, the ferries will be a welcome improvement to the current service.

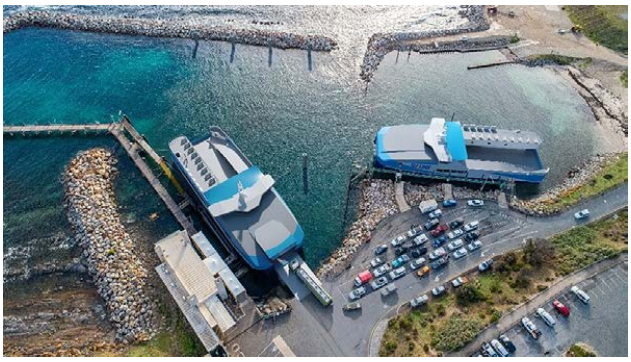
Mirrabooka and *Yarabinjara* will replace the existing ro-ro barges servicing the Redland Bay Islands (Karragarra, MacLeay, Lamb and Russell Islands) route in Queensland.

New Kangaroo Island Ferries from Seatransport

In December 2021 the South Australian Government announced that SeaLink was successful in a competitive tender and would continue to provide the critical transport link between Cape Jervis (mainland) and Penneshaw (Kangaroo Island) as part of the new Kangaroo Island Ferry Service. For this purpose, after tender, Sealink awarded the design of two 60 m catamaran ro-pax ferries to Seatransport and the vessels are currently under construction. The shore facilities are due to be upgraded as well.

The two vessels will provide much greater capacity in transport for Kangaroo Island. They are designed to have state-of-the-art facilities for tourists and passengers, while serving the commercial truck transport activities for the island. Boasting two truck lanes and space for 45+ cars onboard, there is a number of design innovations and extra fire and safety features on these vessels which makes them unique. The vessels use moving shore ramp facilities to safely speed up roll-on/roll-off vehicle transfer.

Jalal Rafieshahraki



Artist's impression of the new Kangaroo Island ferries at Cape Jervis
(Image courtesy Sealink)

Xin Ming Xhu VIII from IncatCrowther

A new cutting-edge passenger fast ferry, *Xin Ming Xhu VIII*, is now servicing commuters on Hong Kong's iconic waterways after Incat Crowther delivered the first of six new passenger fast ferries to mass-transit operator Sun Ferry. *Xin Ming Xhu VIII*, built by Guangzhou-based shipbuilder Afai Southern Shipyard, is now in operation on the busy Central Ferry Pier to Mui Wo and Cheung Chau commuter routes in Hong Kong.

Capable of transporting up to 500 passengers in safety and comfort, the new low-draft vessel features Incat Crowther's latest generation hullform providing significant improvements on previous-generation vessels. *Xin Ming Xhu VIII* is capable of reaching a top speed of 30 kn and

maintaining an operational speed of 27 kn, comfortably exceeding Sun Ferry's minimum requirements.

Designed to provide an elevated customer experience, *Xin Ming Xhu VIII*'s air-conditioned main deck features spacious seating for 299 passengers including six wheelchair spaces and two dedicated areas for customers travelling with pets. It also caters for parents, with stroller storage areas and private change-table facilities. In addition, there is a storage space for walking frames and mobility aids for passengers with restricted mobility. Large internal luggage storage spaces have been incorporated into the design of the main deck, including a protected 7 m^2 cargo area.

Boarding efficiency has been optimised via three locations on both the port and starboard sides of the main deck, while large internal and external staircases lead to the upper deck which can accommodate an additional 201 passengers. The air-conditioned upper deck also hosts a large, elevated wheelhouse which provides crew with a 360 degree view.

Commenting on the delivery of *Xin Ming Xhu VIII*, Incat Crowther's Technical Manager, Sam Mackay, said "The delivery of this vessel is the culmination of a collaborative design-and-construction process between our team of naval architects and the teams at Sun Ferry and Afai Southern Shipyard. Not only has this vessel been delivered on time, but it has exceeded performance expectations and met Sun Ferry's brief of providing the people of Hong Kong with a world-class mass-transit customer experience".

"With dedicated facilities for parents, passengers with pets and the elderly, all customers are catered for by these vessels. Sun Ferry's commitment to sustainability is also illustrated by the inclusion of 140 solar panels on the vessel's roof providing 14 kW of on-board power," said Mr Mackay.

The second tranche of vessels in the new Sun Ferry fleet is now under construction with the final vessel expected to be delivered by the end of 2025.

Principal particulars of *Xin Ming Xhu VIII* and the following vessels are

Length overall	44.8 m
Length waterline	43.0 m
Beam overall	11.1 m
Depth	3.40 m
Draft (hull)	1.37m
Passengers	500
Crew	5
Fuel oil	8 000 L
Fresh water	1000 L
Sullage	1000 L
Urea	500 L
Main engines	2×MTU 16V2000 M72 each 1440 kW @ 2250 rpm
Propulsion	2×Kamewa S71-4 waterjets
Generators	2×Dongfeng Cummins 6CTA8.3
Speed (service)	27 kn
(maximum)	30 kn
Construction	Marine-grade aluminium
Flag	Hong Kong
Class/Survey	CCS ★CSA Catamaran HSC, Passenger B Coastal Service Restriction, ★CSM

Xin Ming Xhu VIII on trials
(Photo courtesy Incat Crowther)

Burra and *Girrawaa* from Incat Crowther

Sydney Harbour has new stalwarts to support critical maritime capabilities, with an $11.5 million dollar investment in two operational vessels, custom-built in the heart of regional New South Wales. The state-of-the-art vessels, *Burra* and *Girawaa*, are the fastest response vessels ever commissioned by Port Authority. They are designed to play a pivotal role in major on-water incidents, including firefighting operations both on and from the water. Each year, Port Authority of NSW responds to over 1000 incidents in Sydney ports alone, including vessel fires, oil pollution and water rescues.

The vessels were constructed by local manufacturer and family-run shipyard, Birdon in Port Macquarie involving around 60 workers.

The multimillion-dollar build was a critical project for Port Authority of NSW, replacing *Shirley Smith* and *Ted Noffs*, which have been retired after almost 40 years of loyal service.

These vessels:

- Play a key role in emergency actions and marine pollution response to protect life, property, infrastructure and the marine environment.
- Are capable of firefighting both on water and from the water where fires are in difficult locations for land crews.
- Support Maritime NSW and NSW Police in major on-water operations.
- Can pump 16 000 L/min of sea water—equivalent to the capacity of four large fire engines.
- Can project water to over 90 m—almost the length of a standard soccer field.
- Can travel at speeds of 27 kn.
- Can turn 365° in 60 m while travelling at 20 kn, making them extremely agile in the water.
- Are capable of travelling in shallow water.
- Are fitted with an underwater surveillance measuring and monitoring systems.

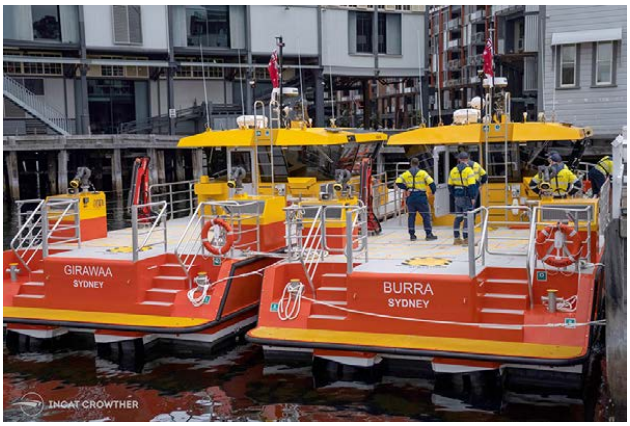
Transport Minister, Jo Haylen, said "Today is a landmark day as we unleash *Burra* and *Girawaa*, two sleek vessels designed to safeguard our waterways with unmatched speed and precision for decades to come. Seeing these vessels in action, you know that our lands and waterways are in safe hands. This investment has delivered cutting-edge vessels for Sydney Harbour and Botany Bay, supported

local manufacturing, retained highly-skilled workers, and stimulated our regional economy."

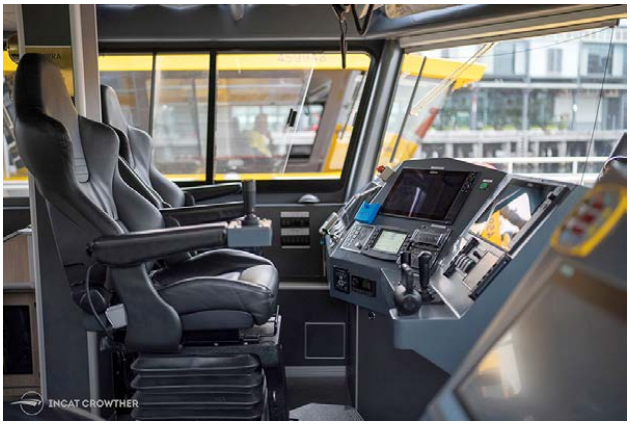
Port Authority CEO, Captain Philip Holliday, said "These vessels are befitting the hard-working harbours for which they have been especially built, and embody Port Authority's commitment to excellence and innovation. *Burra* and *Girawaa* will become the new icons of our working harbours, honouring the rich tapestry of maritime heritage in coastal Sydney and the Traditional Owners whose waters and lands we help to protect every day."

Principal particulars of *Burra* and *Girrawaa* are

Length OA	17.8 m
Length WL	17.5 m
Beam OA	5.50 m
Depth	2.40 m
Draft (hull)	0.90 m
Crew	6
Fuel oil	4000 L
Fresh water	120 L
Black water	120 L
Main engines	2×Scania DI16-076M each 651 kW @ 2100 rpm
Gearboxes	2×ZF665
Propulsion	2×NAMJet TJ611
Speed (service)	27 kn
(maximum)	29 kn
Construction	Marine-grade aluminium
Flag	Australia
Class/Survey	NSCV Class 2C



Stern view of *Burra* and *Girrawaa*
(Photo courtesy Incat Crowther)



Wheelhouse on *Burra*
(Photo courtesy Incat Crowther)

32 m Rottnest Island Passenger Ferry from Incat Crowther

Construction of a new 32 m passenger ferry, designed by Incat Crowther for Western Australian ferry operator, Rottnest Fast Ferries, has commenced at Austal Philippines. The new ferry will operate on the popular Perth–Rottnest Island tourism route, with the 32 m aluminium catamaran set to have an operational capacity of up to 400 passengers and five crew seated over three decks. The vessel will also feature extensive cargo and luggage space for passengers, including bicycle storage areas on the main and mid decks.

The main deck of the vessel will boast seating for 202 passengers and will also feature a large bar and kiosk area, as well as five bathrooms. The vessel's mid deck will feature seating for 143 passengers—including 68 passengers in a spacious aft deck which has been designed to protect customers from the elements. The aft deck also provides access to the vessel's open-air sun deck which is fitted with 56 seats.

Starboard quarter of 32 m Rottnest Island ferry
(Image courtesy Incat Crowther)

Operational efficiency has been optimised via the installation of two 1029 kW MAN D2862 diesel engines driving fixed-pitch propellers. The vessel will have an operating speed of 25 kn and will complete the nearly 30 km journey from Hillarys Boat Harbour in Perth to Rottnest Island in 45 min.

Incat Crowther's Technical Manager, Dan Mace, said "Incat Crowther is pleased to collaborate with Rottnest Fast Ferries in the development and delivery of this next-generation vessel following the success of the existing Incat Crowther-designed *Harbour Master* on the Perth–Rottnest Island route."

In a joint statement, Rottnest Fast Ferries Directors, Luke Crispin and James Mulholland, said "Incat Crowther has paid close attention to the operational details which are required to deliver an exceptional passenger experience on our iconic Perth–Rottnest Island route. Incat Crowther's team has supported us every step of the way through the shipbuilding process, and we are confident that the new vessel will deliver a world-class customer experience for our passengers."

The new vessel is expected to be in operation in December, ahead of the peak tourist season in Western Australia.

Principal particulars of the new vessel are

Length OA	32.0 m
Length WL	31. 5m

Beam OA	10.3 m
Draft (hull)	1.41 m
Depth	3.00 m
Personnel	400
Crew	5
Fuel oil	7400 L
Fresh water	2000 L
Sullage	3000 L
Main engines	2×MAN D2862 each 1029 kW @ 2100 rpm
Propulsion	2×fixed-pitch propellers
Speed (service)	25 kn
(maximum)	28 kn
Construction	Marine-grade aluminium
Flag	Australia
Class/Survey	NSCV Class 1C/1D

25 m Catamaran Research Vessel *807* from Incat Crowther

Thailand's Department of Marine and Coastal Resources (DMCR) has taken delivery of a new state-of-the-art research vessel designed by Incat Crowther. The Incat Crowther 25, built by Thai shipbuilder Seacrest Marine, will be used by the DMCR to patrol Thailand's coastal environments and monitor the nation's fisheries and marine resources. Based on a proven Incat Crowther design, the 25 m catamaran has a range of innovative features and equipment to help its crew monitor and protect sensitive coastal areas while having minimal impact on the environment.

Designed to accommodate 12 crew and 16 passengers in six sleeping quarters, the main deck features three of the vessel's sleeping quarters, five bathrooms, a large mess, an outdoor dining area, galley and a conveniently-located storeroom.

The upper deck features an office and operations control room with a day head and an ensuite cabin for the captain. The large wheelhouse has been designed to optimise the captain's line-of-sight, while the upper deck also provides storage for a tender and jet ski—both readily available for fast deployment via a strategically-positioned crane. The hull features three crew cabins.

Tanapat Hemangkorn, Managing Director of Seacrest Marine, said that the on-time delivery of the new research vessel to the DMCR is testament to the cooperative and collaborative approach employed by Incat Crowther, Seacrest Marine and the DMCR.

"Incat Crowther's approach to digital shipbuilding helped support the success of this project from the bid stage all the way through to delivery. Seacrest Marine and Incat Crowther have a track record of successfully partnering on a range of projects, with the delivery of this vessel being the sixth Incat Crowther design, yet another example of our thriving partnership," said Mr. Hemangkorn.

Incat Crowther's Technical Manager, Dan Mace, said "Using a tried-and-tested design as a foundation, this vessel has been customised to the DMCR's unique coastal research and monitoring needs and integrates the latest technological advancements."

"The market-leading hull design, refined through extensive model tank testing, sets new standards for performance. With a propulsion system enabling maximum speeds of over 30 kn and efficient fuel consumption, this design also maximises operational efficiency without compromising performance," said Mr Mace.

Incat Crowther is proud to have worked with the DMCR for a second time, following the delivery of the Incat Crowther 26 Research Vessel *Pakarang* in 2019.

"We're excited to deliver to the DMCR another cutting-edge, tailored research vessel to support the important work of protecting Thailand's fisheries and marine resources. This project also continues our long and successful history working with the Government of Thailand, including delivering three vessels for the Royal Thai Marine Police," said Mr Mace.

Principal particulars of *807* are

Length OA	25.0 m
Length WL	24.8 m
Beam OA	9.50 m
Depth	3.95 m
Draft (hull)	2.22 m
Passengers	16
Crew	12
Fuel oil	7200 L 800 L day tank
Fresh water	4000 L
Sullage	200 L
Main engines	2×MTU 12V2000 M96 each 1342 kW @ 2450 rpm
Propulsion	2×propellers
Generators	2×Deutz BF 4M 1013MC each 97 ekW
Speed (service)	20 kn
(maximum)	30 kn
Construction	Marine-grade aluminium
Flag	Thailand
Class/Survey	LR SSC Patrol G2A

Stewart Marler

Port bow of *807*
(Photo courtesy Incat Crowther)

Main deck mess on *807*
(Photo courtesy Incat Crowther)

Cruising in NSW

The summer season continued through late February with visits by *Viking Sky, Disney Wonder, Carnival Splendor, Resilient Lady, Viking Neptune, Royal Prncess, Seabourn Sojourn, Queen Elizabeth, Ovation of the Seas, Seabourn Odyssey, Insignia, Arcadia, Majestic Princess, Silver Shadow, Ambience, Celebrity Edge, Queen Mary 2, Viking Orion, Borealis, Coral Princess, Azamara Onward and Seven Seas Mariner.*

The season wound down through autumn, with return visits in March by many of these vessels plus visits by *Volendam, Queen Victoria, Norwegian Spirit, Silver Muse, Europa 2, Serenade of the Seas, Noordam, Costa Deliziosa, Regatta, Crystal Serenity, Pacific Adventure, Brilliance of the Seas, Nautica* and *Grand Princess.*

April saw return visits by some of these vessels and added visits by *Celebrity Solstice,* and *Scenic Eclipse II,* while May saw only return visits and the addition of *Pacific Explorer.*

Pacific Adventure, Pacific Explorer, Carnival Splendor and *Coral Princess* are scheduled for cruises over the winter months, the increasing number (up from two a few years ago) being indicative of the increasing demand for winter cruises. The arrival of *The World* on 7 October and *Carnival Luminosa* on 12 October will signal the start of the next summer season.

Cruise vessels operating out of Sydney and Melbourne have continued to call at Eden, NSW, with vessels berthing at the Cruise Ship Wharf and passengers going ashore to visit local sights, shops and museums.

Viking Neptune, Seabourn Odyssey, Silver Shadow, Celebrity Edge, Azamara Onward, and *Majestic Princess* visited in late February.

March saw return visits by a few of these vessels and added visits by *Norwegian Spirit* (twice)*, Celebrity Edge, Grand princess, Crystal Serenity, Nautica* and *Resilient Lady*, while April added a lone visit by *Pacific Adventure* and the winter layoff began. The arrival of *Disney Wonder* on 30 October will signal the start of the next summer season in Eden.

Phil Helmore

Disney Wonder departing Sydney on a January cruise
(Photo John Jeremy)

Norwegian Spirit berthed at the Eden Cruise Ship Wharf on 27 March
(Photo courtesy Robert Whiter)

The Impacts of Operational Environments on Blast Survivability and Operability Performance

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Roberto Ojeda[2], Rouzbeh Abbassi[3]
Defence Science and Technology Group, Department of Defence, Australia[1]
Australian Maritime College, University of Tasmania, and Defence Materials Technology Centre Limited [2]
Macquarie University[3]

ABSTRACT

Modern naval surface combatants are now designed to operate for 30 years at higher utilisation rates driven by growing operational requirements. The prolonged operational lifespan and requirements expose the vessel to various oceanographic zones and demanding missions, elevating the risk of material fatigue and operability performance. Although material fatigue is unlikely to cause catastrophic structural failure when proper maintenance is employed, it may reduce blast survivability. The study focuses on the exemplary vessel DTMB-5415 to investigate the interplay between operational environment on material fatigue, blast survivability and operability. The vessel operated in three distinct oceanographic areas representing different sea-state levels, encompassing Northern Australia, the Southern Oceans, and Ocean Areas around Australia.

The study utilises the rapid life-of-type and blast-loading models developed by the Australian Maritime College and Defence Materials Technology Centre Limited. These models are integrated with Defence Science and Technology Group's platform performance modelling and analysis tool, InteShip. InteShip facilitates comprehensive performance assessments, trade-offs in platform designs, and insights into the intricate interactions between sub-systems and performance requirements against objective performance measures. InteShips' holistic perspective sheds light on the implications of operational environments impacting blast survivability and operability performance. By considering these impacts within the ship's operational environment, naval architects can ensure sustained mission capability, bolster operational readiness, and effectively meet the evolving demands of modern naval operations.

INTRODUCTION

Modern naval combat ships represent highly-advanced and sophisticated military platforms which operate in complex and dynamic environments, carrying out diverse missions involving unconventional and conventional threats. As military platforms, they are inherently vulnerable to air or underwater weapon threats which have the potential to inflict fatal damage to the crew and the ship, impeding their mission-execution capabilities. Additionally, material fatigue becomes a growing threat with the increased use of higher-strength steels, operational lifespan, and utilisation rates. Moreover, rapidly changing mission requirements further strain the ship's structure and systems, potentially accelerating material fatigue. Although engineers and designers address these challenges, further research and development are necessary to prevent and mitigate material fatigue's effects on blast loads for surface combatants. Identifying practical solutions to improve ship safety, reliability, and availability is of concern [1].

Magoga *et al*. [2] have recently revealed significant deviations from the initially planned usage patterns of naval platforms, with these vessels being utilised more frequently and for extended durations. This increased operational tempo has substantial implications for the structural integrity of these platforms. The Royal Australian Navy has encountered challenges, as highlighted in the Rizzo Report [3], including the early decommissioning of HMAS *Manoora* and a culture prioritising short-term operational objectives over technical and structural integrity. Furthermore, delays in developing replacement platforms have necessitated life-of-type extension (LOTE) programs for existing vessels, as emphasised in The Defence Strategic Review [4]. Given these circumstances, assessing the impact of structural aging on these ships is of growing importance. Such evaluations are vital for determining whether the vessel can remain "fit-for-purpose" for future modifications and retain operational flexibility to adapt to rapidly-changing mission requirements.

Structural degradation in aging vessels is attributed mainly to fatigue induced by variable loading conditions. The stress magnitudes in these loading cycles can vary significantly for naval platforms, and the expected total number of loading cycles can range from 10^7 to 10^8 [5]. The accumulation of such a substantial number of loading cycles can result in progressive cracking of structural components. These cracks can ultimately lead to catastrophic failure if left undetected or unaddressed. Therefore, to ensure the vessel's physical and operational availability, naval architects must consider the effects of material fatigue on the structure from the early concept phase and throughout the in-service phase.

Understanding fatigue life in conventional failure modes of naval structures is well-established. However, there is a need to explore how fatigue life influences unconventional failure modes, particularly the effects of high-strain rate blasts on fatigued components, which pose a significant threat to naval surface combatants and crew. In the context of blast events, the primary objective of platform structures is to contain the blast within the affected compartments and prevent the blast overpressure from damaging adjacent compartments. However, fatigue cracks in the structure can significantly affect its ability to withstand and contain the blast, which may substantially impact its survivability. To bridge this knowledge gap and account for the influence of fatigue cracks on blast survivability, Clayton [6] developed a numeric modelling tool. This tool assesses the reduced capacity of a fatigued panel after a blast, improving naval combatant design and crew safety against unconventional threats.

In collaboration with Defence Materials Technology Centre Limited, the tool has been further enhanced to incorporate

Life-of-Type (L-o-T) assessment capabilities. L-o-T assessment estimates a ship's operational relevance and value over its lifespan in naval operations. It considers various factors, including fatigue life, blast resistance, and the associated costs of repairing or replacing damaged components. Preserving naval vessels' availability and structural integrity relies on proper design and maintenance practices. The L-o-T tool facilitates the evaluation of these factors, supporting decision-making processes related to ship maintenance and mission readiness.

InteShip [7, 8] is a comprehensive modelling and simulation framework which provides a holistic view of ship systems. It offers a robust platform for analysing and understanding the performance measures of ship systems and identifying inter-dependencies in dynamic environments. By considering the ship as a complex system, InteShip enables a better understanding of trade-offs between different design choices and facilitates the development of more effective solutions, bolstering improved recommendations. InteShip facilitates integrating various ship systems, such as resistance, stability, propulsion, range, and structure. Previous research [2, 9, 10] has demonstrated the effectiveness of InteShip in providing valuable recommendations and insights.

InteShip has progressed with integrating the L-o-T tool with the benefits of using frequency-domain programs to obtain load responses. Within InteShip, a design environment was constructed to investigate the impact of operational conditions on fatigue growth and blast survivability, as well as the ship's capacity to operate in Australian coastal waters during transit, helicopter, and replenishment-at-sea (RAS) operations. This research aims to identify optimal design choices and operational strategies to enhance naval surface combatants' overall availability, longevity, and mission readiness.

VESSEL SPECIFICATIONS

This study focuses on the David Taylor Model Basin (DTMB) model 5415, a scaled-down version of a modern naval monohull frigate, as shown in Figure 1. The hull design of the model features a sonar dome, transom stern, two bilge keels, fin stabilisers, and rudder appendages.

Figure 1: The DTMB 5415 hullform is shown with highlighted appendages. Bilge keels are marked in teal, drive shafts in red and rudders in yellow [11]

Table 1 contains comprehensive details of the primary characteristics of the hull, while Figure 2 demonstrates the estimated mass distribution of a full-scale model hullform based on Sun *et al.*[12].

Table 1 Principal characteristics for the selected DTMB 5415 hullform [12]

Parameter	Value	Parameter	Value
Length between perpendiculars	142 m	Midship section coefficient	0.821
Beam	20.03 m	LCB (fwd of AP)	70.03 m
Draft	6.31 m	LCG (fwd of AP)	70.35 m
Volumetric displacement	9032 m^3	Metacentric height	3.187 m
Wetted surface area	2973 m^2	Roll radius of gyration	7.05 m
Block coefficient	0.4909	Yaw radius of gyration	35.5 m

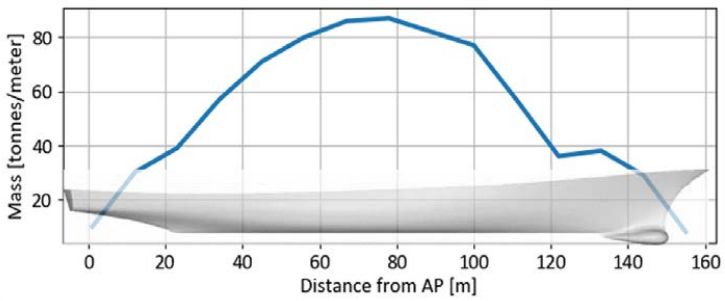

Figure 2: Weight distribution of the DTMB hullform in intact stability, with hullform overlayed [12]

LIFE-OF-TYPE MODELS

Cyclic Loading

The cyclic loading model predicts the number and magnitude of cyclic loads on a ship's hull girder over its operational lifespan. Probabilistic methods developed by Sikora *et al*. [5] are utilised to estimate the lifetime exceedance load spectra. The operational life of a ship considers various factors, such as the operational profile and environment. The load responses are obtained for each short-term distribution through analytical or algorithmic methods. The vessel's response spectrum is assumed linear to the encounter sea state and is modelled by the Rayleigh distribution. The measured count and magnitude of the response spectrum are taken as m_0, the zeroth order moment under this distribution, as shown in Eq. 1.

$$P(X > x) = exp^{\left(-\frac{x^2}{2m_0}\right)} \quad \textit{Eq. 1}$$

Where x is the expected vertical bending moment, and X is a random variable. The model considers load contributions from low-frequency wave-induced events and high-frequency slamming events [13].

Fracture Mechanics

The fracture mechanics model predicts the growth rate of a crack that has already been initiated if the material in use has a linear elastic behaviour. The growth rate is measured using the Paris-Erdogan equation, as shown in Eq. 2, which quantifies the change in crack length.

$$\frac{da}{dN} = C\left(\Delta\sigma Y\sqrt{\pi a}\right)^m \quad \textit{Eq. 2}$$

The change in the bending stress range is denoted by increments of $\Delta\sigma$. The change in the expected number of stress cycles is represented by N. The current crack size is indicated by a, and Y is the geometry constant associated with the crack growth rate with respect to crack length and the material constants C and m govern the characteristics and sensitivity of crack growth behaviour. The elastic flexure formula, shown in Eq. 3, measures the change in nominal bending stress. Additionally, the material should not be stressed beyond its proportional limits.

$$\sigma_{max} = \frac{My}{I} \quad \textit{Eq. 3}$$

Where M is the calculated vertical bending moment found in the cyclic loading model, y is the distance to the neutral axis, and I is the vertical moment of inertia. Based on shipyard repair data [14], it has been determined that a ship's hull can develop cracks at any point during its lifespan. Probability distributions were used to identify the most likely time of cracks initiating. The two-parameter Weibull distribution was the best fit with alpha and beta behaviour parameters set to 1.8 and 13, respectively. Eq. 4 demonstrates the relationship between time, alpha, and beta regarding the time it takes for a crack to form.

$$f(t_i) = \frac{\alpha}{\beta}\left(\frac{t_i}{\beta}\right)^{\alpha-1} e^{\left[-\left(\frac{t_i}{\beta}\right)^{\alpha}\right]} \quad \textit{Eq. 4}$$

Blast Survivability

The blast survivability model is based on research by Clayton [6], which estimates the blast size required to fracture a panel. The model utilises a multilayer perception classifier Neural Network [15], which quickly interpolates a set of inputs onto a numerical simulation output database. This database predicts the necessary blast magnitude for plate fracture at a given confidence interval while considering various factors such as crack length, charge size and stand-off distance. The placement of the panel at the keel amidships on the vessel is strategically chosen since localised stress amplitudes are known to be the highest in that area. This positioning increases the probability of fatigue crack formation due to the higher stress levels experienced in that region.

Panel Specifications

The generic stiffened panel developed by Clayton [6] was based on the experiments performed by Houlston and DesRochers [16]. Figure 3 presents the specifications and intricacies of the scantlings.

The panels' mesh consisted of 345 000 elements of 17.5 mm non-crack elements and three element divisions through the thickness of the plate as a result of convergence studies. The initial length of the crack is set to 4 mm, just below the 5 mm threshold detectable by the human eye as suggested by [17].

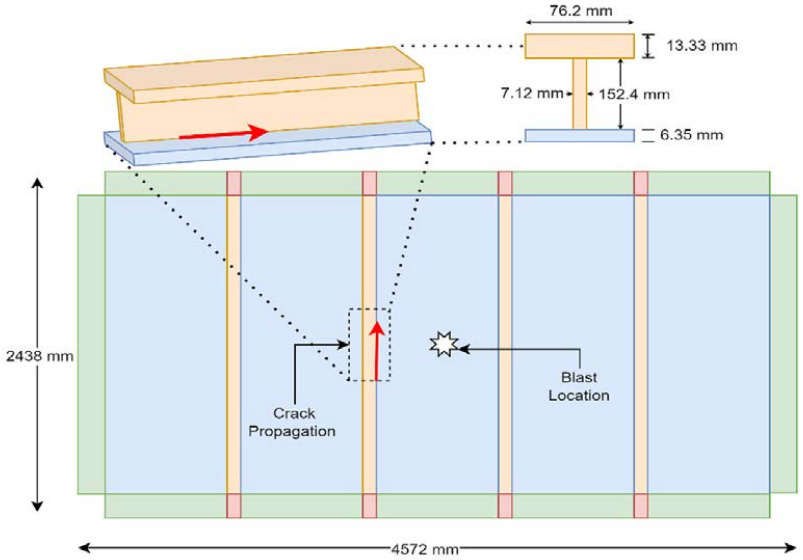

Figure 3: Generic stiffened panel is shown with highlighted components. The panel is marked in blue, stiffeners in orange, boundary material in green, and combined welded boundary in red—a snapshot showing the crack's location and propagating direction is produced

SEAKEEPING MODELS

Seakeeping Operability

Seakeeping operability models produce an operability measure between 0 and 1 for a ship's performance in specific operating contexts. Mission-based context includes transiting, RAS, helicopter operations, and work and accommodation. The metrics used for some mission-based criteria include measuring the count of occurrences of deck wetness, slamming, keel emergence, motion-induced interruptions (MII), vertical displacement, vertical velocity and acceleration, and lateral and longitudinal accelerations.

Seakeeping Load Responses

Seakeeping load response models use the frequency-domain program Shipmo7 [18] to develop a matrix of responses to different speed, heading and sea-sate conditions. The load prediction model evaluates the root-mean-square horizontal and vertical shear, bending, and torsion moments in irregular seas. This model is used as a plugin to the fatigue life model.

MODEL FRAMEWORK

The InteShip Model Repository has been utilised for constructing a simulation workflow to model relevant performance aspects of the vessel holistically. The models are set up in a design environment to quantifiably predict the effects of a vessel's operational profile and intensity on material fatigue, relative survivability, and operability performance; Figure 4 shows the simulation workflow. The design space considers various factors such as vessel size, weight distribution, loading conditions, environmental factors, and material properties to estimate the likelihood of unconventional fatigue-related failure.

SIMULATION SETTINGS

Wave Height Probability

The wave height probability tables are crucial in influencing the study's outcomes. These tables represent the likelihood or probability of significant wave heights occurring in each oceanographic zone. In this study, the wave tables used are prescribed in [19]. By utilising the wave height probability tables and defining the operational environments in different ocean areas, the study can accurately represent the expected wave conditions and their variability. Figure 5 (left) displays the wave height probability distribution for selected operational environments using a Bretschneider wave spectrum model. The zones and annual mean sea-state for each operating environment are shown in Figure 5 (right).

Operational Profile

The ship's operational profile defines the specific set of conditions in which it is designed to operate. This profile outlines the ship's likelihood of operating at different speeds and headings in a prevailing sea state. The profile distributions become narrower and more focused at extreme operating conditions, guided by the decisions made by captains or ship operators. This study references the empirical operational profile of a standard frigate, as determined by [5]. By referencing this empirical profile, the study incorporates realistic operational constraints and aligns the simulations with actual ship operations.

Panel Material Properties

Similar to the study by Sun *et al.* [12], specific material properties have been specified for the panel being analysed. These properties include the moments of inertia and neutral axis. The panel's local vertical moment of inertia is 28.96 m^4, with a neutral axis above the baseline of 6.57 m. Additionally, the vertical and longitudinal locations of the panel are given as 0 and 72 m, respectively (fwd of AP). The chosen material for the panel is high-quality ABS-graded DH36 strength steel.

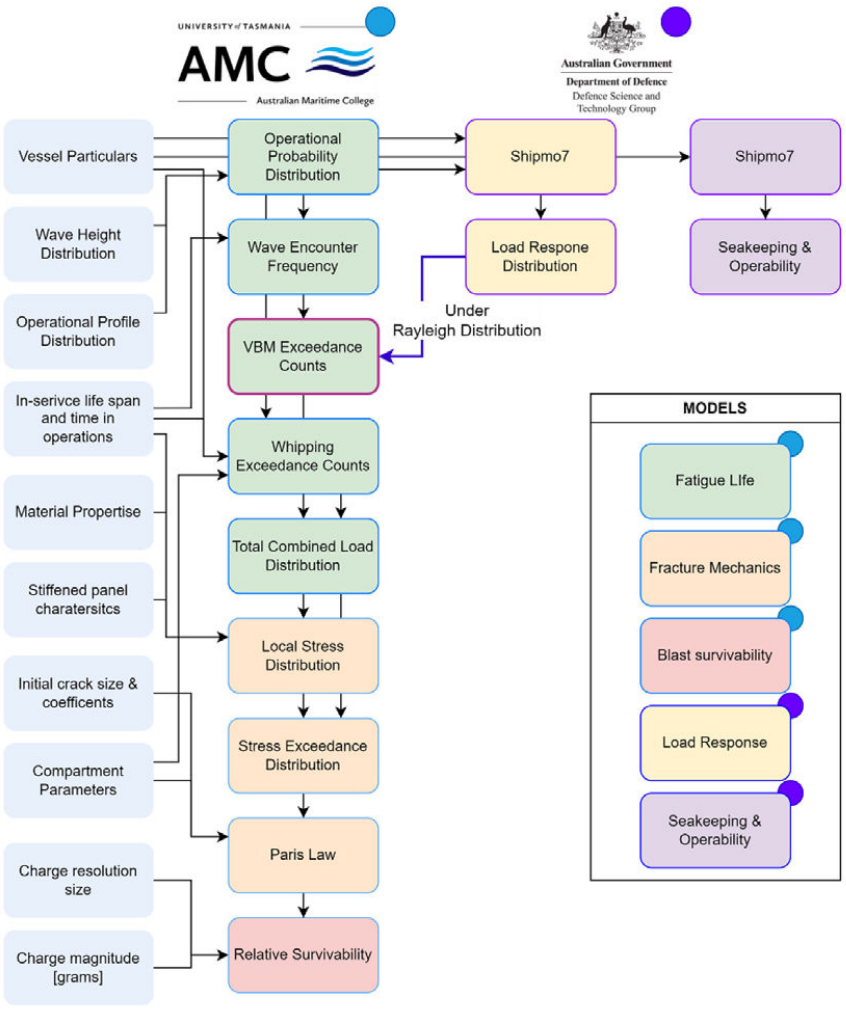

Figure 4: Flow diagram of the information exchange between models. Light Blue squares represent input parameters

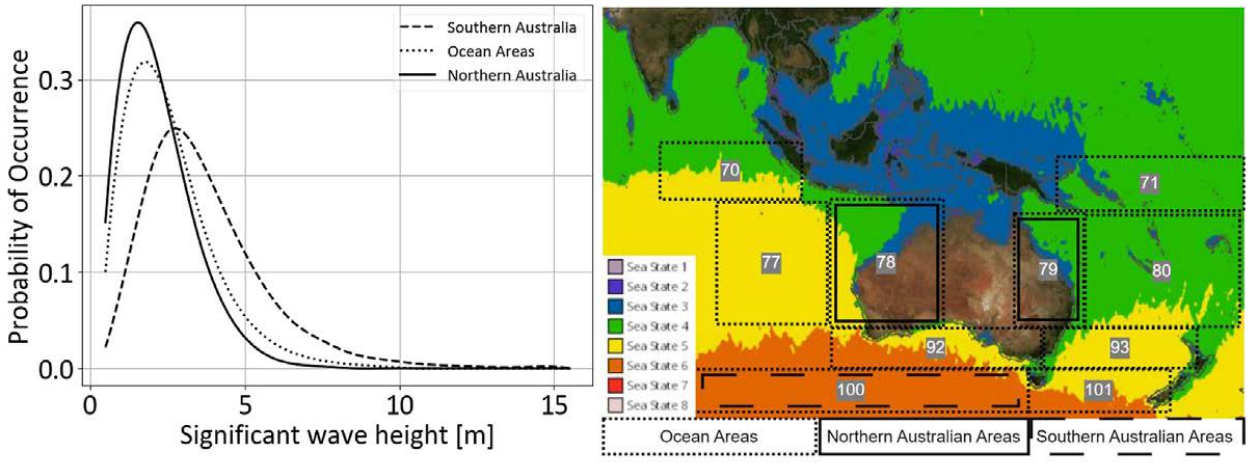

Figure 5: Significant wave height observed record distributions (left). Annual significant wave heights around Australia's coastal oceans with markings highlighting the areas of operation for the three operating profiles (right)

This type of steel typically exhibits a yield stress ranging from 355 MPa to 460 MPa. The constants m, c and Y used in the Paris law Eq. 2 are specified as 3, 7.49^{-9} mm/(cycles $*$ MPa $*$ $m^{0.5}$) and 1 [20].

Seakeeping and Operability

The operability model settings have four conditions with specific criteria, locations, sea states, and speeds. The data table of these settings is shown in Table 2 and Table 3.

Table 2 Criteria for calculating the operability index specified [19]

Operation	Criteria	Label	Sea State	U_S (knots)
Transit	Deck wetness < 30 events/hour MII: 1 events/min Slamming < 20 events/hour Emergence < 90 events/hour	A B C D	Bretschneider	5
Helicopter	Vertical velocity < 2.0 m/s Vertical acceleration < 2.0 m/s^2 Lateral acceleration < 1.2 m/s^2	G G G		15 25
Replenishment at Sea	Deck wetness < 0.5 events/min MII < 0.5 events/min	E, F E, F		

Table 3 Operability locations

Location	Label	X [m]	Y [m]	Z [m]	Z deck [m]
Bridge	A	99.4	7	21	20
Foredeck	B	142	0	15	14
Keel	C	113.6	0	0	0
Propeller	D	11.7	5	1.8	1.8
RAS 1	E	113.6	4.5	15	14
RAS 2	F	113.6	7.5	12	11
Flight deck	G	13.5	0	11	10

RESULTS

Cyclic Loading

The endurance of structures under a higher count of significant stresses is primarily affected by the energy level of the operating environment's wave system and the duration actively spent performing operations. In the Southern Ocean zones of Australia, the exceedance curve is consistently higher than in the Northern and Ocean Areas, which implies that this environment reduces the structural integrity faster, and in turn, structural availability. However, the hours spent performing operations do not significantly affect the severity of the moment and stress exceedance curves, as demonstrated in Figure 6. The curves suggest a power-law correlation between the anticipated magnitudes and the likelihood of exceeding them. This pattern is also evident in the measured stresses, as the elastic flexure formula is used, with only the induced vertical bending moment varying.

Crack Propagation

In Figure 7, a comparison of crack growth rates in three different operating environments and time spent in operations is made. The crack growth rates range from 4 to 40 mm, and the time spent in operations ranges from 2500 to 3600 hours per year. Each environment has a unique spectral energy profile which significantly impacts the ship's lifetime fatigue.

Fracture-mechanics modelling reveals that, when operating in southern Australian waters for 3500 hours per year, a crack reaches its maximum length of 40 mm after approximately 11 years. In Ocean Areas, it takes around 18 years; in Northern Australian waters, it takes approximately 23 years to reach the same maximum crack length. However, suppose the operating rate is lower at 2500 hours per year. In that case, the time span changes to approximately 16 years in Southern Australian waters, 26 years in Ocean Areas, and 33 years in Northern Australian waters. It is important to note that the growth rate of the crack is influenced by the mean stress effect, where higher mean stresses lead to an accelerated crack growth rate. This means that each operating environment experiences a change in growth rate of approximately 30% compared to the others. While the growth curves are similar in shape, the slope varies depending on the operating environment.

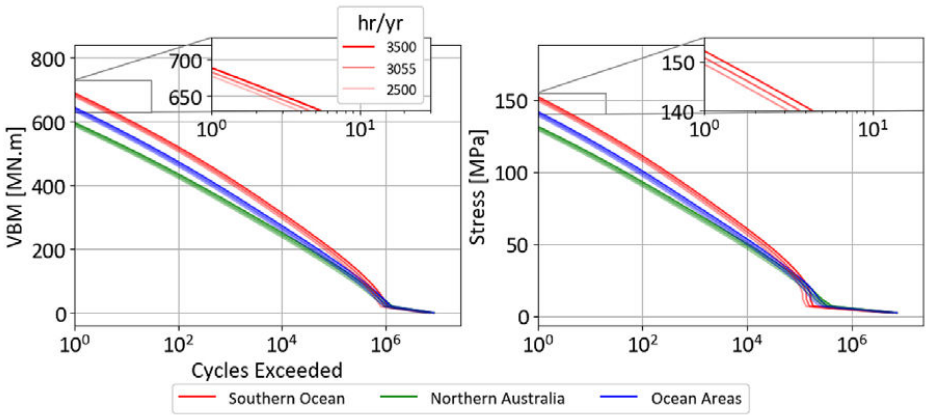

Figure 6: Lifetime exceedance curve of a ship's operating environment's vertical bending moments (left) and local stress (right)

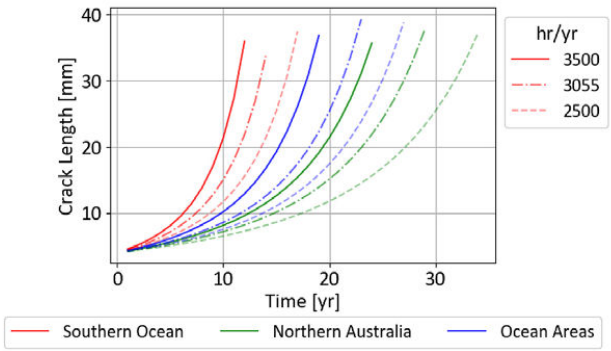

Figure 7: Crack length propagation per year of operation for varying times spent in three different environments

Survivability.

Charge Size

Figure 8 shows the blast survivability model results, which were trained using numerical investigations and validated with experimental results [6]. The model shows a reduction in blast survivability of a ship's panel with increasing operational time, given that a fatigue crack is present. Failure of a ship's structure is defined as a fracture occurring in the panel's plate section rather than a stiffener's failure, which prevents the blast from propagating to neighbouring compartments. The numerical investigations involved subjecting a stiffened panel to increasing sizes of explosive charges ranging from 2–40 kg of TNT at two stand-off distances: 300 mm and 1000 mm. The results of an initiated through-thickness crack of 4 mm when subjected to a blast 1000 mm away from the keel amidships has a 95 % chance of panel failure when the charge size reaches approximately 27.6 kg. Additionally, plate failure can occur at a stand-off distance of 300 mm with a charge size of around 7 kg.

If the panel is left unrepaired or unaltered for five years, the threshold charge size which leads to plate failure decreases. The reduced threshold charge size in Southern Australian waters is approximately 24.9 kg, while in Northern Australian waters, it is approximately 26.8 kg. Similarly, the corresponding values for the charge size at a stand-off distance of 300 mm are approximately 6.3 kg and 6.6 kg, respectively. In Ocean areas, the threshold charge size for plate failure is further reduced to approximately 26.4 kg and 6.55 kg. The difference in charge size between regions indicates that the crack growth rate plays a crucial role in the rate of reduced survivability.

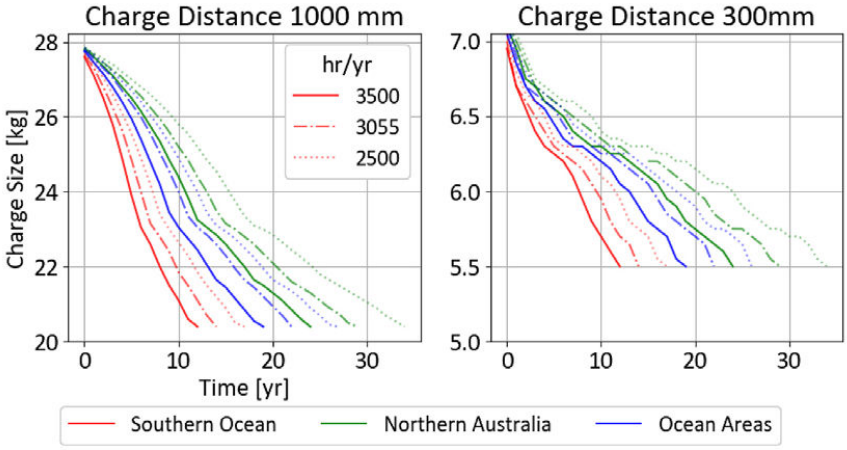

Figure 8: Charge size in kg to cause panel failure at (LEFT) charge distance of 1000 mm and (RIGHT) 300 mm

As the crack length increases over time, the magnitude of the charge size required to cause plate failure steadily decreases. It is essential to note that the specific effect of charge size and crack length on plate failure highly depends on the vessel's waters. The operating environment significantly influences the crack growth rate and, subsequently, the vulnerability of the panel to blast loads. Thus, understanding the characteristics of the operational waters is critical in accurately assessing the risk of plate failure and determining the appropriate measures for maintaining the structural integrity and survivability of the naval vessel.

Loss of Relative Survivability

Survivability of a ship's structure is defined as the charge weight to cause failure for a given crack length at a given charge standoff. The survivability has been made relative to the survivability for a 4 mm crack. The loss of survivability plots shown in Figure 9 allows designers to rank the performance of different designs against one another.

As the crack size increases due to prolonged exposure at sea, the likelihood of surviving a blast event decreases for both charge distances considered. Moreover, more operational hours per year result in a more rapid decline in relative blast survivability. When analysing the trend for a charge distance of 1000 mm, it is observed that an increase in operational hours per year, combined with a growing crack size, leads to a notable reduction in relative survivability. This indicates that the crack size significantly influences the likelihood of panel failure under blast loads. On the other hand, for a charge distance of 300 mm, the trend shows a swift decrease in survivability during the initial six years after crack initiation, with less dependence on the operational hours per year. This suggests that the smaller the scaled distance, the more likely an uncracked panel will fail. Therefore, the sensitivity of survivability on the crack length decreases.

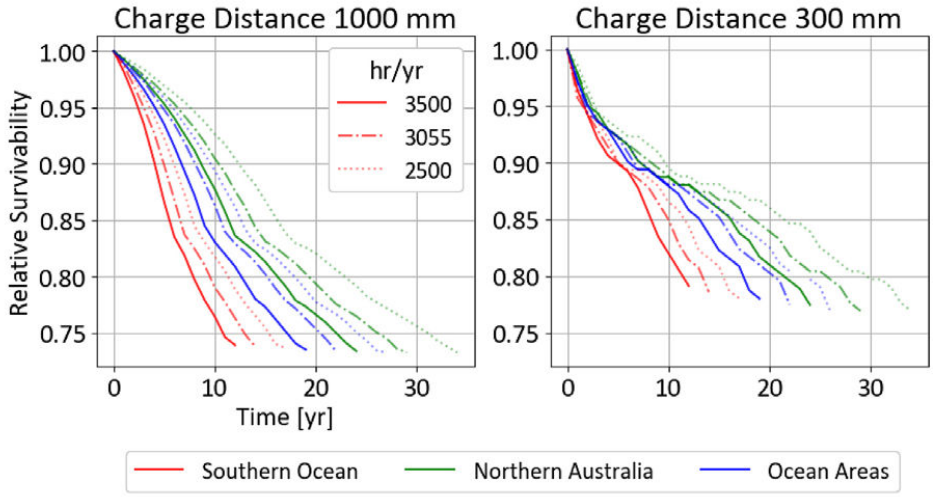

Figure 9: The loss of survivability of the panel subjected to blast loads for each operating environment relative to the initial condition

Beyond the initial response, the trends align with the 1000 mm charge distance observations, where blast survivability diminishes rapidly with increasing operational hours per year. The disparity in the percentage change in blast size required to induce plate failure underscores the criticality of scheduled maintenance and repair for naval vessels. It emphasises the need for tailored maintenance strategies which account for the specific operating region of the ship. The maintenance efforts should be aligned with the operational environment to address the challenges posed by crack growth and blast resistance, ultimately ensuring the vessel's structural integrity and operational effectiveness. Naval engineers and maintenance crews can develop targeted maintenance schedules and practices by investigating and understanding the specific dynamics of crack growth, blast loads, and maintenance requirements in different operational regions. This approach will enable them to effectively manage and mitigate the risk of plate failure, enhance the survivability of naval vessels, and extend their operational lifespans.

Operability

The effects of the operating environment impacting blast survivability and the potential impacts in performing operations in different sea conditions must be considered. The operating environment affects operability performances which are measured by an operability score. The score is calculated on a scale from 0 to 1.

When assessing the measured cumulative operability score from the operability model, all operations achieve the highest operability score in the Northern Australian waters, driven by the relatively lower significant wave heights. When operating in Ocean Areas, a slightly more significant reduction in operability is measured due to the minimal change in the significant wave height median point. The lowest operability score was calculated when operating in Southern Australian waters, with a substantial drop for all three operations, with the least favourable score of 0.92 when performing replenishment-at-sea (RAS) operations and 0.96 when transiting in the Southern Ocean, as depicted in Figure 10.

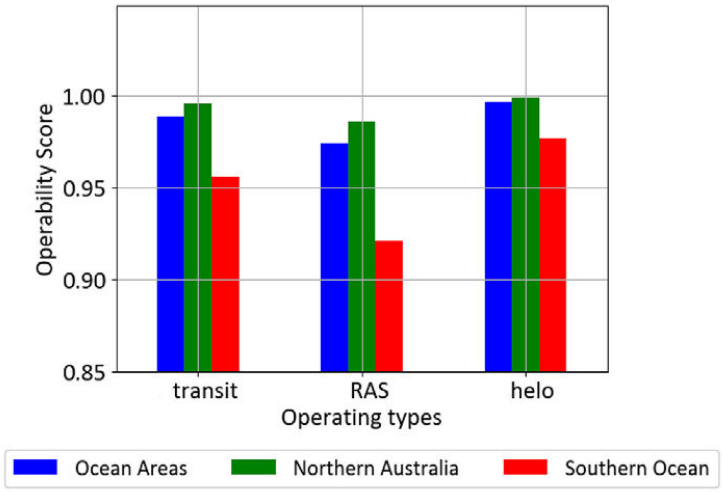

Figure 10: Comparison of the operability score in three different environmental conditions

The lower operability scores in RAS operations indicate a reduced ability to conduct efficient and effective replenishment activities in challenging oceanographic conditions, particularly in the Southern Ocean. Factors such as increased motion-induced interruptions and the likelihood of deck wetness events contribute to the lower cumulative score, highlighting the operational challenges and limitations in those specific operating environments.

DISCUSSION AND CONCLUSION

A time and cost-effective tool for assessing the L-o-T for naval ships has been successfully integrated into a holistic design environment. This integration involved introducing additional complexities to enable designers and evaluators to analytically determine ship load responses, considering specific information about the ship, such as offsets, hull shape, and mass distribution. A simulation workflow and design environment were constructed within InteShip, which facilitated connectivity with other seakeeping models available in the repository. This integration gave a comprehensive understanding of the intricate relationships between operational conditions, material fatigue, relative survivability and performance aspects for operability, promoting a holistic approach to ship design and evaluation. Furthermore, using InteShip demonstrated a capability to assess platform performance measures. By leveraging the tool's functionalities, naval architects and engineers can efficiently evaluate and analyse the performance of naval ships across different operational scenarios and environmental conditions.

The investigation found that operating under more severe environmental conditions without adapting the operating profile results in drastic changes in the structural integrity of a panel which starts with a 4 mm crack and relative survival from unconventional loading events. Also, minor changes in performing operations at sea are measured. The models predict that operating in Southern Australian waters significantly affects material fatigue and operability performance. Operating for 12.5 years results in a drop of 16% in the panel's relative survivability. Likewise, operating in Ocean watrs showed a reduction in relative survivability of 7%—and a 5% reduction in Northern Australian waters. The cumulative operability scores show a relatively significant difference when comparing Southern Australian to Ocean and Northern Australian environments to meet the operability score of 1. Transit operations in Southern Australian waters showed a reduction in operability of 4%, 8% for RAS and 2% for helicopter operations. From these results, it is essential to take a holistic approach to mitigate the effects of material fatigue on ships, coupled with the impacts on performing operations in Australian waters.

It is crucial to consider the spectral energy response of the ship from the input wave system and operating profile when designing a ship to ensure the physical and operational availability, longevity, and safety. By considering the crack's growth rate and anticipated operating conditions, naval architects and engineers can make informed decisions regarding design modifications, and operational strategies. This knowledge enables the development of tailored solutions to mitigate the risk of plate failure and enhance naval surface combatants' overall blast resistance and survivability in specific ocean areas. Even a tiny crack can significantly compromise the blast performance of the panel during the first six years of operation following its formation. Monitoring and addressing crack growth during this early period is essential to ensure the panels' structural integrity, blast resistance and safety for the on-board crew.

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This paper was presented at the Indo Pacific International Maritime Conference 2023 (IMC2023) and was awarded the Bob Campbell Prize for best written paper and presentaion at the Conference.

The Anzac-class frigate HMAS *Stuart* pushing a sea aside during officer-of-the-watch manoeuvres with HMAS *Warramunga* off the WA coast. *Stuart* returned to sea on 29 January 2024 after nearly three years, having undergone substantial upgrades under the Anzac Midlife Capability Assurance Program (AMCAP). AMCAP is an ongoing upgrade which focuses on updating ageing platform systems, communications, installation of a long-range air-search radar and general maintenance. *Warramunga* is the sixth of eight Anzac-class frigates to undergo the AMCAP upgrade program
(RAN photograph)

HMAS *Adelaide* recently conducted the first Landing Helicopter Dock-sized berthing alongside the brand-new Kuru Wharf at HMAS *Coonawarra*, Darwin. This event marks a significant achievement in the ongoing upgrades of waterfront facilities at the Larrakeyah Defence Precinct. The Kuru Wharf measures approximately 250 m in length, with two approach jetties. The new wharf is now able to support up to LHD-size naval vessels, providing game-changing capability support in the north
(RAN photograph)

INDUSTRY NEWS

Digital Technology and the Hunter-class Frigate Program

Adelaide manufacturer MG Engineering is constructing bulkheads and side shell panels which join together to form the exteriors of Hunter-class frigate blocks.

A digital 'thread' linking the company's manufacturing facilities and BAE Systems' operations at Osborne enables the MG Engineering team to complete the initial construction of each section of the ship before it reaches the shipyard.

This build process tests MG Engineering's capabilities and fosters its alignment with the Hunter program's systems and manufacturing processes. This both reduces production risks and enhances production by using an alternative site and workforce to deliver ship sections when the Osborne Naval Shipyard is at full capacity.

The side shells, each weighing in excess of 10 t, will be delivered to Osborne and installed on the Hunter program's fourth prototype block prior to it undergoing abrasive blasting and painting.

BAE Systems Maritime Australia appointed MG Engineering and Century Engineering to the Strategic Supplier Panel as part of a pilot program for the integration of production methods, processes and technologies to drive greater efficiencies and collaborative working relationships.

Anschütz Passes Design Milestone in the Hunter-class Frigate Program

Anschütz was selected as the supplier of Warship Integrated Navigation and Bridge Systems (WINBS) for the Australian Hunter-class frigates in 2021. At the end of 2023, the design and manufacturing contract for three ships and a land-based test system was placed. Anschütz, in partnership with Raytheon Australia, has now passed the System Design Review closure (SDRc).

The WINBS are tailor-made for the Hunter-class program and include multifunctional consoles for warship electronic-chart display and information systems as well as a unique naval radar capability, combining navigational and tactical features with unsurpassed situational awareness. Additionally, the WINBS are integrated with steering-gear control systems and the customer-specific combat-management systems.

Not only are the WINBS characterised by the system-wide use of consistent and validated data, but they also have user-friendly and intuitive user interfaces as well as extensive functions for tactical navigation and safe operations at sea. The intelligent and sustainable system architecture combines safety standards and integrated redundancies with efficiency on board and ashore.

Currently, Anschütz' WINBS have been selected for the integrated navigation and bridge systems of large naval surface combatant program, including the Royal Navy's Type 26 and Type 31e classes, the German K130 and F125 classes, and the Brazilian Tamandaré program.

Netherlands Defence Ministry Selects French Design for Replacement Submarines

The Dutch Ministry of Defence has awarded the French shipbuilder Naval Group a preliminary contract for the design and construction of new submarines for the Royal Netherlands Navy.

The submarines will be diesel-electric powered variants of the nuclear-powered Barracuda-class boats originally developed by Naval Group for the French Navy.

The four submarines to be built by Naval Group will be known as the Orka-class in Dutch service. Each will have a displacement of 3300 t, a length of 82 m, a hull diameter of 8.2 m, a range of 15 000 n miles, space for up to 43 crew members, and torpedo and cruise missile armament.

The propulsion system will also include lithium-ion batteries.

The Orka-class submarines will replace the Royal Netherlands Navy's ageing Walrus-class boats, which were originally designed in the late 1980s.

In March Naval Group also signed a contract for the supply of two Scorpène-class evolved full lithium-ion battery submarines for the Indonesian Navy. The submarines will be built in Indonesia by Naval Group's partner PT Pal.

In addition to these two Indonesian Scorpène-class submarines, 14 other units designed and adapted by Naval Group for the export market are in operational service or under construction around the world.

These include two submarines for the Chilean Navy, two for the Malaysian Navy, four for the Brazilian Navy and six for the Indian Navy. Recently, the third Scorpène-class submarine for the Brazilian Navy was launched at the Itaguaí Naval base.

Austal Confirms Receipt of Unsolicited, Conditional, Non-Binding Indicative Proposal from Hanwha

On 2 April Austal confirmed that it had received an unsolicited, conditional and non-binding indicative proposal from Hanwha Ocean Co. Ltd (Hanwha) to acquire Austal by way of a scheme of arrangement (Indicative Proposal). Under the Indicative Proposal, Austal shareholders would receive $2.825 cash per Austal share.

Hanwha's Indicative Proposal is subject to numerous conditions, including due diligence, various regulatory approvals including Australia's Foreign Investment Review Board (FIRB), the Committee on Foreign Investment in the United States (CFIUS) and the US Defense Counterintelligence and Security Agency, final approval of the Hanwha Board, the unanimous recommendation of the Austal Board, and Austal shareholder approval.

In a press release, Austal stated that it invests considerable time and resources into deciding whether it should grant a potential purchaser access to the company's otherwise confidential detailed financial records, forecasts and contracts as part of a due diligence process.

In doing so, it assesses a range of factors, including but not limited to the potential for shareholder value creation, competition concerns and a potential purchaser's ability to ultimately complete a transaction (which would include necessary government approvals). This latter consideration is particularly relevant in relation to the proposal from Hanwha, given Austal's position as the designer and builder of defence vessels for the Australian and US navies and ownership clauses associated with defence contracts. Austal also notes the announcement by the Australian Government on 23 November 2023 that Austal and the Department of Defence had executed a Memorandum of Understanding (MoU) to negotiate a Strategic Shipbuilding Agreement (SSA), under which Austal would be appointed as the Commonwealth's strategic partner for vessels to be constructed in Western Australia.

In announcing the MoU for the SSA, the Commonwealth Department of Defence noted that "a sovereign and enduring naval shipbuilding and sustainment industry at Henderson is central to the Government's commitment to ensuring continuous naval shipbuilding in Australia and delivering the capabilities needed to keep Australians safe."

The Austal Board, together with its advisers, has considered the Indicative Proposal in detail and engaged with Hanwha in relation to whether the transaction described in the Indicative Proposal would obtain the relevant regulatory approvals in Australia and the USA to enable it to proceed. At present Austal is not satisfied that these mandatory approvals would be secured; however, the company is open to further engagement if Hanwha is able to provide certainty on whether a transaction would be approved.

On 1 May, in response to a question from a journalist, the Minister for Defence, the Hon. Richard Marles MP, stated "In respect of Austal. Look, ultimately, this is a matter for Austal. They are a private company. From the government's perspective, we don't have any concern about Hanwha moving in this direction. We have identified Austal as a strategic shipbuilder for Australia in WA. Wherever Austal goes, whatever it does, there will obviously need to be security arrangements put in place in respect of sensitive technologies and intellectual property which would have to be managed no matter what the future of Austal. And were there anything that were to transpire in relation to Hanwa that would need to be managed in that context as well. But fundamentally, this is a matter for Austal as a private company."

Wärtsilä 31 engines for Canadian Polar Icebreaker

Wärtsilä will supply the engines for a new Canadian Coast Guard Polar Icebreaker. The ship is being designed and built at Seaspan Vancouver Shipyards and will be the flagship of the Canadian Coast Guard's icebreaking fleet. Because of the long operational range required for the vessel's employment in arctic waters, fuel efficiency was a prime design consideration in the selection of the Wärtsilä 31 engine. The Wärtsilä 31 engine has been recognised by Guinness World Records as the world's most efficient four-stroke diesel engine and was therefore considered an obvious choice. The order was booked by Wärtsilä in the third quarter of 2023.

An impression of Canada's new Polar Icebreaker (Image courtesy Seaspan Shipyards)

The 158 m long multi-mission Polar Icebreaker will operate under PC2 conditions with four 16-cylinder and two 8-cylinder Wärtsilä 31 engines, delivering 47 MW of power. The engines will be fitted with Selective Catalytic Reduction (SCR) systems for IMO Tier III environmental compliance. Wärtsilä will also supply the centre shaft line with a stainless-steel ice-class propeller, as well as Wärtsilä's NACOS Platinum navigation system.

"Wärtsilä has a fine track record and years of experience in delivering high-class marine technologies, including recently delivering the propulsion equipment for the Offshore Fisheries Science Vessels (OFSV), plus the diesel generator sets for the Offshore Oceanographic Science Vessel (OOSV) built at Seaspan for the Canadian Coast Guard," commented Leo Martin, Senior Vice President—Programs, Seaspan Shipyards.

"The fuel efficiency of the Wärtsilä 31 engine was a determining factor in the award of this prestigious contract. However, equally important was our project delivery experience and service support across Canada. Furthermore, our previous cooperation with both the Canadian Coast Guard and Seaspan has been very successful, and we are honoured to be again working with them," said Simon Riddle, General Manager, Naval Sales, Wärtsilä.

The Wärtsilä equipment is scheduled to be delivered to the yard in 2025. When built, the new vessel will be the Canadian Coast Guard's largest icebreaker and will replace CCGS *Louis S. St-Laurent*, which is due to retire at the end of the decade after 60 years of service. Seaspan Shipyards is known as a world class builder of high-technology ice-class vessels.

Wärtsilä secures China's largest-ever Methanol Order

Wärtsilä is to supply the methanol-fuelled auxiliary engines for five new container vessels for COSCO Shipping Lines Co. Ltd, and seven new container vessels for Orient Overseas Container Line. Each vessel will operate with three 8-cylinder and two 6-cylinder Wärtsilä 32M engines. To complement the solution, the ships will be equipped with the Selective Catalytic Reduction exhaust cleaning systems and alternators. These will be supplied through Wärtsilä's joint venture company, CWEC (Shanghai).

The Orient Overseas Container Line's 24 000 TEU ships are to be built at the Nantong COSCO KHI Ship Engineering yard, and the COSCO Shipping Line's 24 000 TEU ships at the Dalian COSCO KHI Ship Engineering yard. The vessels are expected to commence commercial operations in 2026.

KBR Selected for Amphibious and Replenishment Ship CLCM Contract

KBR has been selected as the industry partner to deliver a sovereign sustainment capability to the Royal Australian Navy's Amphibious and Replenishment Ship fleet.

This is one of the first Capability Life Cycle Management (CLCM) sustainment programs to include multiple asset classes—the Landing Helicopter Dock ships HMAS *Adelaide* and HMAS *Canberra*, Landing Ship Dock HMAS *Choules* and Auxiliary Oiler Replenishment ships HMAS *Supply* and *Stalwart*.

For over two decades KBR has provided the RAN with strategic asset management planning, engineering design effort and supply-chain optimisation to support a more affordable and operationally available fleet. KBR will build on this foundation to support complete lifecycle sustainment for the RAN's Amphibious and Replenishment ships over five years.

A workforce of around 100 highly-skilled employees will be based at Fleet Base East at Garden Island Defence Precinct in Sydney to support the stewardship of these critical fleet assets which are core to Australia's maritime and joint forces operational effectiveness.

The team will be supported by Australian-based companies including Babcock Australasia, Atlantic & Peninsula and Goal Group. The CLCM team will contribute to the continued development and growth of the nation's sovereign maritime sustainment capabilities.

"The depth of knowledge and experience of supporting the Amphibious and Replenishment fleet in our team is measured in decades and reflects our ambition to provide both fleet availability and capability required by the Navy," said Nic Mann, KBR Vice President Government Solutions for APAC.

"Combining the unique capabilities and skills of our team will provide strategic asset management services which ensure that Navy gets the most out of these ships throughout their lives. The CLCM model is one that fosters a more collaborative and transparent approach between the RAN, KBR and our team, reflecting the aspiration of Defence's Plan Galileo and the Maritime Sustainment Model."

National Defence Strategy 2024

On 17 April the Commonwealth Government released a *National Defence Strategy*. The Strategy was prepared in response to the *Defence Strategic Review*, released last year, and is supported by an *Integrated Investment Program* which was released concurrently. The section in the Strategy of particular interest to RINA members is that entitled *Naval Shipbuilding and Sustainment Enterprise Strategy.* That section of the document states:

8.18 Naval shipbuilding and sustainment is a whole-of-nation endeavour critical to our national security and sovereignty, requiring a significant uplift in Australia's shipbuilding workforce, industry and infrastructure to generate a modern and capable naval capability. The Government is committed to supporting the growth of a productive and resilient sovereign shipbuilding and sustainment industrial enterprise, including its underpinning supply chains and workforce. This is reflected in the most significant investment in maritime capability in Australia's history, which encompasses building, sustaining and upgrading naval vessels and maritime capabilities, including nuclear-powered submarines.

8.19 The dual objectives of the Government's Naval Shipbuilding and Sustainment Enterprise Strategy are to:

- uplift the capacity, productivity and resilience of Australia's shipbuilding and sustainment industrial ecosystem, to provide national preparedness as a direct input to the operations of the ADF; and
- generate ongoing economic, export and employment opportunities for decades to come.

8.20 Australia's Naval Shipbuilding and Sustainment Enterprise Strategy comprises the following lines of effort:

- optimising Australia's existing naval shipbuilding and sustainment industrial base to support continuous naval shipbuilding at two principal shipyards in South Australia and Western Australia, accompanied by a national maritime sustainment network, in conjunction with establishing a nuclear-powered submarine industrial base to support the acquisition and sustainment of nuclear-powered submarines;
- balanced investment over significant planning and delivery timeframes to support the timely and cost-effective acquisition, upgrade and sustainment of minimum viable maritime capability, whilst also providing a predictable pipeline of work and consistent demand signal to industry to encourage investment;
- developing strategic partnerships with industry to strengthen the industrial base and to improve capability and participation of mid-tier supply-chain companies;
- managing workforce demand pressures through new and innovative approaches to upskill and support over 8500 direct jobs by 2030 in conventional shipbuilding and sustainment as well as around 20 000 direct jobs over the next 30 years as part of the nuclear-powered submarine pathway;
- expanding infrastructure capability and capacity to support planned acquisition and sustainment activities, while optimising productivity at the principal shipyards;
- enhancing physical security measures at the principal shipyards and supporting Australian industry partners to uplift security standards and compliance for defence industry, their workforce and supporting supply chains; and
- national and international partnering and collaboration, including with state and territory governments, industry partners, academic and training institutions, and international partners.

8.21 Realising the ambitions of Australia's Naval Shipbuilding and Sustainment Enterprise Strategy will see a transformational uplift of Australia's industrial and advanced manufacturing capability, and enhanced national resilience and prosperity through:

- a productive and resilient industry which can innovate and rapidly scale with manageable risk to meet the needs of the ADF;
- an appropriately-skilled and experienced workforce, developed as an enduring sovereign asset to deliver and operate maritime capability and generate broader national security and economic effects;
- a modern shipbuilding and sustainment infrastructure network, expanding Australia's industrial capacity and overall force flexibility; and
- a risk-based approach to the security of acquisition and sustainment activities.

8.22 The implementation of Australia's Naval Shipbuilding and Sustainment Enterprise Strategy will be detailed in an updated Naval Shipbuilding and Sustainment Plan to be released later this year, which will be updated biennially in conjunction with the biennial National Defence Strategy cycle and the Defence Industry Development Strategy.

8.23 The 2024 Naval Shipbuilding and Sustainment Plan will set out the Government's approach to supporting the growth of a productive and resilient sovereign shipbuilding and sustainment industrial enterprise. It will be complemented by a Shipbuilding Forecast for industry and the public to build confidence in Australia's shipbuilding industry. Future iterations of the forecast will be issued in line with the biennial National Defence Strategy cycle.

The *Integrated Investment Program* expands on the information provided in the *Defence Strategic Review* about the plans for the RAN's surface combatant fleet stating:

3.3 The Integrated Investment Program includes funding of $39–$55 billion to deliver the Government's response to the review of Navy's surface combatant fleet. This investment will enhance the surface fleet's strike, air-defence and undersea warfare capabilities, and bolster its ability to conduct presence operations. The enhanced-lethality surface-combatant fleet will consist of:

- three Hobart-class air-warfare destroyers upgraded to the Baseline 9 Aegis combat system with enhanced strike and airdefence capabilities;
- six Hunter-class anti-submarine frigates of a single design which will boost Navy's undersea warfare, strike and air-defence capabilities;
- 11 new general-purpose frigates, constructed through an offshore then onshore build strategy to accelerate delivery, to replace the Anzac-class frigates. These vessels will operate independently and in conjunction with the Hobart-class air-warfare destroyers and Hunter-class frigates to secure maritime trade routes and northern approaches and escort military assets;
- six Large Optionally Crewed Surface Vessels to be built in Western Australia to increase Navy's longrange strike capacity and overall fleet lethality, to be delivered in the 2030s. These systems can provide high endurance at a lower cost, and will be optimised for operating in company with the rest of the surface combatant fleet. These vessels will be provided with up to 32 vertical launching system cells to increase long-range strike capacity and overall fleet lethality. Large Optionally Crewed Surface Vessels are currently being developed by the United States Navy; and
- six Arafura-class offshore patrol vessels and 10 Evolved Cape-class patrol boats as part of Navy's minor war vessel program. The Arafura-class offshore patrol vessels will perform a maritime patrol and response role for Navy. Of the 10 Evolved Cape-class vessels, the last of the eight fulfilling a maritime security role will be delivered by the end of 2024 and the remaining two vessels, which will provide a navigation and seamanship training capability, will be delivered by end of 2026.

3.4 Defence will decommission the two oldest Anzac-class frigates as per their planned service life. HMAS *Anzac* will be withdrawn from service in 2024, and HMAS *Arunta* will be decommissioned in 2026, subject to an assessment of its condition. The remaining six ships will remain operational, enabling Navy to maintain its fleet availability levels while retaining workforce and industry skills. This will provide improved value-for-money relative to previous plans, with the Government prioritising funding for the acceleration of new general-purpose frigates rather than an extended period of sustainment for the oldest Anzac-class frigates.

In regard to facilities, the *Integrated Investment Program* states:

3.7 Essential logistics support and amphibious capabilities for the fleet will be maintained through continued investment in the two Supply-class replenishment oilers and sustainment enhancements to the two Canberra-class landing helicopter docks and HMAS *Choules*. The Government is also investing in surface fleet support infrastructure, including the redevelopment of the Garden Island Defence Precinct in Sydney, to ensure that these facilities can securely and efficiently berth, maintain and repair Navy vessels.

3.8 Consolidation of the Henderson precinct in Western Australia is currently under way, as recommended by the *Defence Strategic Review*. Successful and timely consolidation will enable eight new general-purpose frigates to be built at the Henderson precinct and will also enable a pathway to build six new Large Optionally Crewed Surface Vessels in Western Australia.

Both documents can be downloaded from https://defence.gov.au/nds.

EDUCATION NEWS

UNSW Canberra

Having passed the halfway point of Semester 1 in the third year of teaching our grey-ship focussed program, we can report that we have been busy planning and executing field trips for both our Year 3 and Year 4 naval architecture cohorts and associated students.

In April, we took a party of six (our three Year 4 students and three staff members) to Tasmania and had a wide range of wonderful experiences and learning opportunities across six days. Dr Nick Johnson (National Centre for Maritime Engineering and Hydrodynamics) was our key host at AMC, with whom we conducted resistance, seakeeping and self-propulsion tests on FTV *Blue Fin* in the towing tank (see Figure 1). Thanks for a very useful set of labs, Nick! The experience and learning gained by all were formative and will not be forgotten. Tours of other AMC facilities included the wave basin, cavitation tunnel, bridge simulator, survival centre, and autonomous systems in Launceston and Beauty Point. They were all highly valued and informative.

Figure 1: UNSW Canberra students and staff with Dr Nick Johnson on the AMC Towing Tank Carriage
(Photo Warren Smith)

Driving down to Hobart and return, we had time to reflect and build relationships in different ways around meal tables and social activity, involving Kunanyi/Mt Wellington, MONA, Salamanca Market and Wooden Boats. However, we also had a very busy day of visits beginning with a tour onboard RSV *Nuyina* built by Damen. Impressive! This was followed by a visit to Incat Tasmania and a tour through the yard with Jason McVicar, Design Manager at Revolution Design. The focus, naturally, was on the construction of the 130 m lightweight battery-electric ship for Buquebus (Hull 096), the largest of its kind. Everywhere we looked brought theory into practice and smiles to our faces (see Figure 2). After this visit, and a late lunch, we were received at Sentinel Boats by George McGuire, CEO, and Adil Khawaj and given a tour of their operation. Again, impressive. This had a highlight with a demonstration of an 8 m craft, designed by One2three Naval Architects, on the Derwent conducted by Jason Cummings, Project Manager Marine, reaching 40 kn and demonstrating the soft and quiet ride of the boat's novel HDPE hull construction—see Figure 3.

Figure 2: All smiles after a tour of Incat Tasmania
(Photo Warren Smith)

Figure 3: More smiles after a Sentinel run on the Derwent
(Photo David Lyons)

In early May, two cars were loaded with eight students (four Year 3 NA and four Year 4 ME and EE students) and two staff for a road trip to Sydney. An inclining was conducted on HTS502 *Currawong* at the Sydney Heritage Fleet Shipyard in Rozelle Bay. *Currawong* is likely the most inclined vessel as students from UNSW have descended upon her for 11 years. We kindly thank Tim Drinkwater for facilitating our visit and Phil Helmore for his contributions to the experiment, of which it is said to have delivered the most consistent set of results. We were blessed by the weather to complete the task without getting too wet.

Figure 4: The inclining crew on *Currawong* having completed the job
(Photo Warren Smith)

A visit to Garden Island targeting the Captain Cook Graving Dock and the Pump House was arranged during our time in Sydney. Our Thales hosts, Julia Blackman (Naval Architect) and Murray Makin (NA Support Manager) provided great insights into the operation of the dock through a thorough briefing and a tour with plenty of steps. A trip to Belrose and Incat Crowther was also made where the students were exposed to the activities of a very busy naval architecture practice through the eyes of Henry Morgan, Naval Architect. It is fantastic on such occasions to compare and contrast defence and commercial practice. Our final activity was meeting with Graeme Brown (Naval Liaison Manager) at Lloyds Register, during which time classification and naval rules were discussed. There were many *ah-ha* moments experienced and all our hosts during the couple of days are sincerely thanked.

Figure 5: Taking it all in in the Dock Office with Julia Blackman and Murray Makin (Photo Warren Smith)

The third field trip in May (taken while *The ANA* was going to press) involved a party of six (our three Year 4 NA students, a Year 4 ME student and two staff members) going to sea for three days and two nights onboard MV *Sycamore*. This represents another wonderful experiential opportunity, to feel and explore an operating ship, taking some control to run a range of trials. The crew and support agency for *Sycamore* are gratefully thanked.

In closing, I again wish to emphasise the 2 + 2 nature of our degree—one which facilitates students transferring to UNSW Canberra to pursue naval architecture, having undertaken the first two years of an accredited mechanical (or aeronautical) engineering four-year degree program at another Australian or New Zealand tertiary institution. I encourage organisations to consider growing naval architects to meet their future needs through the provision of support of a scholar transferring to UNSW Canberra to undertake their naval architecture studies. The supply-and-demand system is not in equilibrium and assistance is required to provide the feedstock which will develop the workforce for sovereignty, continuous naval shipbuilding and AUKUS.

A/Prof. Warren Smith
Naval Architecture Program Coordinator
School of Engineering and Technology
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.

THE PROFESSION

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 March 2024 e-Newsletter included:

- Draft instruction to surveyors now available—Ultrasonic thickness measurement for metallic vessels
- Do you know all your transitional requirements?
- Have your say on the proposed changes to SAGM Pt 2 [*Comments closed at midnight on2 April*—Ed.]
- Stability booklets—Required loading conditions
- Conditions of specific exemptions and how they relate to survey
- Survey Matters suggestions

The article on *Stability Booklets—Required Loading Conditions* is reproduced below.

Phil Helmore

Stability Booklets—Required Loading Conditions

AMSA audits accredited marine surveyors to ensure that the correct procedures and protocols set out in the National Law—Marine Surveyors Accreditation Guidance Manual (SAGM) and the Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013 (the regulations) are being implemented.

AMSA regularly performs audits related to stability approvals from accredited marine surveyors (AMS). Most of the submissions from accredited surveyors are found to be compliant and many positive observations are noted.

However, during recent audits, findings regarding the extent of loading conditions presented in stability booklets have become common. Rather than just demonstrating compliance with the applicable stability criteria, AMS are encouraged to focus on providing clear guidance to an operator for them to be able to operate the vessel within the allowable limits. Below is some guidance on how to identify what loading conditions to include in stability documentation.

NSCV Requirements

It is a required outcome of NSCV C6A for the intact stability to be safe over the range of foreseeable conditions of loading. Clause 2.2 states:

2.2 CONDITIONS OF LOADING TO BE SAFE

A vessel must have characteristics of stability over the range of foreseeable conditions of loading in both normal and abnormal conditions of operation, sufficient to:

(a) minimise the risk of the vessel capsizing;

(b) avoid excessive angles of heel that could threaten the safety of persons on the vessel; and

(c) return the vessel to the upright condition.

NOTES:

1. Foreseeable conditions of loading include light and laden conditions, arrival and departure conditions, and critical intermediate conditions.
2. Excessive angles of heel can result in personal injury, the shifting of cargo, furniture and other masses on the vessel, flooding of spaces, malfunction of essential machinery and systems, anxiety and fatigue of persons, as well as hampering the crew in performance of their duties.

Note 1 clarifies the extent of the term "foreseeable conditions".

Requirements for the form and content of a stability booklet are found in the National Standards for Commercial Vessels (NSCV), Section C6C, Annex F. This annex details all the information required to be included in the stability book and is a normative (compulsory) part of the standard (see also the December 2019 edition of *Survey Matters*).

Clause F5, Table F1 of Annex F outlines the required contents of a stability book and points to Clause F9 for the loading conditions. Clause F9 stipulates that a range of loading conditions be presented in the stability book, and highlights the need to include any loading conditions which may have marginal stability characteristics (worst-case scenarios). It also includes an important note about consulting with the operator to ensure that the loading conditions of all intended operations have been assessed. Table F3 outlines the standard departure and arrival loading conditions applicable to all vessels, and Table F4 includes the minimum vessel-specific loading conditions to be included in a stability book. It is important to note that Table F4 requires all vessels to include a lightship condition.

Importance

Vessels may vary significantly in design and operation and there may be additional conditions over and above the minimum requirements which must be analysed to ensure that all limiting conditions have been identified. For certain vessels the limiting conditions may be readily identifiable; however, they may not be so clear for other vessels which, for example, are variably loaded (vertically, longitudinally and transversely), have movable ballast, have lifting and grounding effects, have multiple consumables tanks, or have tracked or wheeled plant loaded from the shore.

By analysing the full range of loading conditions and looking in detail at activities which can impose additional heeling moments on the vessel, all potential operating profiles are analysed prior to the vessel entering service. Worst-case loading conditions (limiting conditions) must be identified by the surveyor (preferably in collaboration with the operator) and guidance addressing these conditions must be included in the stability book in accordance with clause F9.

Survey Matters, March 2024

MEMBERSHIP

Australian Division Council

The Council of the Australian Division of RINA met on the afternoon of Tuesday 12 March 2024 by Zoom-conference under the chairmanship of our retiring President, Jim Black, in Perth with links to Airlie Beach, Gold Coast, Sydney, Canberra, Melbourne, Hobart, Adelaide and Perth.

Among the items discussed were:

Naval Shipbuilding Program

Council to write to the Minister for Defence expressing concern at the adverse effect of the Enhanced Lethality Surface Combat Fleet upon the development of maritime engineers underpinning the program.

Election of Vice President and Filling Council Vacancies

Council agreed to a process for nominations and election for these positions.

Improvement Committee

Council gave in-principle endorsement for the Committee to make preparations for a workshop to discuss and refine services to Division members.

Succession Planning

A decision was taken to develop a Division handbook including including strategies for filling key positions which are expected to become vacant into the medium term.

Senate FADT Legislation References Committee

It was noted that on 13 March the Institution would appear before the Committee's inquiry on the Australian Naval Nuclear Power Safety Bills. RINA's submission and the appearance are available through aph.gov.au.

Victoria/Queensland Engineer Registration

A progress report on our applications as an "assessment entity" was presented. Further to the re-approval by Queensland in December, the Division is working with HQ to provide the necessary website guidance for applicants. A Victorian response is still awaited.

WARSHIP 2024, Adelaide 18–19 June 2024

Council welcomed a progress report indicating that arrangements and registrations were progressing well.

Council noted that this was its final meeting before the Division AGM the following week. Accordingly, retiring Council members were thanked for their service and the retiring President, Jim Black, wished Jonathan Binns every success as his successor.

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

Australian Division Annual General Meeting

The Annual General Meeting was held as a virtual meeting on 19 March 2024. With an attendance of 22 covering all of our Sections, the requirements for a quorum were comfortably met.

Business of the meeting included consideration of the final annual report by Jim Black as President, the financial report and appointments to Division Council. It was notable that the Division's newfound ability to hold its assets outside of bank accounts had resulted in a rare profit in a non-IMC year.

The meeting thanked outgoing Council members for their service.

In response to a statement by the President, the meeting gave strong support to the ongoing work of the Secretary and Treasurer who are appointed by Division Council.

Noting that his presidential term would end at the conclusion of the meeting, Jim Black welcomed Prof. Jonathan Binns as our new Division President for the coming two-year term, assuring his best wishes and ongoing support.

At the close of the meeting the Institution's new Operations Director, Neil Hancock, introduced himself and gave a brief outline of his role which includes providing active support to Divisions, Branches and Sections and avoiding being seen as UK-centric. As an illustration of this the forthcoming WARSHIP conference in Adelaide (18–19 June 2024) was being held outside the UK for the first time.

Rob Gehling AO
Secretary
rinaaustraliandivision@gmail.com
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, so that you don't miss out on any of the RINA London publications, *The Australian Naval Architect*, or section notices.

Contact details advised to RINA London only filter down to divisions and sections annually so, to keep up-to-date with local events, please advise RINA London, *and* the Australian Division, *and* your local section:

RINA London	hq@rina.org.uk
Australian Div.	rinaaustraliandivision@gmail.com
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

THE ROYAL INSTITUTION OF NAVAL ARCHITECTS

WALTER ATKINSON AWARD

A PRIZE FOR THE BEST WRITTEN PAPER PRESENTED TO A RINA FORUM IN AUSTRALIA IN 2023–24

The Walter Atkinson Award was established in 1971 and its aim is to raise the standard of technical papers presented to the naval architecture/maritime engineering community in Australia.

The Award comprises three components:

- an engraved trophy or medal.
- a certificate for each author.
- a ticket to the event at which the award is to be presented.

The Award will be presented by the President of the Australian Division (or their nominee).

A nomination must be of a written paper, not simply a presentation, first presented either at a RINA Section technical meeting or RINA-supported conference in Australia such as the *Indo Pacific 2023 IMC*, or first published in a RINA-supported publication in Australia (e.g. *The ANA*). Papers published in *The ANA* are automatically considered to have been nominated but other papers may only be nominated by a Section Committee.

All authors are eligible—Australian or overseas, members or non-members. Papers by multiple authors are eligible.

Visual presentations are not eligible unless they reflect the content of the presenter's written paper. Nominations of papers published in the period 1 July 2023 to 30 June 2024 must be received by the Secretary no later than 19 July 2024.

For further information refer to the Division's Walter Atkinson Award page on the RINA web-site or contact the Secretary.

The Secretary
RINA Australian Division
PO Box 462, Jamison Centre, ACT 2614
rinaaustraliandivision@gmail.com
0403 221 631

ACKNOWLEDGEMENT

The Australian Division of the Royal Institution of Naval Architects gratefully acknowledges the generous support of AMDA Foundation Limited for the conduct of the International Maritime Conferences organised by RINA, the Institute of Marine Engineering, Science and Technology and Engineers Australia in conjunction with AMDA's Indo Pacific Maritime Expositions.

Without such support the International Maritime Conferences and the publication of *The Australian Naval Architect* would not be possible.

NAVAL ARCHITECTS ON THE MOVE

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

Greg Carmody (ex Laanemaa) has moved on within Turner & Townsend and has now taken up the position of Senior Project Manager in Sydney.

Peter Dandy has moved on from Bastion Defence Consulting and has taken up the position of Principal Naval Architect with Expleo Group in Preston, UK.

Gordon Danton has moved on within ResMed and has taken up the position of Chief of Staff in their San Diego, USA, office.

James Davies has moved on from Crowley Solutions and, after some time at McDermott International, INPEX and BridgePro Engineering, has taken up the position of Manager/Director with Sub41 in Rowella, Tasmania.

Pierre de Chateau Thierry has moved on within Bureau Veritas and has taken up the position of Vice President Commercial—Marine & Offshore in Paris.

Larissa Deck has moved on from freelance writing and is now consulting as In My Own Garden in Creswick, Victoria, a green-thumb coach for busy people.

Lina Diaz has moved on from Petbarn and has taken up the dual positions of Customer Service Representative with Greencross and Managing Director with Dulceria Lollies in Sydney.

Luke Dodds has moved on from Woodside Energy and, after some time at McDermott International and TechnipFMC, has taken up the position of Project Manager with BE&R Consulting, seconded to Oil Search, managing their offshore IRM campaigns on the export system (jacket, pipelines and CALM buoy) in Papua New Guinea.

John Donovan has moved on from Orwell Offshore and has taken up the position of Principal Naval Architect with Apollo in Edinburgh, UK.

John Drake has moved on from Schwetz Design to BAE Systems Australia, where he has now taken up the position of Senior Detail Designer in Sydney.

Robert McConachie has moved on within Coronado Global Resources and has taken up the position of Vice President Investment Valuations & Treasury in Brisbane.

Doug Matchett has moved on from the Australian Maritime Safety Authority and has taken up the position of Principal Engineer/Statutory Specialist with Bureau Veritas on the Australian Naval Classification Authority project, working from Mermaid Beach, Queensland.

Katrina Pearson (nee de Graaf) has moved on from the Australian Maritime College and, after some time at DST Group and Yards, has taken up the position of freelance gardening columnist for *The Community Leader* in Brisbane.

Jake Prince has moved on form Lloyd's Register and has taken up the position of Senior Specialist with Bureau Veritas in Sydney.

Karl Slater has moved on from DST Group and has taken up the position of Director Platform Design and Performance with the Australian Submarine Agency (ASA)—in this new role he has been embedded into the Submarine Delivery Agency (SDA) and is based in Bristol, UK.

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 email address changes.

Phil Helmore

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

Bookmark this website and keep your eye on it!

Video recordings of Australian section presentations should be sent to Abigail Forbes and Klaudia Rogala-Haracz <marketing@rina.org.uk> at RINA HQ for uploading.

To find a recording of an Australian section presentation, click on Playlists in the menu bar. Scroll down and click on *View full playlist* under Australian Division (fourth from the left in the second row).

If you know the name of the presentation, then click in the search box at the top, type the title of the presentation you are looking for (or at least the first few words thereof) and press Enter.

No new webcasts from Australian Sections have been added this year, but those recordings with uploading approval are expected soon.

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

FROM THE ARCHIVES

Specifying an Aircraft Carrier

John Jeremy

Some boxes of books recently donated to the Naval Historical Society of Australia included a small volume, a bit less than A5 size, entitled *Hull Specification for Light Fleet Carriers 1942*. The little book comprises a mere 52 pages. It is unlikely that there are many naval vessel specifications which are anywhere near as concise today.

Somewhat battered and worn, this little book reminds us of the imperatives of war 82 years ago
(Naval Historical Society collection)

At the outbreak of World War II Britain was building several Fleet Aircraft Carriers which were completed during the war. Whilst further Fleet Carriers were ordered, none were likely to be completed during the war and in 1941 the Admiralty faced the need for a significant number of aircraft carriers which could be built as quickly as possible. Liner and cruiser conversions were considered but by December 1941 it had been decided that a new cheap unprotected carrier design should be developed which could be rapidly constructed by the available shipbuilders. To facilitate construction by non-naval shipbuilders commercial practices were to be adopted as far as possible.

Admiralty design resources were stretched and the responsibility for the design of the new light fleet carrier was given to Vickers Armstrongs at Barrow in Furness. The first sketch design was completed on 14 January 1942. That design was modified to better incorporate war experience and the modified design was considered on 23 January 1942. The final design, which became the Colossus class, was approved in February 1942 and the first three ships were ordered in March 1942. Vickers Armstrongs were responsible for the development of the design, and drawings prepared by other shipbuilders were subject to approval by Vickers Armstrongs unless nominated for specific Admiralty approval.

The 695 feet (201.6 m) long ships displaced 18 078 tons (18 368 t) and were powered by steam turbines based on an existing design developed for the Fiji-class cruisers. The Hull Specification gave the shipbuilders considerable discretion; for example, the ships were to be "built of mild steel to the arrangements shown on the approved general drawings. Steel may be of Admiralty or Mercantile quality which ever may be more readily obtained. Welding to be adopted generally for butts of deck plating, and elsewhere to Builder's option. Strict attention to be paid to simplification of the design in structure, systems and fittings so far as consistent with efficiency, in order to facilitate rapid production together with the exercise of rigid economy in the weight of materials employed in the construction."

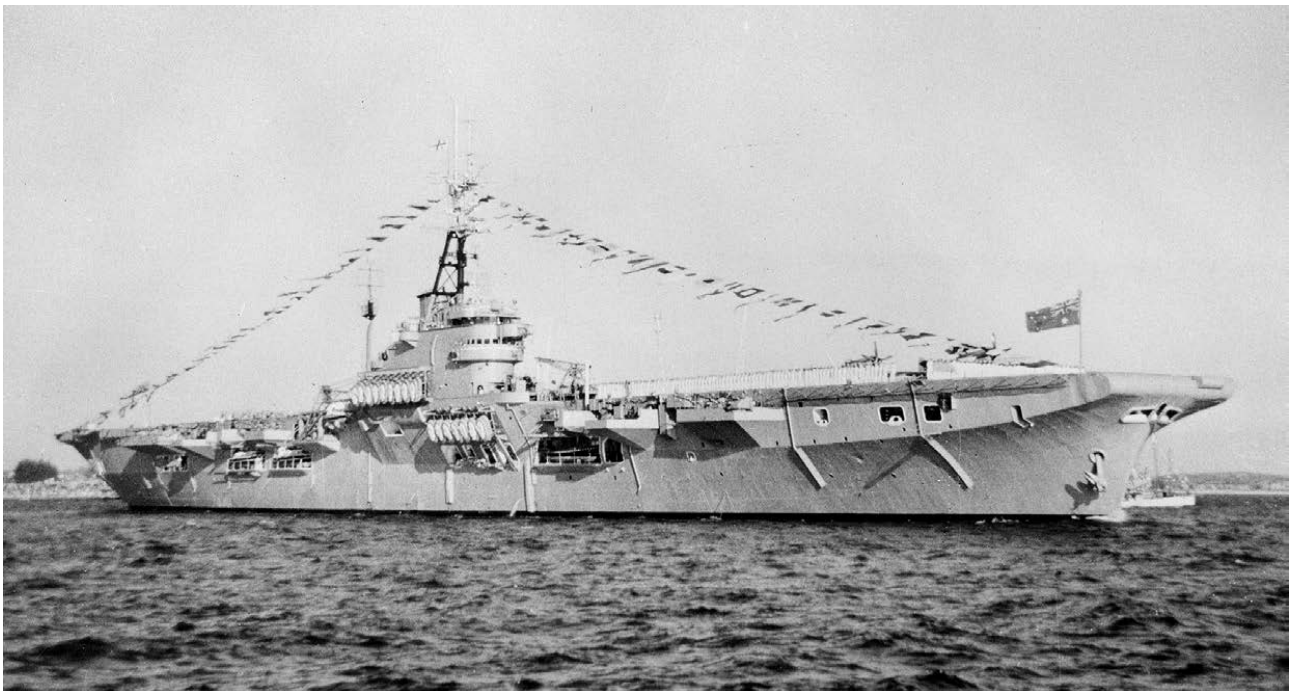
42. Baths, Canvas.
Canvas baths to be provided for tropical service.

Clause 42 is unlikely to appear in any Hull Specification today

The first ship to be completed was HMS *Colossus*, built by Vickers Armstrongs. She was laid down on 1 June 1942 and completed on 16 December 1944. Seven more were completed by May 1946 (a further two were completed as aircraft maintenance ships). Six more were still under construction at the end of 1945. These ships, *Hercules*, *Leviathan*, *Majestic*, *Magnificent*, *Powerful* and *Terrible*, were built to a modified design to enable them to operate heavier aircraft and to incorporate war-time experience. They were all launched by September 1945 but none were completed for the Royal Navy. *Terrible*, the only ship to be built by a Royal Dockyard (Devonport) became HMAS *Sydney*, *Majestic* became HMAS *Melbourne*, *Magnificent* and *Powerful* served in the Canadian Navy (the latter as HMCS *Bonaventure*) and *Hercules* became the Indian Navy's *Vikrant*. *Leviathan* was never completed and she was scrapped in 1968.

Of all the ships in the class, the longest service was that of *Vengeance*, which had served in the RAN between 1952 and 1955. She was sold to Brazil, extensively modernised in Rotterdam and commissioned in December 1960 as *Minas Gerais*. She served in the Brazilian Navy until 2001. These ships were designed for a short life, perhaps only three years. That some would survive for half a century is remarkable.

The British light fleet carrier program was but one of the notable achievements of Allied shipbuilding during World War II (the performance of the United States shipbuilding industry was particularly outstanding). The ships built in accordance with that brief 52-page Hull Specification served far longer than planned. Their expeditious construction was made possible by an industry familiar with Admiralty standards and able to respond to the demands placed upon



Built by Swan Hunters on the Tyne, HMS *Vengeance* was the second Colussus-class aircraft carrier to be completed, on 15 January 1945. She served in the RAN on loan between 13 November 1952 and 26 October 1955. Returned to the Royal Navy, she had a period in reserve before being sold to Brazil in December 1956. She was extensively modernised in Rotterdam and commissioned as *Minas Gerais* on 6 December 1960. She was decommissioned in 2001, becoming the longest serving of all the Colussus-class carriers of World War II
(RAN Historical Collection)

HMAS *Sydney* was launched as HMS *Terrible* on 30 September 1944. After the war her construction was suspended for a time until she was purchased by Australia and completed for the RAN on 5 February 1949. She saw valuable service during the Korean War but plans to modernise her to the same standard as HMAS *Melbourne* were abandoned and *Sydney* was decommissioned on 30 May 1958. She was recommissioned for a new role as a fast troop transport on 7 March 1962. She was finally decommissioned on 12 November 1973
(RAN Historical Collection)

it. The short time achieved from sketch design to operational ships makes the naval shipbuilding programs of today seem positively glacial.

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The steam yacht *Ena* was designed by Walter Reeks and built by Walter 'Watty' Ford in Berrys Bay NSW in 1900. Beautifully restored she is now part of the Australian National Martime Museum's collection
(Phtot John Jeremy)