THE AUSTRALIAN NAVAL ARCHITECT

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The Indonesian Navy's Sail Training Ship KRI *Bima Suci* arriving at Fleet Base East in Sydney on 14 September for a port visit (RAN photograph)

THE AUSTRALIAN NAVAL ARCHITECT

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Cover Photo:
HMAS *Parramatta* arriving at the Henderson Shipyard in Western Australia to begin her Anzac Midlife Capability Assurance Program upgrade
(RAN photograph)

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CONTENTS

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From the Division President

When I took on this position as your Division President earlier this year I didn't really appreciate just how much disparity there was between the very significant amount of work that is ahead of Australian naval architects in the coming years, a rather widespread lack of understanding that it is naval architects that are actually needed, and the horrifyingly low levels of young people actually starting their journey to become naval architects. This year's university undergraduate intake this year barely makes it to double figures — I would consider it no exaggeration to call this a crisis!

In my last column I talked to you about the importance of your own CPD — please keep that up. Hopefully, in the very early New Year, we will see RINA's implementation of the Engineering Council's *MyCareerPath* to assist you. But now I would like to turn the attention of all of you to this current very real crisis: putting the short-term expedient of overseas recruitment aside, the only way we can mitigate this is by ensuring that, in any way we can, current and future school students want to become naval architects. Every one of us can play a part in this!

There would seem to be two levels of school students which we need to engage:

- Those at schools which have maritime studies in their curriculum, to point them towards their best choice: naval architecture.
- Those in other schools at earlier years before they start to drop STEM subjects.

I most certainly don't have all the answers as to how we best do this; being the wrong side of 70 and a non-user of social media I do have certain handicaps, so over to you!

I intend that we work as closely as we can with the current recruitment campaigns of AMC, UNSW Canberra, and any of the local TAFE colleges which are also recruiting in the maritime sector. Please, every one of you, take any opportunity which arises to talk to school students and their parents to enthuse them about the world's best and most exciting profession.

Now, as an example, let me indicate where I have seen some easily filled gaps just this last month:

- Students at a well-respected high school in Adelaide, close to the Osborne shipyards, did not know that they could become RINA Junior Members and possibly attend the local Section meetings.
- Several undergraduates at Flinders University doing the AMC 2+2 are not RINA Student Members and were unaware of the local Section and not aware of their meetings.
- Several recent graduates who have moved inter-state to SA have not advised RINA of their move and consequently are not receiving information about local meetings.

Please, I mean no criticism of the SA Section; I expect this is typical in all states.

I also noted that, at the recent Fremantle Maritime Day, an event with an emphasis on Defence recruiting and where our WA Section had a good stand, there were none of our

Jim Black

Careers in Naval Architecture brochures on the stands of the AMC or the National Shipbuilding College — with a few words to each I was able to remedy this.

These may seem like small steps but they all help. Anything that any of you can do to improve this dire recruitment situation will be most appreciated and if we can coordinate our efforts so much the better — I look forward to your very positive responses. Please understand this is not just verbiage from me — this is a real crisis which you can help to solve. Over to you!

Please remember to keep giving out the message to one and all: ***Naval Architects Create Ships***.

Please feel free to chat to me any time: 0418 918 050, or by email jimblack.marine@iinet.net.au.

Jim Black

Editorial

Our modern world presents us with many challenges — that must surely be an understatement! Of course, challenges are also great opportunities. Not least amongst our challenges are those relating to the imperative of controlling climate change and mitigating the effects of a world population with an insatiable demand for power. Rob Gehling addresses some of those challenges in his *Pacific News* article in this issue. Others are close to home — how are we all to enjoy our way of life without destroying the planet?

Batteries have been part of our life for a long time. Today we enjoy the benefits of the common lithium-ion battery in our phones, cameras, computers and, increasingly, in our cars. The technology is remarkable — long life, ideal discharge characteristics and easily recharged. Lithium-ion batteries are not, however, without their risks. We rely heavily on electronic circuitry to prevent overcharging and the risk of thermal run-away and fire. I imagine that the possibility of the failure of these systems is far from the minds of those who leave their laptop computers plugged in all the time. Yet, failure of these safeguards can result in uncontrollable fires, fortunately rare in our everyday lives.

Lithium-ion batteries are a growing part of the materiel transported around the world by ship, as batteries or in electric vehicles. There have recently been some catastrophic fires in vehicle carriers and container ships which have been difficult or impossible to control by normal means of firefighting. Such fires have been attributed to Li-ion batteries, possibly because of faults in manufacture or inappropriate stowage. Most ships are not equipped with the fire-fighting systems and firefighters trained in dealing with an intense fire in Li-ion batteries. Thermal runaway in Li-ion batteries is a rapid exothermic reaction which can result in combustion temperatures around 800°C which can rapidly spread.

Naval architects need to be fully aware of the risks associated with the cargo intended for the ships they design and, increasingly, with the electrical propulsion systems being installed as hybrid or battery-electric propulsion. Our new world presents increasing on-board firefighting and control challenges.

The financial services company Allianz has recently published an Allianz Risk Consulting Bulletin *Lithium-ion Batteries: Fire risks and Loss Prevention Measures in Shipping* [1] which sets out the risks very clearly with guidance on the proper handling, stowage and shipping of Li-ion batteries. I think it is an interesting bulletin which I recommend that everyone read, even if their exposure to Li-ion batteries is currently limited to phones and laptop computers with the electric vehicle sometime in the future when they become more affordable.

John Jeremy

[1] The bulletin is available at: https://www.agcs.allianz.com/news-and-insights/reports/lithium-ion-batteries.html.

Always a spectacular site for sailing, Sydney turned on unusually beautiful weather for the MC38 class Australian National Championships conducted by the Royal Sydney Yacht Squadron on 4–6 November. The series was won by *Lazy Dog* (MH777)
(Photo John Jeremy)

COMING EVENTS

SMIX Bash

The 22nd SMIX (Sydney Marine Industry Christmas) Bash will be held on Thursday 1 December aboard Sydney Heritage Fleet's beautifully-restored barque, *James Craig*, alongside Wharf 7, Darling Harbour, from 1730 to 2200. This party for the whole marine industry is organised jointly by RINA (NSW Section) and IMarEST (ACT & NSW Branch). Join your colleagues in the maritime industry and their partners for drinks and a delicious buffet meal on board this unique vessel. Dress is smart casual, but absolutely no stiletto heels!

Bookings are open on the Trybooking website. Click on *Explore Events*; type SMIX into the *Search Event Name* box, click on *SMIX 2022*, and then *Book Now*. Registration is $55 for members of RINA or IMarEST, and $70 for non-members. Payment can only be accepted by Visa or Mastercard.

Australian Wooden Boat Festival

The Australian Wooden Boat Festival is the largest celebration of wooden boats and maritime culture in the Southern Hemisphere and will be held on 10–13 February 2023 on the Hobart Waterfront.

Events include the Derwent River Cruise and Cocktail Party, boats afloat, boats ashore, tall ships, parade of sail, noisy boatyard, shipwrights' village, symposium, maritime marketplace, quick'n'dirty boatbuilding challenge, and more.

The program is shown at https://www.australianwoodenboatfestival.com.au/whats-on-2023/.

AOG Energy 2023

AOG Energy is Australia's premier oil, gas and energy trade event held annually in Perth, and is organised by Diversified Communications Australia.

For over 40 years, AOG Energy has been recognised as the premier Australasian oil, gas and energy event, bringing together the entire supply chain from across Australia and the globe.

We regularly connect with our community so that AOG Energy can continue to meet the needs of the industry. Recently we surveyed our audience, spoke to key exhibitors and consulted with our industry committees on their objectives for AOG Energy 2022. The results demonstrated that, while there is an appetite for local connection, it is abundantly clear that there is a stronger desire for this to happen at the large global scale to which the industry is accustomed.

We are committed to delivering the event annually; however, we understand that 2022 has continued to present its challenges in connecting the market at scale. We want to do the best by you and reunite the industry at the right time, and therefore made the difficult decision to cancel AOG Energy for 2022.

We look forward to bringing the industry back for a true celebration of what the Australasian oil, gas and energy market has to offer and to continue to innovate towards a clean energy future.

The next edition will next take place on 15–17 March 2023 at the Perth Convention & Exhibition Centre.

For further details, visit the AOG Energy website at https://aogexpo.com.au/

Indo Pacific 2023

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.

Indo Pacific 2023 will be held 7–9 November 2023 at the International Convention Centre Sydney.

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 (IMC2023) organised by the Royal Institution of Naval Architects, the Institute of Marine Engineering, Science and Technology and Engineers Australia. Keep an eye out for the Call for Abstracts!

Further conferences will be held in Sydney on the following dates:

Indo Pacific 2025 November 2025
Indo Pacific 2027 November 2027

Put these dates in your diary now and plan to be there.

NEWS FROM THE SECTIONS

ACT

Validation of Frequency-Domain Ship Motions

Prasanta Sahoo, Visiting Faculty Member at UNSW Canberra at the Australian Defence Force Academy, gave a presentation on *Validation of Frequency-domain Ship Motions* at an in-person meeting at the Australian Defence Force Academy in Canberra with the Chair of the ACT Section, Warren Smith, as MC, and streamed live via Zoom on 23 August. This presentation attracted 12 attendees and 8 participating online on the evening.

Prasanta began by saying that an attempt has been made to validate a frequency-domain seakeeping code. Two-dimensional hydrodynamic added-mass and damping coefficients were calculated by using multipole expansion theory and conformal mapping. The Lewis conformal mapping technique was used to obtain the hydrodynamic coefficients. Excitation terms for pitch and heave motions were computed by using a head-seas approximation. A user-friendly code interface was designed for presenting frequency-domain computations. Response amplitude operators for the motions of Australian Maritime Engineering Cooperative Research Centre (AMECRC) hulls were plotted at different advance speeds and in head waves. The results were compared with those obtained by experiments and were observed to be in good agreement. The entire process was conducted using MATLAB code.

The Presenter

Prasanta graduated from the Indian Institute of technology in Kharagpur with a bachelor's degree with honours and subsequently obtained his PhD from the University of Rostock in Germany.

After working with a defence shipyard in India, where he was primarily involved in design and CAD/CAM activities for offshore patrol vessels, tugs, missile craft, etc. over a period of six years.

In 1993 he joined the Australian Maritime College as a lecturer and taught several courses such as Ship Structures, Ship Hydrostatics, Ship Resistance and Propulsion, Seakeeping and Manoeuvring, and one semester teaching JAVA programming.

In 2009 he left the AMC to take up the position of Associate Professor at Florida Institute of Technology where he served for 12 years.

In 2022 he joined UNSW Canberra at ADFA as a Visiting Faculty Member. In between he spent his sabbatical leave teaching at the University of British Columbia in Vancouver, Canada, the University of Liege in Belgium and Yildiz Technical University in Istanbul.

Over the course of his academic career, he has published more than 70 papers in journals and peer-reviewed international conferences while also serving on the editorial board of several journals/conference proceedings, and as Associate Editor of *Journal of Ship Design & Production* and ASME.

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

The "thank you" bottle of wine was delivered to Prasanta via an eGift card.

Hull Resistance Components, Running Trim and Wetted Surface Area Effects

Torsten Lau of Gibbs & Cox Australia, gave a presentation on *Hull Resistance Components, Running Trim and Wetted Surface Area Effects at Trans-critical Depth Froude Numbers* as a webinar hosted by RINA using the Zoom software platform with the Chair of the ACT Section, Warren Smith, as MC on 1 November. This presentation attracted 14 participating on the evening.

When a vessel passes through a finite-depth waterway, not only are there significant effects on the wake pattern, but also on the size of the waves created and the hull resistance. This change has an effect on powering and fuel consumption of a vessel. The study investigated the effect which the trans-critical speed zone has on the major components of ship hull resistance and running trim angle. Physical scale model experiments were performed on two different hullforms, a monohull and catamaran at the AMC Model Test Basin. Both hullforms tested had similar waterline lengths and the same total displacement. The main areas of interest in this study were resistance coefficients, running trim and dynamic wetted-surface/wetted-length values.

The Presenter

Torsten graduated from the Australian Maritime College

with his Bachelor of Engineering degree in naval architecture last year. For his thesis project he investigated the hull resistance components, running trim and wetted surface area effects on ships at trans-critical depth Froude numbers. The research was conducted throughout 2021. He joined Gibbs & Cox Australia in November last year and took on a role in the autonomous-systems team working on the EMPAS Project.

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

The Effect of Submergence on the Wave Attenuation Performance of an Artificial Reef

John Lynch of CASG's SEA5000 Branch, gave a presentation on *The Effect of Submergence on the Wave Attenuation Performance of an Artificial Reef* as a webinar hosted by RINA using the Zoom software platform with Chair of the ACT Section, Warren Smith, as MC on 1 November. This presentation attracted 14 participating on the evening.

Deploying an artificial reef to attenuate incident wave energy presents a solution to coastal erosion which comes with added benefits such as habitat development and an undisturbed coastline aesthetic. Wave energy attenuation is dependent on the operating environment and so the artificial reef was investigated across the tide cycle for incident wave events. The experimental investigation was conducted in the AMC Model Test Basin for three submergence levels representing low, mean, and high tide conditions. Twin wire wave probes were used to measure the height of incident and transmitted waves in a 'protected' region in the lee of the reef. Capturing the spread of transmitted wave heights in this region indicated the influence of wave diffraction on the reef's attenuation performance.

The Presenter

John graduated from the Australian Maritime College with his Bachelor of Engineering degree in naval architecture last year. For his thesis project he investigated the wave attenuation properties of artificial reefs. This research was conducted throughout 2021 and was presented to a panel of AMC staff and industry representatives at the end of the year. He joined BMT in January and took on an embedded role in CASG's SEA5000 Branch from May this year.

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

Jordan Rayson

New South Wales

Committee Meetings

The NSW Section Committee met on 11 October and, other than routine matters, discussed:

- SMIX Bash 2022: Sponsorships are coming in, but more are required to cover costs; SMIX Bash Committee meeting to be convened soon.
- TM Program 2023: Presentations to be sought.
- Correspondence: The secretariat at RINA HQ has been reorganised and the new positions and personnel are as follows:

Chief Operations Officer	Sally Charity
Operations Director	Dmitriy Ponkratov
Business Development Director	Jesicca Murphy
Membership Manager	David Mitchell
Marketing & Communications Manager	John Morecraft
Events Coordinator	Rusne Ramonaite,
Technical Assurance Manager	Jaime Perez-Martinez

Electric-drive Technology for Tugs

Mark Todd, Damen Shipyards Representative with Asiaworld Shipping Services, was scheduled to give a presentation on *Electric-drive Technology for Tugs — The Future is Now* as our first post-pandemic face-to-face meeting in the new Harricks Auditorium at Engineers Australia in the Sydney CBD on 7 September.

However, due to double bookings in the Harricks Auditorium, this meeting has been postponed to 2023.

Hover-capable Autonomous Underwater Vehicles

Lachlan Toohey, Senior Technical Officer, Australian Centre for Field Robotics at the University of Sydney, gave a presentation on *Hover-capable Autonomous Underwater Vehicles: Design and Use Cases* as a webinar hosted by Engineers Australia using the WebEx software platform with committee member of the ACT & NSW Branch of the IMarEST, Simon Wong, as MC on 26 October. This presentation attracted 92 participating on the evening.

Autonomous underwater vehicles are increasingly being employed to explore our oceans in applications ranging from defence to industry and science. The Australian Centre for Field Robotics has been deploying AUVs for the last 15 years, with a focus on hover-capable platforms capable of high-resolution seafloor imaging for supplying images of reefs to marine scientists around Australia. Other partnerships have included archaeology and defence. The last six years have seen the Centre move from modifying AUVs designed and built elsewhere to designing and manufacturing our own AUVs to fill a gap in the market for our use cases, with the second generation of these entering open water deployments this year.

This presentation covered the uses of hover-capable AUVs capable of operating in open water, and the design, manufacturing, and field trials of the first two generations of in-house AUVs, including lessons learned between the two generations and for future designs.

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

The certificate was subsequently posted to Lachlan, and the "thank you" bottle of wine delivered via an eGift card.

Phil Helmore

Queensland

Engineering our Future

Robert Palmer, Manager Sales and Development, AMC Search, gave a presentation on *Engineering our Future* as a webinar hosted by RINA using the Zoom software platform with the Chair of the Queensland Section, Jalal Rafieshahraki, as MC on 28 September. This presentation attracted 17 participating on the evening.

In his presentation, Rob outlined a critical issue at the AMC which will have a long-term impact on the maritime engineering sector in Australia. Over the past several years, enrolments into the engineering degrees at AMC have fallen significantly. The decline is so serious that it threatens the

viability of running the naval architecture degree program at the AMC.

However, there is a plan to turn the ship around, and Rob described how industry support will be critical to rebuilding student numbers and ensuring the long-term sustainability of maritime engineering at the AMC.

The Presenter

Dr Rob Palmer has worked in several roles for the Australian Maritime College and AMC Search since 2004. He managed the AMC Marketing Department for several years, and presently works in a commercial role as Manager of Sales and Development with AMC Search. He is passionate about the maritime industry and works tirelessly to see the AMC succeed and flourish.

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

Ashley Weir

South Australia and Northern Territory

The ARES Submarine Project and LOCAUST

Eric Fusil, Senior Lecturer at the University of Adelaide, gave a presentation on *The ARES Submarine Project and LOCAUST* at an in-person meeting at the University of Adelaide, and streamed live via Zoom on 17 August.

A collaborative research team of Australian universities and industry partners has developed a feasibility study for ARES, the Australian Research and Experimental Submarine as a free-running model for hydrodynamic testing of submarines and UUVs. With acknowledgment from DST's Chief Scientist, the ARES project proved relevant to SEA1000 topics of interest but the question became "Where to from there till we secure future funding?"

In parallel, The University of Adelaide has initiated studies on a low cost UUV which could be used as a force multiplier in case of a Ukrainian war scenario: LOCAUST, similar but different to the LOCUS project from the USA.

Indo Pacific 2022 proved the huge interest which navies have in UUVs, but how can we make this a sovereign capability, in very practical terms? Building on the success of the project, Eric described the continuing development to the benefit of Defence but with a focus on developing capability for the Defence industry from a people and tools perspective.

The Presenter

Eric Fusil is a French-Australian submarine addict, having dedicated all his 20+ years of professional life to the submarine industry. He is a naval architect and had his experience crafted by a variety of roles covering the full spectrum of a boat lifecycle (design, build, test, activation and sustainment) and worldwide (USA, France and Australia) including submarine shipyard facilities (performing reviews for overseas customers to assess fitness for purpose). With nearly 10 years in Australia, he is fully aware of the challenges stemming from the local environment and can put the Australian future submarine project into perspective.

Cameron Wilkinson

Victoria

Metocean Engineering

Prof. Alexander Babanin of the University of Melbourne gave a presentation on *Metocean Engineering in the context of Naval Architecture and Marine Infrastructure* as a webinar hosted by RINA using the Zoom software platform with the Chair of the Victorian Section, Tom Dearling, as MC on 24 August. This presentation attracted 17 participating on the evening.

Metocean applications cover marine meteorology, oceanography, dynamics of surface waves, air-sea interactions, air-sea boundary layers and marine climate.

Alexande discussed their significance and applications in the context of needs for naval architecture and marine infrastructure. These included environmental influences in the deep ocean, finite depths and shallow water — above, below and at the ocean interface.

The Presenter

Alexander Babanin is a Professor in Ocean Engineering and the Director of the Centre for Disaster Management and Public Safety at the University of Melbourne. He has worked as a Research Scientist in the Marine Hydrophysical Institute in Sebastopol, as an academic at UNSW at ADFA in Canberra, at the University of Adelaide in South Australia, and at Swinburne University of Technology in Melbourne. His areas of expertise, research and teaching include wind-generated waves, maritime, coastal and Arctic engineering, air-sea interactions, ocean turbulence and ocean dynamics, climate, environmental instrumentation and remote sensing of the ocean.

The presentation was recorded and is now available on the RINA YouTube channel (see *The Internet* column).

The upcoming event planned for the Victorian Section is *Reliability and Safety on RAN Vessels* by AMOG Consulting; date TBA.

Victorian Registration of Engineers

The Victorian Section has been focusing its efforts heavily on clarifying the Victorian Government's requirements for naval architects in Victoria to become registered engineers. These efforts were summarised in an email to the members of the Victorian Section on 14 September and concluded that naval architects do need to register with the Victorian Government. The default discipline under which naval architects are to be registered is mechanical engineering, for which registration is required by 1 December 2023. Please note that this applies to all naval architects working *for* projects in Victoria, and not just those working *in* Victoria.

Victorian Section AGM

The Victorian Section held its Annual General Meeting on 14 September. We welcomed Samuel Smith as a committee member and Jonathan Binns as Deputy Secretary. The role of Secretary will be held by Samuel Price. Keegan Parker and Jesse Millar have stepped down from their roles and we thank them for their contributions to the committee. All other positions remain unchanged. As a result, the committee now stands at

Chair	Tom Dearling
Secretary	Samuel Price

Deputy Secretary	Jonathan Binns
Treasurer	Alex Conway
ADC Nominee	Nathan Wallace
Members	Karl Slater
	Samuel Smith

The Section is looking to expand its committee and would welcome enquiries from any members who might be interested. Please contact the Chair, Tom Dearling, at vicsec@rina.org.uk if you would like to find out more.

Keegan Parker

Western Australia

Alternative Fuels for Ocean-going Vessels

Kjeld Aabo, Director New Technologies, Promotion and Sales Department, MAN Diesel & Turbos, Copenhagen, gave a presentation on *Marine Alternative Fuels* at an in-person meeting at the Flying Angel Club in Fremantle, and streamed live via Teams on 18 August. This presentation attracted 15 attendees and 5 participating online on the evening.

Kjeld informed the meeting about the market trends which he and his team are seeing as they interact with marine industry stakeholders, including ship owners, large and small, across the globe.

He also provided a brief overview of MAN Energy Solutions' two-stroke marine engine product-development activities as we meet the challenge to decarbonisation our industry.

The Presenter

Kjeld Aabo is based in Copenhagen and is the Director New Technologies, Promotion and Sales Department, MAN Diesels and GenSets. He is Chairman of the CIMAC Heavy Fuel Working Group, and Member of the ISO 8217 Heavy Fuel Oil Working Group.

This presentation was not recorded.

Lessons Learnt from Oil and Gas

Alex Mosnier and Matthew Williamson, Floating Solutions Consulting, gave a presentation on *Lessons learnt from Oil and Gas: Practical Opportunities to Increase Operability and Capability through Optimising Inspection, Engineering and Repairs* at an in-person meeting at the Flying Angel Club in Fremantle, and streamed live via Teams on 26 October.

Traditional hull integrity management methods originally designed for trading vessels on a regular docking cycle are sub-optimal for assets which have different usage patterns, e.g. FPSOs moored offshore. Given the constraints around inspection and repair timing, novel and innovative methods have been developed to achieve a more targeted and flexible approach. These methods prioritise engineering investigation and structural risk evaluation over taking an asset out of service for survey and repair.

This presentation gave results from several case studies and details the savings and increases in operability achieved. Areas where a tailored engineering strategy and risk-based approach prove advantageous compared to the simpler prescriptive approach of periodical inspections, drydockings and repairs were presented. Furthermore, the regulatory context within Australia from a classification and statutory perspective was discussed. The commercial techniques and case studies were then reviewed within a naval context, in particular given the latest "goal-based regulations", exploring how similar approaches might increase capability and operability of front-line naval assets.

The Presenters

Alex is a chartered naval architect and project manager with over 20 years' technical, strategic and management experience in ship building and operating, across the oil and gas, defence and commercial sectors. He has particular expertise in structural design, construction, technical integrity and operations support. His focus now is the optimisation of floating structures integrity management, combining an engineering passion for structures with the drive to achieve improvement and change. He founded Floating Solutions Consulting in 2017 to deliver fit-for-purpose practical hull integrity solutions which demonstrably improve economics and reduce risk.

Matthew is a chartered naval architect with a career which has spanned oil and gas, defence, and commercial shipbuilding. He is a professional engineer with a proven record in technical delivery and project management in the marine field. His experience includes the full range of projects from conception and bid through contract negotiation, detail design, build and in service. This has been whilst working for suppliers, prime contractors, regulators and clients internationally and within Australia. This understanding of the full life-cycle of marine projects is now being leveraged with Floating Solutions Consulting to deliver optimised inspection and repair scopes for marine assets.

Ken Goh

Tasmania

Preserving Our Maritime History Using Photogrammetry

Dougal Harris, Council Member of the Australian Register of Historic Vessels and Volunteer with the Tasmanian Maritime Museum, gave a gave a presentation on *Preserving Our Maritime History Using Photogrammetry* at a room-and-zoom meeting (in person at the Derwent Sailing Squadron in Hobart, Zoomed to the Australian Maritime College in Launceston, and streamed live via Zoom to the wider fraternity) on 11 August. This presentation attracted 20 attendees in Hobart, 4 in Launceston, and 5 participating online on the evening.

Introduction

Tasmania is an island state with a rich maritime history. It began with the Indigenous people, the convict boatuilding era and the whaling and couta-fishing trades up until today with the high-speed aluminum boat construction industry. All around the state, historical vessels can be seen on moorings, in fields and backyards in various states. These vessels all have an important story to tell, and the Maritime Museum of Tasmania would like to discover and preserve these important pieces of Tasmania's history. Preserving old boats is costly and if a boat cannot be physically preserved the second-best option is a digital record. This article will outline the various methods we have investigated and our current process for creating digital models of historically-significant vessels.

Surveying Methods

Traditionally the Tasmanian Maritime Museum surveyed vessels manually. This method acquires a set of offsets by physical measurement of a series of points on the surface of a hull using measuring tapes, set squares and plumb bobs. The offsets are then used to fair the lines by hand and produce the vessel's lines plan.

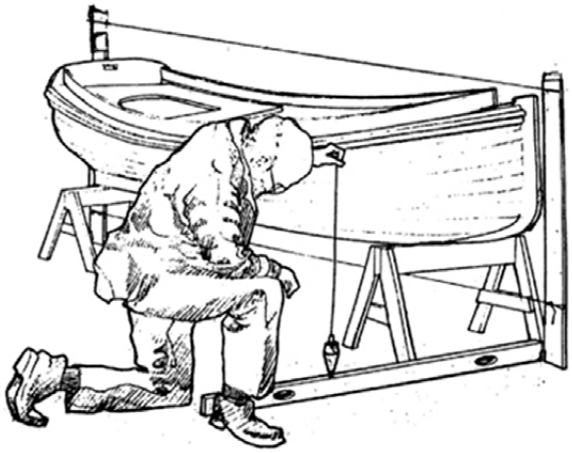


Figure 1 Manually lifting offsets
(Sketch courtesy Dougal Harris)

This technique is labour-intensive (both during measurement and when fairing) and can be prone to human error. The result is a relatively small data set of offsets.

Our first attempts at digitally recording the offsets were done using a surveyor's total station. This method allowed us to record accurate measurements for any size of vessel. The offsets were then imported to the Maxsurf Modeler software where a NURBS surface model could be generated. Once a 3D surface model had been created, a digital version of a traditional lines plan was produced. The downside of this method is the expensive equipment required and a relatively small dataset of offsets obtained.

To achieve larger datasets (i.e. a point cloud) we investigated three methods: laser scanning, structured light 3D scanning, and photogrammetry. All methods can generate large datasets of offsets at a level of accuracy required for generation of a digital model. Below is a simplified table of the outcome of this investigation.

Table 1 Modelling rubric
(Table courtesy Dougal Harris)

	Digital theodolite	Laser scanner	Structured light scanner	Photogrammetry
Generate point cloud	No	Yes	Yes	Yes
Within budget	-	No	Yes	Yes
Acceptable accuracy	Yes	Yes	Yes	Yes
All vessel sizes	Yes	-	No	Yes

Initially, we used a Microsoft Kinect (structured light scanner) to survey approximately five vessels, but found it hard to use on vessels larger than a dinghy and the scanning could not be conducted in sunlight. Laser scanning is prohibitively expensive, so the method of photogrammetry is currently the best compromise. The photogrammetry process has been developed and improved over the past five years and has been used on over 30 vessels to generate both a digital 3D surface model as well as the more-traditional lines plans. The only equipment required is a consumer-grade digital SLR camera and adequate computing power for the photogrammetry software (most high-end personal computers are suitable).

Figure 2 *Enterprise* surveyed two hours before demolition in Bicheno
(Photo and image courtesy Dougal Harris)

Photographs to Digital Model: the Workflow

The process we use to generating a digital model can be split into three broad steps:

1. Field work of surveying the vessel with the digital SLR camera.
2. Post-processing the photos using photogrammetric software to generate a point cloud.
3. Fitting a 3D NURBS surface model to the as-measured point cloud data.

Once a model of the vessel is generated it can then be used for all the usual naval architecture analyses, including resistance and powering estimates (Maxsurf Resistance), seakeeping (Maxsurf Motions) and stability (Maxsurf Stability) calculations, as well as generating a traditional lines plan or for parts generation (Bentley MicroStation).

A typical vessel will require 300+ photographs with minimum 75% overlap. This is to allow the photogrammetric software to generate enough "tie" (common) points to accurately generate a point cloud. The photogrammetry procedure is best done with full sunlight and before any fouling is removed (photogrammetric algorithms do not handle featureless shiny surfaces well). If the surface of the vessel is freshly painted and/or shiny, targets in the form of tape or stickers can be applied to the hull to assist the photogrammetry software.

Once the post-processing of the photos has been completed, an output report of the cloud accuracy is produced along with a 3D point cloud. This data is then imported to the naval architecture software package Bentley Maxsurf Modeler, where various tools are used to assist the user in a (semi) automated surface-fitting process. Once the surfaces have been faired, the model is saved and exported for detailing and generation of the lines plan using the Bentley MicroStation CAD package.

The following photos illustrate the various stages of the process. The vessel is *Tamima*, a Huon pine double-ender cruising yacht designed by Sydney naval architect WD Bailey and built in Bellerive in 1930.

Figure 3 One of the 300+ digital photos used to generate the point cloud for *Tamima*
(Photo courtesy Dougal Harris)

Figure 4 Point cloud for *Tamima* in Agisoft photogrammetry software
(Image courtesy Dougal Harris)

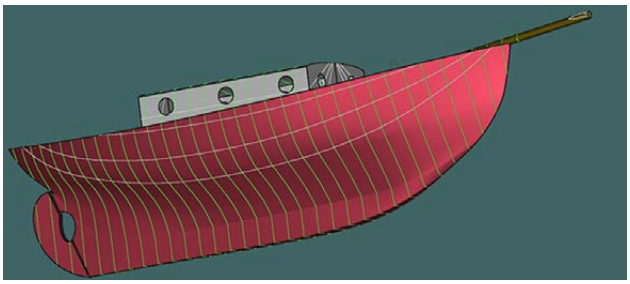


Figure 5 NURBS surface model of the hull and superstructure of *Tamima* in MAXSURF Modeler software.
(Image courtesy Dougal Harris)

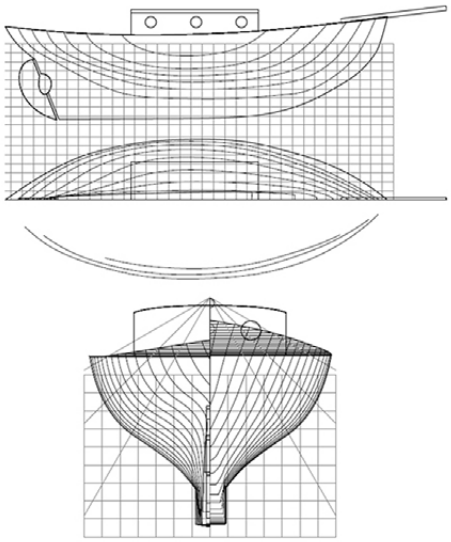


Figure 6 Lines plan of *Tamima* produced in Bentley Microstation from the 3D model
(Drawing courtesy Dougal Harris)

A Selection of Boats Surveyed

To date, we have surveyed 44 vessels using the above-mentioned techniques from which we have generated 3D models of the hull as well as 2D lines plans. Three of these vessels are shown below.

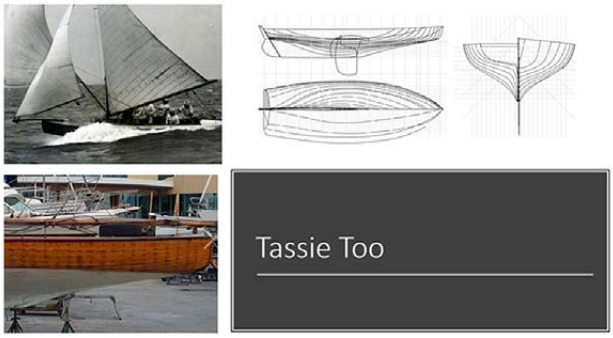


Figure 7 *Tassie Too*
(Photos and drawing courtesy Dougal Harris)

Tassie Too, designed to the restricted 21 ft class, won the Forster Cup — Australia's sailing championship in its day — a record ten times between 1928 and 1952. She was built of huon pine on hardwood frames and had the first pivoting centreboard which, it was claimed, gave her superior performance to windward. A "Friends of Tassie Too" not-for-profit organisation has been established to coordinate the vessel's administrative, financial, insurance, scheduling and maintenance efforts.

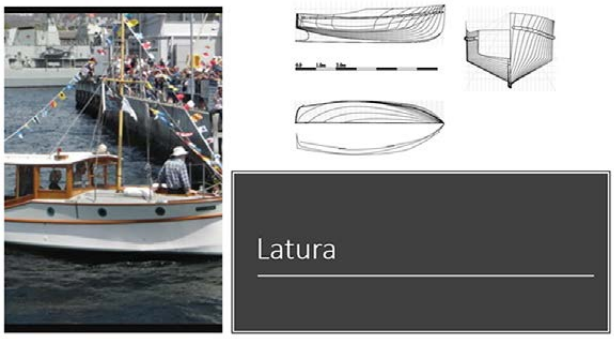


Figure 8 *Latura*
(Photos and drawing courtesy Dougal Harris)

Latura is a William Hand design built by Bayes Bros at Battery Point and launched in 1924. She was found rotting in a farm paddock twenty years ago and has been lovingly restored. Built of huon pine, she was a founding member of the Royal Yacht Club of Tasmania and has cruised the Derwent for over 90 years.

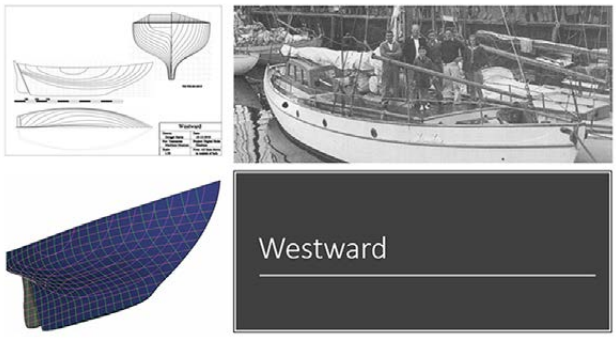


Figure 9 *Westward*
(Photos and drawing courtesy Dougal Harris)

Westward is another famous Tasmanian racing yacht, designed and built in 1946 by Jock Muir, a prolific Tasmanian boat builder. She was originally being built as a recreational fishing yacht; however, the sale fell through part-way through construction. The new owner removed her propeller and transformed her into a "racing yacht". In 1947 *Westward*

won the inaugural Maria Island Race. She followed this up with handicap victories in the Sydney–Hobart Yacht Races of both 1947 and 1948, creating a Tasmanian record which still stands. She also holds the record as the only vessel with a fishing well to win a Sydney–Hobart, a record which will most probably never be beaten! She is now in the custodianship of the Tasmanian Maritime Museum

Conclusion

The method developed to digitally record historical vessels in Tasmania is useful for documenting significant vessels which may be at risk of being permanently lost. The method has been developed over the past decade and is continually revised as newer technologies evolve or become available. If you know of a vessel which may meet the criteria for conducting a survey, then please contact either the Tasmanian Maritime Museum or (nationally) the Australian Register of Historic Vessels through the Australian National Maritime Museum

This presentation was not recorded.

Dougal Harris

Westward alongside in Hobart
(Photo John Jeremy)

Retrofitting Ships Ballast Water Treatment Systems

Michael O'Connor, Design Manager, Taylor Bros., gave a presentation on *Retrofitting Ships Ballast Water Treatment Systems — Design Implications and Experiences* at a room-and-zoom meeting (in person at the Derwent Sailing Squadron in Hobart, Zoomed to the Australian Maritime College in Launceston, and streamed live via Zoom to the wider fraternity) on 13 October. This presentation attracted 8 attendees in Hobart, 3 in Launceston, and 2 participating online on the evening.

The design and installation was carried out by Taylor Brothers and featured 3D laser scanning, enabling components to be built offsite at their Hobart workshop.

Ballast water treatment system, prefabricated in Taylor Bros' workshop
(Photo courtesy Taylor Bros)

Optimal Design of an ASW Frigate

Michael Van Balen AO, Principal of the Australian Maritime College, gave a presentation on *Optimal Design of an Anti-Submarine Warfare Frigate* at a room-and-zoom meeting (in person at the Australian Maritime College in Launceston, Zoomed to the Derwent Sailing Squadron in Hobart, and streamed live via Zoom to the wider fraternity) on 10 November.

This presentation looked at factors which influence the design of an anti-submarine warfare frigate, including the operating environment, engineering design, threats, and tactics. A relevant case study was included and sought to address the question *What if it all goes wrong?*

Australian Wooden Boat Festival

The Tasmanian Section will be involved in the Australian Wooden Boat Festival, to be held on 10–13 February 2023. Events will include a *Technology and Careers* display for the Tasmanian maritime industry and RINA (Tasmanian Section) will take part.

The Derwent River Cruise and Cocktail Party will take place on the evening of 10 February, the first day of the festival. The cruise will be on Noakes' beautifully-restored timber ferry *Regal II*. Tickets are available on the Eventbrite website at https://www.eventbrite.com.au/e/rina-awbf-2023-evening-cruise-cocktail-party-tickets-426035773467

Promotional sponsorship packages for businesses, organisations and sole traders are also available for this event. Please contact Chris Davies at chris@corrosionsolutions.com.au.

Richard Boult

CLASSIFICATION SOCIETY NEWS

ABS Issues AiP for Autonomous System On Board Tug

ABS has collaborated with Sea Machines and Foss Maritime to advance the adoption of autonomous operations at sea by issuing approval in principle (AiP) to their vessel autonomy system, the SM300, which provides autonomous navigation and collision detection and collision avoidance (CDCA).

Foss is to install Sea Machines' SM300 system on board their harbor tug *Rachael Allen* to enhance safety and efficiency of operations. Overall, the system will function for routine transit and stand-by operations with the goals of enhanced safety and alleviating crew fatigue.

Sea Machines' new autonomous system underwent a series of rigorous product reviews to prove that the technology met ABS' requirements for the use of autonomous systems aboard vessels. The SM300 system also assists with station-keeping and is capable of interfacing with Kongsberg-MTU propulsion systems.

"Autonomous technology continues to advance at pace and ABS is committed to supporting its safe adoption by the industry," said Patrick Ryan, ABS Senior Vice President, Global Engineering and Technology. "We are proud to add this project to the list of pioneering initiatives we are supporting all over the world which are gradually realising the potential of autonomous operations for the industry."

Through the AiP process, ABS reviewed numerous documents for Sea Machines, including software test plans and concept-of-operations materials for *Rachael Allen*. In such reviews, ABS seeks to identify potential design risks or issues which may result in substantial change in the direction in the project by evaluating the design approaches, rules, regulations and types of calculations presented.

ABS has been at the forefront of autonomous marine technologies and approved the installation of the Sea Machines SM200 commercial wireless helm for tugs that support articulated tug-barge (ATB) sets.

"Sea Machines worked closely alongside ABS and Foss to yield this most-recent approval, which moves our entire industry yet another step closer to widespread adoption of autonomous marine technologies," said Michael G. Johnson, CEO of Sea Machines. "Earning this approval demonstrates our unwavering commitment to ensuring that these technologies are utilised safely, while making our industries more competitive and productive."

Foss Project Manager, Dan Cole, said "As part of our Always Safe, Always Ready culture, Foss is pleased to be providing the SM300 system for additional crew and vessel safety through the enhanced situational awareness which it will bring to our operations."

See the ABS *Autonomous Vessels* document for insights into the marine industry's use of autonomous technologies and the ABS *Requirements for Autonomous and Remote Control Function*s for more detailed guidance. Visit the ABS Autonomy Services page for additional information.

ABS News, 13 September 2022

DNV Awards AiP to HHI Group's Digital Twin Ship System

At Gastech 2022, DNV awarded an Approval in Principle (AiP) to HHI Group for their innovative Hyundai Intelligent Digital Twin Ship (HiDTS) system.

The AiP confirms the software system HiDTS, which was developed specifically for 174 000 CBM LNG carriers, meets the requirements of DNV's Data-Driven Verification (DDV) class notation of Power Management System (PMS) with the Digital Twin (DT) qualifier.

The HiDTS used in the DDV process was assured by DNV-RP-0513. With the DDV class notation, the testing of the PMS can be performed via a digital twin more conveniently and extensively without a surveyor having to attend physically. Also, using a digital twin enables test run activities and automatically harvests secure and reliable data on the PMS's behaviour. The surveyor can then verify this data using a digital playback application.

The DDV class notation sets the requirements for gathering, treating, and delivering collected data to ensure data quality in a class assessment. This means that for the specified systems, the verified data can be used in the certification and classification of those systems in maritime and offshore vessels.

The notation enables the crew to perform secure and tamper-free data harvesting. Compared to traditional paper-based test reports, the body of evidence represents accurate and detailed documentation of test activities, which can be revisited for as long as the data is stored. In addition, the notation covers several verification methods, including digital survey appliances and self-verifying systems.

Korea Shipbuilding & Offshore Engineering (KSOE), Hyundai Heavy Industries (HHI) and DNV will deepen their cooperation with a new MoU to assess the usability of digital twin and autonomous technologies, which can be applied to large commercial marine vessels, including rules and regulations compliance.

KSOE and HHI will actively contribute to developing an autonomous maritime solution which complies with DNV requirements to verify the target system during the agreement's project period, providing valuable feedback on the current rules and future versions.

"We have been accelerating commissioning technology using digital twin since the 2017 opening of our Hardware-in-the-Loop Simulation (HILS) Centre. Virtual commissioning based on HILS technology is a good way to reduce the risk of errors and delays. We will further strive for advancing technologies which improve safety and cost savings," said Sung Joon Kim, CTO at KSOE.

"It is a meaningful step forward for advanced future digital ships which surpass current smart ships. We believe that our own digital twin technology will contribute to global decarbonisation efforts as well as to the realisation of autonomous ships. Furthermore, the cooperation with DNV will reduce time and cost to provide these high-tech ships to customers," said Won Ho Joo, CTO at HHI.

"This AiP is aligned with DNV's strategy on offering expertise to our customers, supporting them in managing the digital transformation of both shipbuilding and ship operation. It is an important milestone for KSOE, HHI and us to have achieved this concrete result, which sets the stage for further development through the MoU," said Vidar Dolonen, Regional Manager DNV Maritime Korea & Japan.

DNV News, 7 September 2022

Sung Joon Kim (CTO at KSOE) (L), Kwang Hean An (President at Hyundai Engine & Machinery), Won Ho Joo (CTO at HHI), Vidar Dolonen (Regional Manager Korea & Japan, DNV Maritime), Sung Ho Shin (Business Development Manager, DNV Maritime), Seung Hyeon Yoo (Research Engineer Digitalisation, DNV Maritime) at the GasTech signing ceremony
(Photo from DNV website)

LR Signs Contract with Birdon for New RAN STS

Lloyd's Register (LR) has signed a new construction agreement with Australian shipbuilder Birdon to provide classification services and statutory approval for the Royal Australian Navy's *Young Endeavour* replacement Sail Training Ship (STS). The ship, designed by Dykstra and built by Birdon, will be constructed at Birdon's Port Macquarie shipyard in New South Wales, providing significant economic benefit for the region.

Joe Smith (L) and Remko Hottentot at the LR–Birdon signing
(Photo from LR website)

As an STS, the new vessel will continue to deliver youth development within the Young Endeavour Youth Scheme's sail training program. *Young Endeavour* has been operating since 1988, when the vessel was gifted by the British Government to celebrate Australia's Bicentenary.

The *Young Endeavour* replacement will comply with the REGLYC Part A yacht code and Australian Maritime Safety Authority (AMSA).

Remko Hottentot, Business Development Manager Australasia, Lloyd's Register said: "We are extremely excited and proud to be part of this project and very pleased to be working together with Birdon and Dykstra. The result will not only be a great square-rig training ship, but a true head-turner which provides fantastic opportunities as part of the Young Endeavour Youth Scheme."

Joe Smith, General Manager Defence, Birdon, said "We are very proud to have been entrusted to lead this once-in-a-lifetime project. It is a unique and prestigious vessel and we look forward to working with Lloyd's Register to deliver and assure this important capability."

LR News, 5 October 2022

Some 100 yachts of all sizes took part in the colourful Sail Past and Centenary Regatta of the Royal Prince Edward Yacht Club on Sydney Harbour on Wednesday 16 November. A hail storm shortly after the start of the Regatta added a degree of drama to the celebration of the Club's centenary
(Photo John Jeremy)

FROM THE CROWS NEST

WSR Spirit 2

On 8 October 1978, 44 years ago, Ken Warby blasted across Blowering Dam to set his second (and current) 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*.

High alpine winds hampered the team's tests on Talbingo Dam in June and July. The team then concentrated on adjusting the balance of the boat, and making slight adjustments to the horizontal stabilizer.

They had been hoping to run some tests on the Manning River in October to obtain feedback on the modifications, and were working towards that with the authorities, but had to cancel. They are now working towards tests on Blowering Dam in late November or December.

Martin Grimm
Phil Helmore

Spirit of Australia 2 at rest on Talbingo Dam
(Photo from Warby Motorsport Facebook Page)

WSR *Longbow*

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

Cutting plate for the mounting cradle for *Longbow*'s jet engines on the CNC Kronos plasma cutting machine at John W. Laycock
(Photo from Longbow website)

The hull has been turned over, and fit-out is under way. David Aldred has been busy deciding on the location of the twin Rolls-Royce Viper jet engines in the boat. The aim is to have the exit of the jets as close to the water as possible, both in displacement mode and at speed. The trick is to have a margin, allowing for some trim variations, so that in displacement mode water cannot flood into the jet exits and sink the boat.

The design for the mounting cradle for the jet engines has been finalised, and the cradle is now being constructed by John W. Laycock based in Keighley, Yorkshire.

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 at speed
(Image from SP80website)

The SP80 team is now collaborating with Gin Kiteboarding to develop tailored kites. Multiple kites spanning 20 m² to 50 m² are in development. On one side, working with different kite sizes will allow the pilots to optimise the boat as they test it. Furthermore, the possibility to adapt the wingspan of the kite to the conditions gives the team the opportunity to maximise the performances of the boat during record runs.

Tailored to the boat, these kites will be very different from conventional kites and will require extensive R&D beforehand: the significant forces they will have to withstand at 80 kn demand that specific fabric, bridles and lines be developed for the record.

In parallel with the important work done on the kites, the team is developing a unique control system: onboard, in a closed cockpit and with such forces involved, it is impossible to use a conventional kite bar. The team has been working on an innovative piloting system with a wheel and hydraulic controls to manage the kite while respecting rules for the record. Indeed, these rules require that the energy needed to control the boat be provided solely by the pilots: a great technical challenge to overcome before the first tests in 2023!

SailGP Series 3

Series 3 kicked off in Bermuda on 15–16 May, with Australia, Great Britain, Canada, Denmark, USA, New Zealand, Spain, France, and Switzerland all competing. After five fleet races and the grand final race, results were Australia 1, Great Britain 2, Canada 3.

Subsequent events have been held as follows:

Event 2	Chicago, USA	19–20 June 2022
Event 3	Plymouth, UK	30 July–1 Aug 2022
Event 4	Copenhagen, Denmark	19–20 August 2022
Event 5	St Tropez, France	10–11 Sept 2022
Event 6	Andalucia, Spain	24–25 Sept 2022

At this stage, the top of the table shows Australia 1 (50 points), New Zealand 2 (46 points) and France 3 (41 points).

Subsequent events in Series 3 will be held as follows:

Event 7	Dubai., UAE	12–13 Nov 2022
Event 8	Singapore	14–15 January 2023
Event 9	Sydney	18–19 February 2023
Event 10	Christchurch, NZ	18–19 March 2023
Event 11	San Francisco, USA	6–7 May 2023

For all the details, visit the SailGP website at https://sailgp.com/general/sailgp-overview/.

Phil Helmore

World's largest Cruise Ship

Wonder of the Seas is an Oasis-class cruise ship owned and operated by Royal Caribbean International. She was completed in 2022 in the Chantiers de l'Atlantique shipyard in Saint-Nazaire, France, the fifth in Royal Caribbean's Oasis class of cruise ships. At 236,857 GT, she is the largest cruise ship in the world by gross tonnage, surpassing her sister ship *Symphony of the Seas*, also owned by Royal Caribbean International.

Principal particulars of *Wonder of the Seas* are

Length	362.04 m
Beam	47.40 m
Draft	9.30 m
Passengers	5734 at double occupancy 6988 maximum
Crew	2300
Main engines	4×Wärtsilä 12V40F each 14 400 kW 2×Wärtsilä 16V48F each 19 200 kW 2×MTU 16V4000 each 2070 kW
Propulsion	Diesel-electric 3×ABB azipods, all azimuthing
Speed	22 kn cruising

Wonder of the Seas
(Photo from Wikipedia website)

GENERAL NEWS

AUKUS Joint Leaders Statement of 24 September 2022

In September 2021, the leaders of Australia, the United Kingdom, and the United States announced AUKUS, an enhanced trilateral security partnership. The need for this partnership is as clear today as it was a year ago. We stand together to support an international order that respects human rights, the rule of law, and the peaceful resolution of disputes free from coercion. AUKUS is a central element in our efforts to achieve these aims.

Over the last 12 months, we have made significant progress towards Australia acquiring conventionally-armed nuclear-powered submarines. We are steadfast in our commitment to Australia acquiring this capability at the earliest possible date.

As leaders, we remain committed to ensuring the highest level of nuclear safety, security, and stewardship in this endeavour. Australia does not seek and will not acquire nuclear weapons. The United States and United Kingdom are fully committed to establishing an approach to sharing naval nuclear propulsion technology with Australia which meets the highest non-proliferation standard. We welcome International Atomic Energy Agency Director-General Grossi's report to the September IAEA Board of Governors meeting on this issue, in which the Director-General reported his satisfaction with our engagement. The international community can be confident that our nations will continue to work transparently with the IAEA towards an approach that will strengthen the non-proliferation regime.

Through AUKUS, we have also made significant strides in our trilateral cooperation on advanced capability initiatives: hypersonics and counter-hypersonics, electronic warfare capabilities, cyber, artificial intelligence and autonomy, quantum technologies, and additional undersea capabilities. To support further progress on these initiatives, we continue to promote greater information and technology sharing, foster deeper integration of our industrial bases and supply chains, and accelerate our defence innovation enterprises. As our work progresses on these and other critical defence and security capabilities, we will seek opportunities to engage allies and close partners.

Australia, the United Kingdom, and the United States have a proud history of working together, along with other allies and partners, to protect our shared values and uphold the rules-based international order. Today, as we mark the one-year anniversary of AUKUS, we reaffirm our commitment to that critical endeavour and to peace and security in the Indo-Pacific.

Austal Australia has delivered the third Evolved Cape-class patrol boat, ADV *Cape Naturaliste,* to the Royal Australian Navy
(Photo courtesy Austal)

Austal Australia Delivers Third Patrol Boat to RAN

Austal Australia has delivered the third of eight Evolved Cape-class patrol boats to the Royal Australian Navy.

The vessel, ADV *Cape Naturaliste*, was officially accepted by the Commonwealth of Australia.

Austal's Chief Executive Officer, Paddy Gregg, said that the delivery of the third Evolved Cape-class patrol boat highlighted Austal's proven productivity and reliability to deliver naval shipbuilding programs in Australia.

"Austal has now delivered three Evolved Capes to the Royal Australian Navy since the contract was signed in May 2020. Our productivity has improved with each new vessel, to the point where Austal is launching a new Evolved Cape after just 12 months construction.

"The fourth vessel, the future ADV *Cape Capricorn*, is alongside now and we have four more Evolved Capes at various stages of production, here in Henderson.

"With the continued support of our trusted supply chain partners, the Austal shipbuilding team is well on track to deliver all eight Evolved Cape-class patrol boats to the Navy by mid-2024, on schedule.

"Austal is leading the way in delivering effective capability to the Navy and adding value to the National Naval Shipbuilding Enterprise and we couldn't be prouder," Mr Gregg added.

The 58 m aluminium monohull patrol boat is the third of eight to be delivered to the Royal Australian Navy. The first two Evolved Cape-class patrol boats, ADV *Cape Otway* and ADV *Cape Peron* were delivered in March and August 2022, respectively.

Austal Australia to Undertake Patrol Boat Autonomy Trial for the RAN

Austal Australia has taken possession of a de-commissioned *Armidale*-class patrol boat, the former HMAS *Maitland*, from the Commonwealth of Australia, to commence planning, modification, and test and evaluation of autonomous and remotely-operated systems.

The Patrol Boat Autonomy Trial (PBAT) is a collaboration between Austal, Trusted Autonomous Systems Defence Cooperative Research Centre and the Royal Australian Navy Warfare Innovation Navy (WIN) Branch. The Trial will establish robotic, automated and autonomous elements on a patrol boat, providing a proof-of-concept demonstrator for optionally crewed or autonomous operations for the RAN in the future. The trial will also explore the legal, regulatory pathways and requirements of operating an autonomous vessel at sea.

PBAT couples Austal's experience as the expert designer and manufacturer of the Armidale-class patrol boat, with subcontractor L3Harris' experience as a world leader in autonomous vessel technology. With co-funding from the Commonwealth of Australia, guidance and support is provided from the Trusted Autonomous Systems Defence Cooperative Research Centre.

Sentinel, the former HMAS *Maitland*, has arrived at Austal Australia's Henderson shipyard, to commence the modification phase of the Patrol Boat Autonomy Trial for the Royal Australian Navy
(Photo courtesy Austal Australia).

Following the arrival of the vessel in Henderson, Western Australia, the re-named *Sentinel* has entered the trial's modification phase, which includes the fitting of a variety of monitoring and control systems and technologies which enable autonomous and remote operations. From July 2023 the vessel is expected to be registered under Australian Maritime Safety Authority jurisdiction as a domestic commercial vessel to enable sea trials to commence in October 2023.

The PBAT project aims to:

- Significantly progress the concept of remote operations and the autonomous certification approach.
- Increase the understanding of fuel-management, communication, and navigation systems to be made autonomous.
- Investigate and understand the sustained operation of shipboard mechanical systems without crew intervention, including systems of redundancy and reliability to support operations at sea for extended periods.
- Provide input to long-term risk reduction for future naval projects, considering remote or autonomous vessels. This will be extended to other sensors and autonomous vehicles once the initial trial is complete.
- Transfer lessons learned on the application of remote or autonomous systems to the Royal Australian Navy's current fleet to potentially optimise crew workload. Remote and autonomous operation has the potential to reduce crew workload and increase operational safety by reducing human error.

Austal's Chief Executive Officer, Paddy Gregg, said "Austal understands the future of Australia's maritime capability will partly depend on how quickly our naval enterprise can better understand and integrate autonomous and remotely-operated vessels."

"Austal is pleased to be at the heart of Australia's autonomous naval journey, working with our industry partners, the Navy and the Commonwealth, to complete the modification and trials, and share this data to improve the wider knowledge base."

In late 2020 the Australian Defence Force issued a Joint Concept on Robotics and Autonomous Systems (RAS). The concept defines RAS in terms of both the threats and opportunities which it provides across all operating environments (land, sea, and air).

In parallel, the Royal Australian Navy released the Robotics and Autonomous Systems-Artificial Intelligence (RAS-AI) 2040 Strategy outlining its vision for "a fighting and thinking Navy" which embraces RAS-AI, to transform and improve its ability to fight and win at sea.

Austal Philippines launches the Largest Ferry Constructed by an Austal Shipyard

In September Austal Philippines launched the 115 m, high-speed vehicle-passenger ferry *Express 5*, for Molslinjen of Denmark, utilising a new vessel transportation system designed by Austal.

The Auto Express 115 high-speed catamaran ferry is the largest ferry (by volume) constructed by an Austal shipyard and was securely transported onto Austal Philippines' floating dock by a new, rail-based system called 'ANTS', featuring self-drive trollies with variable geometry to suit any hull configuration.

Austal's Hull 423, *Express 5*, is the largest (by volume) ferry ever constructed by an Austal shipyard
(Photo courtesy Austal Philippines).

Austal's Chief Executive Officer, Paddy Gregg, said the successful launch of the company's largest commercial ferry build, utilising Austal's new 'ANTS' vessel transportation system, demonstrated both capability and innovation.

"The launch of *Express 5* is a genuine milestone on a number of levels, as the largest ferry ever constructed by an Austal shipyard; and the first to be launched using our proprietary new vessel transport system," Mr Gregg said.

"The Austal Nautical Transportation System (ANTS) allows us to move any large vessel safely, securely, and efficiently — monohull, catamaran or trimaran — at a fraction of the cost of traditional mobile transporters.

"Congratulations to the Austal Philippines team, who have not only successfully constructed and launched *Express 5* but designed and developed a new vessel transport system to improve efficiency, reduce costs and enhance operations, for the benefit of our customer.

"Our congratulations also to Molslinjen, whom I know are just as excited as us to see this impressive new ferry in the water, with sea trials commencing soon," Mr Gregg concluded.

Austal Philippines President, Wayne Murray, said that the launch of *Express 5* demonstrated the ingenuity and dedication of the local team — and the shipyard's capability to deliver large, world-class ships, cost effectively.

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

The sleek looking 115-metre catamaran was designed by the same Austal Australia team who developed the original, signature raked-bow hull for Molslinjen's *Express 4* (delivered

Express 5 for Molslinjen of Denmark, emerges from the John Rothwell Assembly Bay at Austal Philippines, Balamban, Cebu
(Photo courtesy Austal Phillipines)

in 2019), and includes Austal's proprietary Motion Control and MARINELINK-Smart systems which help deliver a smoother journey for passengers and crew and a more efficient, better performing, 'smart' ship for operators.

Following final fit-out of the vessel alongside at Austal Philippines, *Express 5* is scheduled for delivery early in the first quarter of 2023.

The nuclear submarine HMS *Anson* alongside at Barrow-in-Furness, England
(Photo courtesy UK Ministry of Defence)

Australia Welcomes Submarine Training Opportunity from UK

On 1 September 2022 the Deputy Prime Minister and Minister for Defence, the Hon. Richard Marles MP, was hosted by the British Prime Minister, Boris Johnson, and the UK Secretary of State for Defence, Ben Wallace, at the commissioning of the Astute-class nuclear submarine HMS *Anson* at BAE Systems, Barrow-in-Furness.

As part the AUKUS partnership, Prime Minister Johnson and Secretary Wallace announced the training of Royal Australian Navy submariners aboard the newly-commissioned HMS *Anson*.

Having Royal Australian Navy submariners train alongside Royal Navy crews, is an important step, taken with Australia's partners in the United Kingdom to further strengthen our defence ties.

Australia is embarking on the next generation of submarines and in doing so, ensuring that we have Royal Australian Navy personnel training with our partners under the AUKUS partnership.

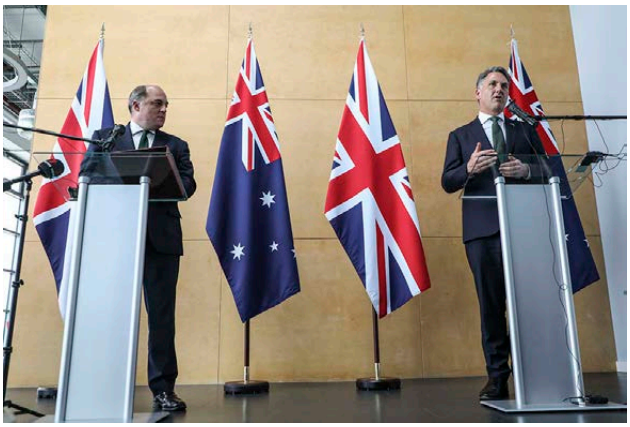
The Deputy Prime Minister, the Hon. Richard Marles MP, said "It was an honour to be hosted by Prime Minister Boris Johnson and Defence Secretary Ben Wallace at today's commissioning ceremony for HMS *Anson*.

"Australia is eager to learn from our counterparts, and who better to learn from than our friends in the United Kingdom.

"Our countries are working hand in glove on training, and building the skills required for our future submarines is an important part of bolstering our Defence Force.

"Today's announcement of Australian submariners training aboard HMS *Anson* says everything about our future plans of building the AUKUS partnership.

"During my visit to Govan shipyard, where the Type 26 frigate is being built, we have Australian workers — engineers, mechanics and the like — who are learning from their UK counterparts to deliver the high-tech skills required to deliver for our frigate program back home in Osborne, SA.



The UK Defence Secretary, Ben Wallace (left), and Deputy Prime Minister of Australia, Richard Marles, during a joint press conference at BAE Systems in Barrow-in-Furness
(Photo courtesy UK Ministry of Defence)

HMS *Anson* will join four other Astute-class submarines in service with the Royal Navy — HMS *Astute*, HMS *Ambush*, HMS *Artful* and HMS *Audacious*.

Two further boats — *Agamemnon* and *Agincourt* — are in various stages of construction by BAE Systems at Barrow-in-Furness as part of £11.2 billion overall investment in the whole Astute-class programme

BAE Systems and Hobart-class Destroyers

It was announced on 13 Oct 2022 that BAE Systems Australia has been selected to partner with the Commonwealth of Australia to deliver a sovereign sustainment capability to the Royal Australian Navy's Hobart-class destroyer (DDG) fleet based in Sydney.

The $155 million contract will see BAE Systems become the Capability Life Cycle Manager (CLCM) for each of the Navy's three Hobart-class destroyers — HMAS *Hobart*, HMAS *Brisbane* and HMAS *Sydney*. Over the next six years, the company will manage the fleet, ensuring that they are ready to fight and win at sea, with the latest capability.

To deliver this contract, the BAE Systems' team will operate from the existing Destroyer Enterprise facilities based at the Royal Australian Navy's Fleet Base East in Sydney.

Since 2017, the company has been the managing contractor for the DDG Enterprise and has a specialised team of around 100 highly-skilled people focussed solely on the delivery of sustainment services to the Hobart-class destroyers. This contract will sustain those positions and grow the local ship sustainment industry into the future.

BAE Systems Australia Managing Director — Maritime, Craig Lockhart, said "We welcome the Commonwealth's decision and look forward to working alongside the Navy and our Enterprise partners to deliver this vital capability.

"Our established team has deep knowledge of the Hobart-class destroyer and will deliver a proven enterprise and collaborative approach which focuses on dependable delivery today and innovative ways of sustaining the class into the future.

"This is another example of how BAE Systems Australia is helping to deliver the next generation of naval capability and building local industry to help keep Australia secure."

Chief Executive Officer, BAE Systems Australia, Ben Hudson and Director General Major Surface Ships, Commodore Brad Smith, CSC, RAN (front) with witnesses BAE Systems Australia Managing Director – Maritime, Craig Lockhart and the Director of the Destroyer Systems Program Office, Captain Grant McLennan, RAN, sign the contract for BAE Systems to be the Capability Life Cycle Manager for the Hobart-class destroyers
(RAN photograph)

Maximising Australian Industry Capability is a critical element of the approach for future sustainment undertaken by BAE Systems Australia and its partners.

The contract comes at a critical time for naval fleet sustainment in Australia as the industry transitions to the Future Maritime Sustainment Model, guided by the vision of the Commonwealth's Plan Galileo. This plan ensures existing and new naval fleets can be effectively sustained and deployed rapidly from strategic locations across Australia and provides a cradle-to-grave approach to asset and capability management.

Hunter-class Frigate Program Progress

Equal to the size of two houses and taking 45 000 h, the first steel 'block' was completed in August by shipbuilders working on the Hunter-class frigate program.

BAE Systems shipbuilders are initially manufacturing five prototype ship blocks to test and refine the processes, systems, tools, facilities and workforce skills ahead of construction of the first Hunter-class frigate. There are 22 blocks in each frigate.

The first prototype block, known as Block 16, weighs more than 140 t and its construction involved the expertise of 35 different trades, including engineers, boilermakers, welders, fabricators and project managers.

This first prototype block (without any Hunter-class design changes) would form part of the middle of the ship where there are accommodation spaces.

Over the coming weeks and months, the Hunter program will continue constructing the second and third prototype blocks, each more complex than the last.

In mid-2023, the prototyping program will commence the production of additional blocks incorporating the Hunter-class design changes, with these blocks actually being used in one of the first three ships.

BAE Systems Australia Managing Director — Maritime, Craig Lockhart, said "Throughout construction of the first prototype ship block, our highly-skilled workforce has been able to incorporate new, more efficient and effective shipbuilding methods and innovations into our processes.

"Already, the quality and productivity we are achieving are well above where we thought they would be at this stage of prototyping. This quality demonstrates the potential of a strong future for continuous naval shipbuilding in Australia.

"We are working towards achieving new benchmarks in manufacturing efficiency and quality and the new processes we are developing allow much greater engagement with Australian suppliers."

The first prototype block constructed as part of the Hunter-class frigate program has been completed by BAE Systems at Osborne, SA
(Photo courtesy BAE Systems)

Austal USA-built EPF 13 completes Acceptance Trials

The future USNS *Apalachicola* (EPF 13), the US Navy's 13th Spearhead-class expeditionary fast transport (EPF) has completed acceptance trials and unmanned logistics prototype trials assessing autonomous capabilities integrated into the shipboard configuration, demonstrating that a large ship can become a self-driving platform.

In transit from Mobile, Alabama, to Miami, Florida, *Apalachicola's* autonomous system completed a stress test in high-traffic coastal areas by taking appropriate ship-handling actions while operating around other ships, boats, yachts, and other craft. Overall, the ship was in autonomous mode for approximately 85 percent of the multiple day at-sea period.

The development of autonomous capability on *Apalachicola* is a result of collaborative efforts with the industry partners, Austal USA, L3 Harris and General Dynamics.

EPFs are shallow draft, commercial-based, catamarans designed for rapid, intra-theatre transport of personnel and equipment.

The EPF's high speed, shallow draft, and ability to load/unload in austere ports enables force agility in achieving positional advantage over intermediate distances without reliance on shore-based infrastructure.

USNS *Apalachicola* is scheduled to be delivered to the US Navy later this year.

EPF 13, built by Austal USA, recently completed acceptance trials (Photo courtesy Austal USA)

Naval Shipbuilding and Sustainment Group

In recognition of the scale and complexity of Australia's naval enterprise, the Deputy Prime Minister and Minister for Defence, the Hon. Richard Marles MP, has agreed to establish a new Group within Defence to focus on naval acquisition and sustainment, as well as developing a competitive shipbuilding and sovereign sustainment industry. The Naval Shipbuilding and Sustainment Group (NSSG) took effect from 4 October.

The NSSG will be the dedicated entity, in partnership with the Royal Australian Navy, to deliver the Naval Shipbuilding and Sustainment Enterprise, building and sustaining maritime capabilities.

The new group is leading the implementation of the Government's initiative to develop a national shipbuilding and sovereign sustainment industry and workforce. The NSSG will drive, inform and influence decision-making related to the acquisition and sustainment of Navy's current and future fleet.

Mr Tony Dalton will head the group, as Deputy Secretary, Naval Shipbuilding and Sustainment. Mr Dalton enjoyed a long career in the Navy where he was responsible for the delivery of shipbuilding programs including the Hunter-class frigate and the Arafura-class offshore patrol vessel.

Mr Dalton will lead a team of dedicated professionals including John Chandler, FAS Submarines; Stacie Hall, FAS National Shipbuilding and Sustainment Enterprise Headquarters; Sheryl Lutz, FAS Major Surface Combatants and Combat Systems; RADM Wendy Malcolm, Head of Patrol Boats and Specialist Ships; and RADM Steven Tiffen, Head of Maritime Sustainment Division.

Additional Guardian-class Patrol Boat for Pacific Maritime Security Program

The Australian Government has ordered an additional Guardian-class Patrol Boat from Austal Australia for $15.2 million.

The 39.5 m steel-hulled patrol boat, to be constructed in Western Australia and delivered in September 2024, is in addition to the 21 Guardian-class patrol boats ordered by the Australian Government under the Pacific Patrol Boat Replacement Project (SEA3036-1) in 2016.

Fifteen of the 21 vessels have been delivered to 11 Pacific Island nations under the Australian Government's Pacific Maritime Security Program, since 2018.

Austal Australia has received an order from the Australian Government for an additional Guardian-class patrol boat
(Photo courtesy Austal Australia)

Finnish Yard lays keel of new Spirit of Tasmania Ro-Pax Ferry

Rauma Marine Constructions of Finland has laid the keel of a new Ro-Pax ferry ordered by the Australian operator TT-Line.

The future *Spirit of Tasmania IV* will be the first of two 1800-passenger ferries which will sail on TT-Line's Spirit of Tasmania service between Geelong and Devonport in Tasmania.

The vessel's delivery is scheduled for the first quarter of 2024. The second ferry in the series will be handed over before the end of that year.

Keel Laid for Fifth OPV

The Arafura-class Offshore Patrol Vessel Program continues to go from strength to strength, with the keel laying ceremony held for the fifth vessel, the future HMAS *Illawarra*.

The ceremony took place in Henderson, Western Australia, and was attended by Deputy Secretary National Naval Shipbuilding, Tony Dalton, Head Navy Capability, RADN Pete Quinn AM CSC, and the Chairman of Luerssen Australia, Tim Wagner.

In keeping with tradition, two shipbuilders from Luerssen Australia placed a coin under the keel, alongside RADM Quinn.

Chairman of Luerssen Australia, Tim Wagner, was delighted to attend the ceremony and congratulate the team.

"The progress on this program has been fantastic and I'm very happy to see that it has opened up new opportunities for local businesses," said Mr Wagner.

"Luerssen Australia is creating local jobs and investing in the shipbuilding industry in Australia. We strongly believe there is a bright future with a lot of opportunities nationally and for exports from Henderson."

Luerssen Australia CEO, Jens Nielsen, said the event showcased the fantastic progress being made on the program.

"I'm extremely proud of the people in our company and the keel-laying milestone is testament to the hard work and commitment of everyone involved," said Mr Nielsen.

"Our supplier partners are critical to our success and I would like to thank them and the Department of Defence for their ongoing support as we help create a sovereign shipbuilding industry in Australia."

RADM Pete Quinn with Luerssen shipbuilders at the keel-laying ceremony for the future HMAS *Illawarra*
(Photo courtesy Luerssen Australia)

Indomal Empire from Incat Crowther

Incat Crowther has announced the successful entry into service of the Incat Crowther 30 *Indomal Empire*. The 255-seat passenger ferry is now operating services on the Malacca Strait between Indonesia and Malaysia and has been performing well in demanding conditions.

Built by PT Cahaya Samudra Shipyard in Batam, Indonesia, *Indomal Empire* is operated by Indomal Express, requiring compliance with local rather than international regulations. *Indomal Empire* was specifically developed to cater for a segment of the market demanding lower ticket prices and subsequently less-complex and yet still very capable vessels.

Indomal Empire has a functional layout of forward-facing seats over two decks and is outfitted to a high standard. Midship entry doors on the main deck provide a central boarding position in direct proximity to stairs to the upper deck. Luggage racks are fitted here and at the forward end of the cabin. The main deck seats 207 and has three bathrooms aft.

The upper deck extends full width and affords a good outlook around the wheelhouse and to the sides. 48 passengers are accommodated, with a single toilet aft. A collection of outboard seats are provided with tables.

Large deck hatches at the midship boarding doors provide access to hull compartments dedicated to luggage storage.

Indomal Empire is powered by twin MAN D2862 LE483 main engines, easily propelling the vessel to a top speed of 30 kn. Propulsion is via a pair of ZF 3050 gearboxes to fixed-pitch propellers.

Indomal Empire's success has resulted in orders for three additional vessels, with further vessels scheduled for construction as 'stock' vessels for general sale.

Principal Particulars of *Indomal Empire* are

Length OA		30.9 m
Length WL		30.3 m
Beam OA		8.5 m
Depth		3.0 m
Draft	(hull)	1.2 m
	(propellers)	1.8 m
Passengers		255
Crew		8
Fuel oil		7000 L
Fresh water		3400 L
Sullage		1000 L
Main engines		2×MAN D2862 LE483 each 1066 kW @ 2100 rpm
Propulsion		2×fixed-pitch propellers
Generators		2×80 kVA Perkins 4.4TW2GM
Speed	(service)	28 kn
	(maximum)	30 kn
Construction		Marine-grade aluminium
Flag		Indonesia
Class/Survey		Biro Klasifikasi Indonesia (BKI)

Starboard bow of *Indomal Empire*
(Photo courtesy Incat Crowther)

Bow view of *Indomal Empire*
(Photo courtesy Incat Crowther)

SHADOWOLF from Incat Crowther and YCTS

SHADOWCAT, the leading developer of catamaran support yachts, has announced that it has expanded its portfolio to include a fully-bespoke monohull shadow vessel. The new concept, SHADOWOLF, is SHADOWCAT's first single-hulled support yacht and is available to meet the increasing demand for guest-level comfort and services. The vessel's new hybrid-hull design SHADOWOLF perfectly supports a superyacht and is ideal for expanding options on multi-day excursions, voyages into more remote locations, and/or for chartering or research purposes.

Designed by SHADOWCAT partners Incat Crowther and YCTS Ltd, the 69.2 m SHADOWOLF has an 11.5 m beam and 3.25 m draft, and will be built on Incat Crowther's award-winning aluminium hull design, enabling some of the highest speeds and superior efficiency of any support yacht available on the market.

Other SHADOWOLF features include a fully-certified helipad and hangar, with accommodation and storage over three decks. The support vessel has an impressive carrying capacity, including space for a submarine, three 11 m tenders, two 8 m tenders, six jet-skis, two 4WDs and two quad bikes. In addition to a 14 crew-member and nine service-personnel capacity, it has accommodation for eight guests or extra resting space for crew from the main yacht. The total complement is 31.

"SHADOWOLF stands out in large part due to its hull being designed specifically for yacht-level comfort whilst offering exceptional efficiency. It also allows owners to commission a fully-bespoke support yacht within a very competitive price range and delivery window via SHADOWCAT's network of builders around the world," said Incat Crowther's Technical

Manager, Dan Mace. “Incat Crowther is well-known for producing award-winning vessels on both catamaran and monohull platforms, and we look forward to this ‘industry-first’ concept coming to life.”

“The addition of a monohull concept to our portfolio is a natural next step for SHADOWCAT, and firmly establishes us as the No. 1 support-yacht developer in the industry. This latest innovative concept delivers extreme comfort at sea, without the need to compromise on performance, speed or customisation options,” said Robert Smith, SHADOWCAT founder and YCTS director. “Because developing shadow yachts is our sole focus, we can deliver a higher level of expertise and vessel customisation across multiple platforms, ensuring that our clients’ operational needs are surpassed.”

The vessel is powered by three MTU 16V4000 M73L IMO3 diesel engines and can reach a top speed of 21 kn. In a unique design for modern support vessels, this model will meet or exceed IMO Tier III emissions guidelines and has innovative green technology to reduce its impact on the environment by providing a zero-discharge operational capability. An onboard treatment plant cleans all wastewater discharged to a drinkable quality, and wet and dry waste is also fully treated onboard to allow the vessel to operate with a zero-discharge policy, to meet a “leave no trace” philosophy. High levels of onboard comfort are aided by a pair of Naiad Dynamics AtRest stabilizers.

Principal particulars of SHADOWOLF are

Length OA	69.2 m
Length WL	68.2 m
Beam OA	11.5 m
Depth	6.00 m
Draft (hull)	3.25 m
Crew	14 + 9 staff
Guests	8
Fuel oil	300 000 L
Petrol	150 L
Jet Fuel (A1)	7500 L
Fresh water	30 000 L
Grey water	40 000 L
Black water	15 000 L
Main engines	3×MTU 16V4000 M73L IMO3 each 2832 kW @ 2050 rpm
Propulsion	3×Helseth controllable-pitch propellers
Generators	2×450 kVA 50 Hz
Speed (service)	21 kn
(maximum)	22 kn
Construction	Marine-grade aluminium
Flag	Cayman Islands
Class/Survey	Lloyds Register SSC & LY3 ILO compliant

Starboard side of SHADOWOLF
(Image courtesy Incat Crowther)

Helipad and boats on SHADOWOLF
(Image courtesy Incat Crowther)

Bird’s-eye view of SHADOWOLF
(Image courtesy Incat Crowther)

Korea Pride from Incat Crowther

Incat Crowther has announced the launch of the 72 m passenger ferry *Korea Pride*. Incat Crowther supported Korea Express Ferry in the building of the ship which will operate from Incheon on the west coast of South Korea. In procuring such a ferry, Korea Express Ferry set very high safety, comfort and performance standards. The operator also specified that the ship be built locally, becoming the first ship of this type constructed in South Korea.

Incat Crowther was selected to design the ship and supervise its construction at Kangnam Corporation in Busan. This choice was based on Incat Crowther's digital shipbuilding credentials and operator-focused design. "It's a great example of our approach to using global experience to support local building", said Incat Crowther's Technical Manager, Dan Mace.

The finished product highlights the developed capability to build this class of ship locally in South Korea. *Korea Pride* features a sleek, single-deck configuration which, Mace explains, was selected to handle the specific conditions which include large swell and wind chop. "Safety and open sea capability drove our design and build. The 72 m platform is longer than usual for a single-deck ship. This delivers greater speed without sacrificing fuel efficiency."

Sung Man Hwang, CEO of Korea Express Ferry, is full of praise for the new ship. "We are very pleased with the outcome," he said. "Incat Crowther's contribution to the project cannot be overstated. We received a high-quality ship which reached an impressive 41 kn on sea trials. It is a very happy day for us to take delivery of such an extraordinary ship. It will serve our passengers very well".

A full complement of 556 passengers will be accommodated across a single deck. To maximise safety and efficiency, passengers board and disembark via six boarding gates/doors, located to integrate with shoreside infrastructure.

On board, passengers are served by economy, business and first-class cabins. A central amenities block features a large well-equipped kiosk in addition to bathrooms and a mothers' room. Luggage racks are plentiful in all cabins. At the aft end of the main deck is a crew area with mess room, office and bathroom. The ship also has a medical room.

Starboard quarter of *Korea Pride*
(Photo courtesy Incat Crowther)

Main cabin on *Korea Pride*
(Photo courtesy Incat Crowther)

Korea Pride is powered by quad MTU 16V4000 main engines, with neat and tidy engine room layout and exposed engine hatches aiding maintenance and removal. The ship has an operating speed of 36.5 kn.

Starboard side of *Korea Pride*
(Photo courtesy Incat Crowther)

First-class seating on *Korea Pride*
(Photo courtesy Incat Crowther)

The ship will be a lifeline for many who live on and trade and travel between these Korean islands and the mainland. To see a video walkthrough of the vessel, please go to https://youtu.be/A0iTMgu6PCM.

Principal particulars of *Korea Pride* are

Length OA	72.0 m
Length WL	69.6 m
Beam OA	16.0 m
Depth	5.5 m
Draft (hull)	1.8m
Passengers	556 + 3 occasional
Crew	10
Fuel oil	30 000 L
Fresh water	4500 L
Sullage	4500 L
Main engines	4MTU 16V4000 M73L each 2880 kW at 2050 rpm
Propulsion	4Kamewa S71-4
Generators	2×290 ekW at 1800 rpm
Speed (service)	36.5 kn
(maximum)	40.0 kn
Construction	Marine-grade aluminium
Flag	Republic of Korea
Class/Survey	Korean Register of Shipping (KRS) ✠KRS0 PASSENGER SHIP CATAMARAN (HSLC-SA2) ✠KRM0 UMA 100 n miles from harbour or safe anchorage

Odalisque III from Incat Crowther

Incat Crowther has been commissioned to design and deliver a new boutique live-aboard cruise vessel for Tasmanian luxury wilderness expedition cruise operator On Board. The 24 m vessel, named *Odalisque III*, is currently being built by Richardson Devine Marine Constructions in Hobart and is scheduled for delivery in early 2023.

Designed to provide guests with a luxurious wilderness escape in the pristine south-west Tasmanian wilderness, the aluminium-hulled *Odalisque III* can host up to 12 guests in seven stylish and flexible cabins, each with its own ensuite. The upper deck features three large guest cabins, a wheelhouse lounge and dining area as well as an outdoor dining and viewing area. The main deck features four cabins, a large indoor dining area, an outdoor viewing platform and the galley. Configured to offer a world-class dining experience while also being operationally efficient, the galley is conveniently located adjacent to pantry, refrigeration and cleaning facilities.

In total, *Odalisque III* boasts three outdoor viewing decks and an open bridge to provide guests with uninterrupted views of the spectacular wilderness. *Odalisque III*'s design has allowed for the addition of two tenders, accessible from the main deck, to allow guests to board a tender for shore excursions.

Incat Crowther's CEO, Brett Crowther, explained that the design had to deliver the right balance of aesthetics and bespoke technical design. "Our team's design expertise and our tailored digital design process meant that we were well placed to bring On Board's vision to reality. Not only did the design of *Odalisque III* need to provide guests with a luxurious experience, but On Board is acutely aware of the need to ensure that their operations do not adversely impact the environment," said Mr. Crowther.

"The design of *Odalisque III* has achieved this by combining an environmentally-conscious technical design with the features which guests expect in a world-class cruising experience, such as a seamless scenic wilderness flight," said Mr. Crowther.

Starboard side of *Odalisque III*
(Image courtesy Incat Crowther)

Port quarter of *Odalisque III*
(Image courtesy Incat Crowther)

Pieter van der Woude, founder of On Board, said he was excited at the prospect of offering a world-class experience aboard *Odalisque III*. "My vision is to offer our guests an experience akin to being in a floating luxury wilderness

lodge. Our guests expect the best, and Incat Crowther's design delivers this. I cannot wait to take guests into Tasmania's World Heritage wilderness on *Odalisque III* early next year," said Mr van der Woude.

Principal particulars of *Odalisque III* are

Length OA	24.8 m
Length WL	24.3 m
Beam OA	8.00 m
Depth	3.25 m
Draft (hull)	1.25 m
Passengers	12 for 1C, 36 for 1D
Crew	5
Fuel oil	16 600 L
Fresh water	4000 L
Sullage	6000 L
Main engines	2×Scania D13 076M each 607 kW @ 2300 rpm
Propulsion	2×propellers
Generators	2×60 kW
Speed (service)	21 kn
(maximum)	25 kn
Construction	Marine-grade aluminium
Flag	Australia
Class/Survey	NSCV Class 1C/1D

Aft decks on *Odalisque III*
(Image courtesy Incat Crowther)

Looking forward in the lounge on *Odalisque III*
(Image courtesy Incat Crowther)

Looking aft in the lounge on *Odalisque III*
(Image courtesy Incat Crowther)

Cabin on *Odalisque III*
(Image courtesy Incat Crowther)

25 m Patrol Vessel from Incat Crowther

Thailand's Department of Marine and Coastal Resources (DMCR) will take delivery of a new state-of-the-art research vessel after digital shipbuilder Incat Crowther won a competitive international tender for the project.

The Incat Crowther 25, which will be delivered in 2023 in partnership with 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 multitude of equipment and features to help its crew protect sensitive coastal areas while having minimal impact on the environment.

Starboard bow of 25 m patrol vessel for DMCR Thailand
(Image courtesy Incat Crowther)

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/operations control room with a day head and the captain's and engineer's cabins with ensuites. The hull deck features two crew cabins.

Incat Crowther's Technical Manager, Dan Mace, said "We are proud to be working with the DMCR on another important project. While this vessel is based on a tried-and-tested catamaran design, it will be tailored to the DMCR's requirements and feature the latest technological innovations."

"The aluminium hull, for example, has been designed and developed following extensive tank testing and has been proven to achieve market-leading performance standards," said Mr Mace.

"The upper deck of the vessel has also been designed to provide the captain with an optimal line of sight, while the inclusion of the crane ensures that the crew can launch a

tender quickly. The propulsion system allows the vessel to achieve maximum speeds over 30 kn and can easily cruise at 20 kn. The impressively low fuel burn helps to maximise the vessel's operational efficiency," said Mr Mace.

Seacrest Marine hosted a keel-laying ceremony in August 2022 attended by government officials and other dignitaries to mark this important milestone.

This project will see the DMCR and Seacrest Marine work together for the second time, following the delivery of the Incat Crowther 26 research vessel *Pakarang* to the DMCR in 2019. This project continues Incat Crowther's long and successful history working with the Government of Thailand, after previously delivering three vessels for the Royal Thai Marine Police, including two Incat Crowther 26 catamaran patrol boats in 2016 and one Incat Crowther 42 monohull patrol boat earlier in 2022.

Principal particulars of the 25 m patrol vessel are

Length OA		26.64 m
Length WL		26.05 m
Beam OA		9.50 m
Depth		3.95 m
Draft	(hull)	1.68 m
	(propellers)	2.22 m
Passengers		16
Crew		12
Fuel oil		8000 L
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

Cruising in NSW

Cruising in NSW has resumed after the quiet of the pandemic with the arrival in Sydney of *Pacific Explorer* on 18 May. She departed Sydney on the first trip with passengers on 31 May, sailing to Brisbane. Since then there has been an increasing number of cruise vessels visiting Sydney.

November moved into high gear, with at least one or two cruise ships berthing almost every day through to the end of February.

Vessels berthing regularly at the Overseas Passenger Terminal at Circular Quay is a sure sign that the summer cruise season is under way.

Cruise ships have also resumed calling at Eden on the south coast, with 18 visits scheduled for November–February.

Phil Helmore

Pacific Explorer arriving in Sydney on 18 April
(Photo from YourLifeChoices website)

Pacific Adventure berthed at the Eden cruise ship wharf on 13 November
(Photo courtesy Robert Whiter)

Autonomous Vessel Regulation in Australia: Why an Australian Code of Practice is Required

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The operation of autonomous or remotely-operated vessels ("autonomous vessels") in Australia requires compliance with the Australian maritime regulatory framework. This national framework is built on a series of assumptions based on traditional vessels; for example: humans on board must be protected; operational risk increases as the vessel travels further from shore, and humans will be making navigational decisions from onboard. For autonomous vessels, the assumptions underpinning the regulatory framework do not always apply. The relatively-recent uptake of autonomous vessels in Australia has highlighted the difficulties in applying the existing regulatory framework to them, particularly due to the lack of tailored standards and the uncertainty and delay which it causes.

This paper argues that an Australian Code of Practice for autonomous vessels is required, because the existing available standards are not suitable. This argument is in three steps; Part 1 sets out briefly the challenges for operating autonomous vessels within Australia's domestic maritime regulatory framework; Part 2 outlines the draft Australian Code of Practice released for public consultation by Trusted Autonomous Systems in 2021 and how it benefits operators in navigating the regulatory framework; and Part 3 demonstrates the efficacy and advantage. of the draft Code by outlining how it could assist operators of a small autonomous vessel being used in Australia, the REMUS 100.[1]

INTRODUCTION

The general term 'autonomous vessel' describes a vessel capable of a broad range of autonomous and remote operations [1]. More specific terms are used to describe whether the vessel operates on the water surface or sub-surface and whether it is remotely operated or autonomous. For example, Autonomous Surface Vessel (ASV); Autonomous Underwater Vessel (AUV); Unmanned Surface Vessel (USV); and Unmanned Underwater Vessel (UUV) [2].

Autonomous and remotely-operated vessels (autonomous vessels) are used by many nations for a growing range of commercial and defence activities [1]. In Australia, the first regulatory approval for an autonomous vessel was issued in 2017, to the C-WORKER 5 Autonomous Surface Vessel (ASV). It is estimated that the Australian Maritime Safety Authority (AMSA) has allowed approximately 10–20 commercial autonomous vessels to operate in Australian waters under a Specific Exemption or other tailored regulatory treatment [2], including for hydrographic surveying, pipeline monitoring, reef monitoring, and defence-related activities [3].

Internationally, many nations are still establishing their regulatory approaches for autonomous vessels [4]. A number of codes and standards for autonomous vessels have been developed internationally in the last five years, including the *UK Code of Practice for Maritime Autonomous Surface Ships 2020*, the *LR Code for Unmanned Marine Systems 2017*, and DNV 's *Autonomous and Remotely-operated Ships Class Guideline 2018* [5]. These codes and standards can be used as a reference for Australian autonomous vessels, but the significantly-different Australian operational context and domestic vessel technical standards limit ease of use [5]. There are also several uncertainties remaining which need to be answered to further inform codes and standards, such as whether autonomous vessels are considered "ships" for the purpose of international and domestic law [4]. The Regulatory Scoping Exercise recently completed by the International Maritime Organisation's Maritime Safety Committee is an important first step in progressing the international regulation of autonomous vessels [6].

This paper argues that an Australian Code of Practice for autonomous vessels is required, because the existing available standards are not suitable. This argument is in three steps; Part 1 sets out briefly the challenges for operating autonomous vessels within Australia's domestic maritime regulatory framework; Part 2 outlines the draft Australian Code of Practice released for public consultation by Trusted Autonomous Systems in 2021 and how it benefits operators in navigating the regulatory framework [7]; and Part 3 demonstrates the efficacy and advantages of the draft Code by outlining how it could assist operators of a small autonomous vessel being used in Australia, the REMUS 100. Future case studies are needed to consider the diverse range of autonomous vessels in operation in Australia, ranging in autonomy levels [8–9], size, speed, and capability [10].

PART 1: CHALLENGES FOR OPERATING AUTONOMOUS VESSELS IN AUSTRALIA

This part identified three primary challenges for the operation of autonomous vessels in Australia. These are lack of tailored standards, lack of a common benchmark for good practice, and lack of resources to support the regulatory process.

Autonomous vessels are primarily regulated by AMSA, under the same framework as 'traditional' vessels, as domestic commercial vessels (DCVs) under the *Marine Safety (domestic commercial vessel) National Law Act 2012* (National Law)[2]. The regulatory requirements which apply to domestic commercial vessels [11–13] arise from the National Law, the National Law Regulation, Marine Orders 501–507 and the National Standard for Commercial Vessels (NSCV) [14–15]. Domestic commercial vessels are

1 The authors would like to thank the peer reviewers and coordinator for their efforts, together with Prof. Kieran Tranter for his ongoing support.

2 AMSA also regulates regulated Australian vessels under the Navigation Act 2012. However, this paper will only deal with domestic commercial vessels, as there is a lack of clarity regarding requirements for autonomous regulated Australian vessels, and no available regulatory decisions by AMSA to provide guidance.

required to hold a unique vessel identifier [16], certification related to survey [16] and operations [17], and be crewed by persons holding the required certificates of competency [19]. The National Law also requires compliance with General Safety Duties by the vessel owner and master, together with anyone else responsible for designing, manufacturing, constructing the vessel or its equipment, or interacting with the vessel (including crew and passengers). Failure to comply with requirements set out in the National Law can result in fines and imprisonment[3] [20–22].

The National Law contains a range of flexibility mechanisms that are intended to enable operation without meeting the full scope of requirements. These mechanisms are Specific Exemptions, General Exemptions, and Equivalent Means of Compliance. Specific Exemptions require application directly to AMSA and enable operation without meeting specified National Law requirements.[4] General Exemptions apply to the operators and vessels which fit the specified criteria, and either apply as of right (i.e., without needing to apply) or have an application process. To grant an exemption, AMSA must be satisfied that the exemption concerned, together with the conditions to which it is subject, will not jeopardise the safety of a vessel or a person onboard a vessel [23]. The National Regulator may impose conditions on exemptions, for example, continuous monitoring while an autonomous vessel is operating, or imposing a speed limit [24]. Equivalent Means of Compliance (EMOC) [25] relate specifically to the NSCV, and enable an operator to comply with a Required Outcome stated in the NSCV by means other than a listed Deemed to Satisfy Solution (DSS). EMOCs are generally not used where the applicant's intent is to avoid compliance with a Required Outcome, rather than seeking an alternative way to comply with it.[5]

In 2021 AMSA issued a Guidance Notice for small, unmanned vessels, which outlines AMSA's approach to specific exemption applications related to a certificate of survey. It applies to vessels less than 12 m in length, non-passenger vessels or fishing vessels, operating in operational areas C, D or E.[6] The Guidance Notice identifies the specific issues to be addressed in an exemption application and increases clarity for applicants by indicating AMSA's expectations. The Guidance Notice is an example of AMSA seeking to support operators within the existing regulatory framework.

The Challenges Raised by the Existing Regulatory Framework

The existing regulatory framework was not intended to apply to vessels without humans on board and which rely on a spectrum of remote operation, autonomy, and artificial intelligence to operate. The challenges raised by the lack of tailored standards include reliance on exemptions and resulting uncertainty and delay, and lack of a common benchmark for good practice. There is also a lack of resources available to support stakeholders to understand and negotiate the complex regulatory process.

Lack of Tailored Standards

There are no standards incorporated into the Australian maritime regulatory framework which are tailored for autonomous vessels. This means that, if operators cannot comply with the existing standards, or choose not to because compliance is overly onerous, they must rely on exemptions to operate.[7] Reliance on exemptions raises uncertainty regarding timeframe and outcome, and places a resources burden on both the applicant and AMSA. For example, applying for and granting exemptions can require a prolonged period of communication between both parties to create a common understanding of the vessel and proposed operation, and the conditions which are appropriate to be imposed. This burden is exacerbated by the two challenges mentioned below: lack of a common benchmark for good practice, and lack of resources to support stakeholders through the regulatory process.

Lack of a Common Benchmark for Good Practice

There is a lack of a common benchmark for good practice for the design, construction, survey and operation of autonomous vessels in Australia. While there are several international codes and standards available, the analysis conducted by Vanderkooi Consulting on behalf of TAS in 2021 identified that their ease of use was significantly limited by the different Australian operational context, the smaller vessels common in Australia, and the need for alignment with the NSCV [5]. This lack of a common benchmark means that operators and AMSA do not have a common starting point for their expectations of how autonomous vessels are designed, constructed, surveyed and operated, leading to uncertainty from all parties and delay. For example, it means applications must be assessed on first principles every time, rather than against a standardised set of requirements acknowledged to be best practice.

Lack of Resources to Support Stakeholders to Understand and Negotiate Regulatory Process

There is a lack of resources available to support stakeholders to understand and negotiate the Australian regulatory process, resulting in further uncertainty and

3 For example, an intentional act or omission that contravenes National Law s12(1) Duty of owners of domestic commercial vessels to ensure safety of vessels, marine safety equipment and operations, carries a penalty under s13(1) National Law of imprisonment for two years, or 1800 penalty units, or both.

4 An example of a General Exemption that is commonly used by autonomous vessel operators is Marine Safety (Temporary Operations) Exemption 2020 (Cth),[24] which is referred to as EX07. EX07 enables Temporary Operations Permits to be issued which allow a vessel to operate for up to 90 days without certification. Temporary Operations Permits are often used by autonomous vessel operators to test and trial their vessels and gather data to support an application for certification (for example, a Certificate of Operation).

5 Marine Orders provide the detail of requirements, processes, etc. for the obligations identified in the National Law, [25–31].

6 The vessels also must not carry persons while underway, carry dangerous goods, engage in vessel towage operations or be set up for that purpose, have an inboard engine operating on fuel with a flashpoint of less than 60 degrees Celsius or operate at greater than 10 kn. The vessels are also expected to be supported by a rescue vessel capable of providing support within six hours.

7 For example, a Specific Exemption from the requirement to comply with the requirement to hold a Certificate of Survey under the National Law.

delay. Operators currently need to either navigate the AMSA website and review several web pages relating to general domestic commercial vessel requirements, or contact AMSAConnect via email or phone to lodge a query. There is no published summary of the specific regulatory requirements and processes for autonomous vessels, and no way to quickly access this information. The involvement of new types of designers and operators, including engineers without a maritime background, and who may not know about AMSA or understand the maritime operating context, makes the need for publication of accessible information more pressing. A lack of stakeholder resources also adds to the resource burden faced by AMSA as more operators need to seek individualised advice, rather than relying on published guidance materials.

The lack of suitable stakeholder resources is likely for several reasons, including the lack of tailored standards or common benchmarks of good practice to refer to, the resulting individualised nature of assessing applications, and the nuance and complexity of the regulatory framework. It is also likely reflective of the limited resources available within AMSA as a safety regulator to produce guidance materials which draw together regulatory and policy, operational, and survey-related advice of the nature needed by autonomous vessel operators. If there were tailored standards and a common best practice benchmark for reference, then it would likely be easier to put in place the sort of resources which stakeholders need to understand and negotiate the regulatory process.

PART 2: THE AUSTRALIAN CODE OF PRACTICE AND HOW IT BENEFITS OPERATORS IN NAVIGATING THE REGULATORY FRAMEWORK

This part discusses the voluntary Australian Code of Practice for the Design, Construction, Survey and Operation of Autonomous and Remotely Operated Vessels ('Australian Code of Practice'). The development of the Australian Code of Practice was led by Trusted Autonomous Systems (TAS), with a Consultation Draft released in November 2021, and intended publication in March 2022. The Code was developed with support and ongoing engagement from AMSA and a wide range of commercial, Defence and Government stakeholders and industry members. The purpose of developing the Australian Code of Practice was to provide a tailored voluntary standard suitable for autonomous vessels operating in Australia, and therefore improve efficiency and reduce uncertainty for these vessels within the maritime regulatory framework. The intent is for operators to comply with the Australian Code of Practice as a common benchmark of good practice, and to provide evidence to AMSA of their compliance, to receive a specific exemption enabling operation. The Guidance Materials which will be published alongside the Australian Code of Practice are intended to provide clear information on regulatory requirements and process, how to use the Code, and how to demonstrate compliance. These Guidance Materials are intended to address the third challenge identified in this paper, being the lack of resources to support stakeholders in understanding and negotiating the regulatory process.

Prior to development of the Australian Code of Practice a report was prepared analysing existing, publicly available standards and codes for autonomous vessels, and providing recommendations [5]. Informed by the Report and consultation workshops, the following key principles were identified:

- the Code should align with the Australian regulatory framework for conventional DCVs as far as possible and appropriate;
- a risk analysis approach, which focuses on the impact of potential failures, should apply to the development and testing of novel systems on the vessel; and
- requirements should be commensurate with risk posed.

Draft content for the Australian Code of Practice was then considered by 11 workshops with government and industry stakeholders, including AMSA, vessel operators, accredited marine surveyors, seafarers, creators of autonomous technology, ship and equipment builders, Australian Defence and Defence industry stakeholders. The outcomes of these workshops informed the development of the draft Australian Code of Practice.

Under the Australian Code of Practice, modified conventional vessel standards and additional performance requirements apply to the vessel's navigation and situational awareness system, control system, communications system, and operations. These, and other novel systems on the vessel, must be developed through risk-based analysis. In addition, there are requirements for contingency planning, software integrity, cyber security, testing, vessel surveys, and third-party review of risk assessments. To ensure that the requirements of the Australian Code of Practice are tailored to the risks of the vessel, it includes three vessel categories: autonomous and remotely-operated marine equipment; survey-exempt vessels; and vessels in survey, as set out in Figure 1.

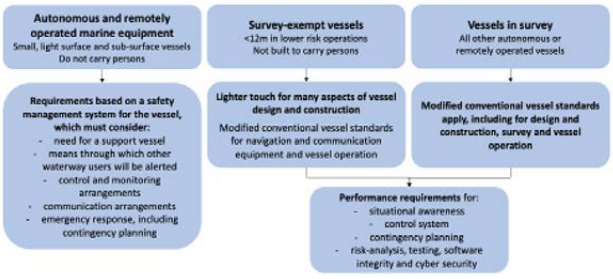

Figure 1. Vessel categories in the Australian Code of Practice

Autonomous and Remotely Operated Marine Equipment Requirements

This category includes small, light and slow vessels, including vessels likely to be less than 5 m in length and operating at speeds slower than 5 kn [32]. The Australian Code of Practice requires that "…vessel and operational risks are managed through a safety management system, which identifies risks and includes procedures to eliminate or minimise those risks so far as reasonably practicable. The safety management system must address the need for a support vessel; the means through which other waterway users will be alerted as to the presence of the vessel; the control and monitoring arrangements for the vessel; communication arrangements; and emergency response arrangements, including contingency planning" [32]. These vessels are also required to "…be collected

within a reasonable period if it stops operating, not contain hazardous materials which may pose a risk to the environment or third parties if the vessel stops operating, and comply with some aspects of COLREGS, such as the lights requirements" [32].

This category will be particularly assistive for operators of smaller autonomous vessels such as the REMUS 100 or Coral AUV, in providing them with a tailored regulatory approach which matches the risk profile of the vessel and its proposed operation. It provides certainty in the applicable requirements and should enable a faster regulatory process for the operator, and a lesser resource burden on AMSA in assessing it. The resources available in the Guidance Materials will assist operators in completing their safety management system and appropriate crewing assessment, and in understanding what to apply to AMSA for, and how.

Survey-exempt Vessel Requirements

This category includes "…low-complexity vessels less than 12 m in length which are not built to carry persons and do not carry dangerous goods, tow other vessels or have an inboard petrol engine" [32]. The Australian Code of Practice, consistent with the existing requirements for lower risk conventional vessels, contains requirements related to "…the construction, flotation/stability, machinery, steering, watertight and weathertight integrity and fire safety aspects of the vessel...modified conventional vessel standards and additional performance requirements apply to the vessel's: navigation and situational-awareness system; control system; communications system; and operations. These, and other novel systems on the vessel, must be developed through risk-based analysis. In addition, the draft code requires survey-exempt vessels to meet requirements for contingency planning, software integrity, cyber security, testing and third-party review of risk assessments" [32].

This category will be particularly assistive for operators of medium autonomous vessels such as the Ocius Bluebottle, ixblue DriX or Saildrone, in providing them a tailored regulatory approach which matches the risk profile of the vessel and its proposed operation. Similar to the previous category, the survey-exempt category provides certainty in the requirements which apply, and how to demonstrate compliance with those requirements. It should enable a faster regulatory process for the operator, and a lesser resource burden on AMSA in assessing it. The resources available in the Guidance Materials will assist operators in completing their documentation, including the Concept of Operations, Design Record, and Safety Management System.

Vessels in Survey Requirements

This category includes all vessels which do not fit the categories of 'autonomous and remotely-operated marine equipment' or 'survey-exempt'. For these vessels, "… modified conventional vessel standards and additional performance requirements apply to all aspects of the vessel, including its navigation and situational awareness system, control system, communications system, watertight and weathertight integrity, construction, engineering, stability and auxiliary and anchor systems; fire-safety system; and operations. All novel systems on the vessel must be developed through risk-based analysis." Vessels in survey are also required "…to meet requirements for contingency planning, software integrity, cyber security, testing, vessel surveys, and third-party review of risk assessments" [32].

This category will be particularly assistive for operators of larger, faster, and higher-risk autonomous vessels in providing them a tailored regulatory approach which matches the risk profile of the vessel and its proposed operation. Similar to the previous category, the survey vessel category provides a higher degree of certainty in the requirements which apply, and how to demonstrate compliance with those requirements. It is closely cross-referenced with the NSCV, but with amendments or additions to ensure it is appropriate for autonomous vessels, enabling a faster regulatory process and a lesser resource burden on AMSA in assessing it. The resources available in the Guidance Materials will assist operators in completing their documentation, including the Concept of Operations, Design Record, and Safety Management System.

The development of the voluntary Australian Code of Practice was necessary to address the lack of tailored standards for autonomous vessels operating in Australia, the lack of a common benchmark for good practice, and the lack of available stakeholder resources. Elements of the project, such as the initial analysis undertaken of existing standards and codes, the extensive consultation undertaken with AMSA and other stakeholders, and additional reviews of the Code content by AMSA, points towards its capability in addressing those challenges. Once the Australian Code of Practice is publicly released, and operators start using it as part of their regulatory process, it will be possible to gather evidence to determine whether the Code has truly addressed these challenges and to what degree.

PART 3: IDENTIFYING THE IMPACT OF THE AUSTRALIAN CODE OF PRACTICE THROUGH A CASE STUDY: SMALL AUV — REMUS 100

This part uses a case study to highlight the challenges faced by operators of autonomous vessels in Australia, and to identify the impact of the Australian Code of Practice in addressing those challenges. The REMUS 100 was chosen as the subject of the case study because it is a popular off-the-shelf small autonomous vessel, the required data was available to the authors, and the authors had operational experience with it and the corresponding regulatory process. Further case studies should be developed to represent the breadth of autonomous vessel types in operation in Australia.

This case study starts by setting out the vessel particulars and common operational practices for the REMUS 100, and then identifies the regulatory requirements which apply under the existing maritime regulatory framework, together with the requirements that will apply under the Australian Code of Practice. The case study will conclude with consideration of the impact of the Australian Code of Practice.

The REMUS 100 (Figure 2) is a compact AUV and part of the REMUS (Remote Environmental Monitoring UnitS) series of vehicles, which are amongst the most commonly used AUVs in the world. The REMUS 100 is designed to operate to a depth of 100 m, with a speed of approximately 4 kn, depending on current conditions. The system is

propelled by a single propeller and powered by a bank of lithium-ion batteries. The REMUS 100 is typically about 1.8 m in length, 0.19 m in diameter and weighs between 35 and 55 kg in air. Endurance of the REMUS 100 varies by generation, configuration, and operational conditions, but ranges between four and 20 hours.

The small size of the vehicle makes it suitable for rapid

Figure 2. REMUS 100 beginning a dive to map seabed on the west cost of Tasmania.
(Photo courtesy Guihen)

environmental assessment, where a large area can be surveyed from a small boat. This is particularly beneficial in regions that are difficult or dangerous to access, or where a certain range to the seafloor is desired. The AUV is deployed from a support boat using a cradle or by hand. Two people are typically required to lift the vehicle into and out of the water, making for low logistical overhead and with operation from small support boats quite common.[8]

Domestic commercial vessels are required to have a unique vessel identifier, a certificate of survey, be listed on a certificate of operation, and be crewed by persons holding the required qualification, unless a specific exemption or general exemption applies. General safety duties also apply to the owner, operator, crew, and other persons interacting with the vessel. A Safety Management System (SMS) must also be developed for the vessel and proposed operations. It is necessary to consider the specific regulatory requirements which apply to a vessel based on its specifications, intended operation, and risk factors, noting that these factors also impact the flexibility mechanisms which are available. The information below has been presented in a consciously detailed way, to highlight the complexity and nuances involved in the regulatory process, and the difficulty this causes to both operators and AMSA.

Unique Vessel Identifier (required)

The REMUS 100 must have and display a unique vessel identifier [35], unless an exemption applies. It is unlikely that the general exemption *Marine safety (Vessel identifiers) Exemption 2020 (EX01)* would apply because the REMUS 100 does not fit the exemption parameters.

Certificate of Survey (likely exempt)

There must be a Certificate of Survey in force for the REMUS 100 [36], unless an exemption applies or the Guidance Notice previously mentioned applies.

If an exemption or the Guidance Notice Applies

There are several options which would need to be explored by the operator, as follows:

- *Marine Safety (Certificates of Survey) Exemption 2021* (EX02): If the REMUS 100 was intended to operate in sheltered (Area D or E) waters, it could be exempt from the requirement to hold a Certificate of Survey under EX02, noting that an application for approval is required, and conditions include, unless the National Regulator determines otherwise, compliance with specified design and construction standards.
- *Marine Safety (Class C restricted operations) Exemption 2021 (EX40):* If the REMUS 100 was intended to operate in Area E, D, or the designated part of C waters, it could be exempt from the requirement to hold a Certificate of Survey under EX40, noting that an application for approval and an initial survey is required, and there are a range of conditions which need to be complied with.
- *Guidance Notice — Small Unmanned Autonomous vessels:* If the REMUS 100 was intended to operate in E, D or C waters, it fit the scope and requirements identified for the Guidance Notice, and an application for a specific exemption were made and approved, it could be exempt from the requirement to hold a Certificate of Survey.

If a Certificate of Survey is Required

If a Certificate of Survey was required, for example, if the REMUS 100 was to be operated in Area B or B extended waters, an application must be made to the National Regulator, and the National Regulator must be satisfied that the vessel meets the standards mentioned in Marine Order 503 (Certificates of Survey — National Law) 2018 for the vessel. For the REMUS 100, if it is surveyed by an accredited marine surveyor and not a recognised organisation, and if it is classified as a 'new vessel'[9], the applicable standards are set out at Marine Order 503 s7(3) [37], including in relation to arrangement, accommodation

8 Further operational information for the REMUS 100: At the start of deployment, the AUV acquires a GPS signal to establish a location. Most commercial AUVs contain an inertial navigation system (INS), which aligns with the GPS while the AUV is at the surface. Once this alignment is of sufficient quality, the AUV is ready to dive. After checking for errors, the operator triggers the start of a mission and the REMUS follows a set plan that has been provided to it. In general, they have limited freedom to deviate from this plan, except where obstacle avoidance sonars are fitted, in which case the AUV may enact a basic avoidance behaviour, such as early termination of the mission or change of depth. Though the AUV attempts to follow the plan, it is not always capable; strong currents, degraded navigation, or system faults may complicate the trajectory of the mission. AUV missions are typically monitored by humans at the surface, who keep a watch for other water users, as well as for the position and status of the submerged asset. There are currently no commercially available systems to support either the avoidance of boats by the AUV when surfacing or the updating of position to other users. These functions must therefore be performed by human operators. Communication between the operators and the underwater vehicle is limited to acoustic modem messages which are significantly bandwidth constrained and have update frequencies of 30–120 s. The operation of platforms like this challenges the traditional notion of watch-keeping, crew competencies and the legal definitions under which the platform operates.

9 The standards which apply to a vessel under Marine Order 503 depend on whether it is classified as an existing vessel, transitional vessel, or new vessel. These terms are defined in Marine Order 503 s22. A vessel is a new vessel if it does not fit the definition of an existing vessel, generally being a vessel constructed before 1 July 2013, or a transitional vessel, which is generally a vessel which was a new vessel but then a change mentioned in Schedule 1 Marine Order 503 occurred, or the vessel's certificate of survey ceased to be in force for more than two years. It is likely most autonomous vessels will be 'new vessels', i.e. vessels built after 1 July 2013.

and personal safety, watertight and weathertight integrity, construction, fire safety, engineering, stability and equipment. If an election was made for the REMUS 100 to be surveyed by a recognised organisation, also known as a classification society, the applicable standards set out in s8(2) are a combination of the class rules and the NSCV. The owner of the REMUS 100 would need to contact an accredited marine surveyor or recognised organisation for assistance in identifying the requirements which apply to the vessel, and to conduct the required surveys, in accordance with the *National Law – Marine Surveyors Accreditation Guidance Manual 2014.*

Certificate of Operation (required, plus a specific exemption)

The REMUS 100 must be listed on a Certificate of Operation [38], unless an exemption applies. It is understood that AMSA's current policy is that an autonomous vessel cannot meet minimum crewing requirements if there are no crew on board, meaning a specific exemption is also required, together with the Certificate of Operation.

If an Exemption Applies

If the REMUS 100 was intended to operate in sheltered (Area D or E) waters, the relevant exemption to consider is *Marine Safety (Certificates of operation) Exemption 2020* (EX0*3)*. This exemption does not require approval, and the applicable conditions are that the vessel must (a) have and comply with a safety management system which addresses the operation requirements in Schedule 1 and 2 of Marine Order 504 that apply to the vessel; or (b) comply with Part A of the ISM Code (noting that for complying with Part A of the ISM Code, the relevant national requirement for crewing is Clause 6 of Schedule 1 to Marine Order 504). It is noted that Schedule 1 of Marine Order 504 contains minimum crewing requirements, and therefore will be difficult for an autonomous vessel to comply with. Under s4(4) and (5) EX03 the owner of a vessel can apply for approval to operate in a way which does not comply with a condition, but the approval is limited to no more than 90 days.

If a Certificate of Operation is Required

If a Certificate of Operation is required, then an application, together with a declaration that there is a safety management system in place for the vessel, must be submitted to the National Regulator, and to approve the application the National Regulator must be satisfied that the vessel meets the criteria set out in s5 of MO 504. The criteria include that the vessel has a unique vessel identifier, and the operation of the vessel complies with Schedule 1 of MO 504 or Part A of the ISM Code [39]. S7 of Marine Order 504 lists the conditions that the certificate of operation is subject to, which includes that there continues to be a safety management system in place for the vessel [40].

Crewing

The REMUS 100 must be crewed by persons holding the required certificate of competency [41], unless an exemption applies. Marine Order 504, Schedule 1 — Operation Requirements, requires an appropriate crewing assessment, noting that the number and certification of the determined appropriate crewing must be at least equal to that of minimum crewing.[42] As per the table in Schedule 1, for a vessel less than 12m in length, the minimum crewing is 1, and the certificated crew and master is stated as 1 [42]. This means that, subject to the appropriate crewing assessment, the minimum crewing for the REMUS 100 could be one person. NSCV Part D Crew competencies, Schedule 2 Duties Holder May Perform, sets out the duties able to be performed for each certificate. It is likely that the operator of the REMUS 100 would need to hold a Coxswain Grade 2 NC or a Coxswain Grade 1 NC, subject to the exact duties being performed and further advice from AMSA [43].

Specific Exemption from Minimum Crewing

If it is determined that a specific exemption is required from the minimum crewing requirement, or from a crew competency requirement, the operator will need to apply for a specific exemption [44]. Reviewing the Guidance Notice — small unmanned autonomous vessels will assist operators in understanding the type of information AMSA will require.

It is evident from the regulatory analysis that identifying the exact regulatory requirements and flexibility mechanisms which apply to the REMUS 100 is a complex, nuanced process, requiring an understanding of the National Law, Marine Orders and the NSCV, and the exact operations intended to be undertaken. There are also options in some cases that an operator would need to choose between, requiring an understanding of the benefits and limitations of each approach. This complexity leads to uncertainty and delay for operators and AMSA.

Regulatory Analysis — Requirements under the Voluntary Australian Code of Practice

The Australian Code of Practice is divided in to three clear categories, with specific requirements applying to each category, as illustrated in Figure 3.

An operator seeking to comply with the voluntary Australian Code of Practice must identify which category and corresponding requirements apply, prepare the necessary documentation, and then apply for a specific exemption from AMSA, for example from the requirement to hold a certificate of survey and certificate of operation. The operator would be expected to provide evidence of compliance with the Code to AMSA as part of their application. The Guidance Materials which accompany the Australian Code of Practice provides diagrams, lists, concise information and examples to assist with all steps in the regulatory process.

It is likely that the REMUS 100 would be classified as autonomous and remotely-operated marine equipment under the Australian Code of Practice, because of its small size and low operating speed [45]. The requirements which apply are compliance with Chapter 2 of the Code and preparation of a Safety Management System, with evidence of compliance then being provided to AMSA with an application for a specific exemption.

Safety Management System

Assuming that the REMUS 100 is classified as autonomous and remotely-operated marine equipment, the Australian Code of Practice requires a Safety Management System to be prepared and implemented for the vessel

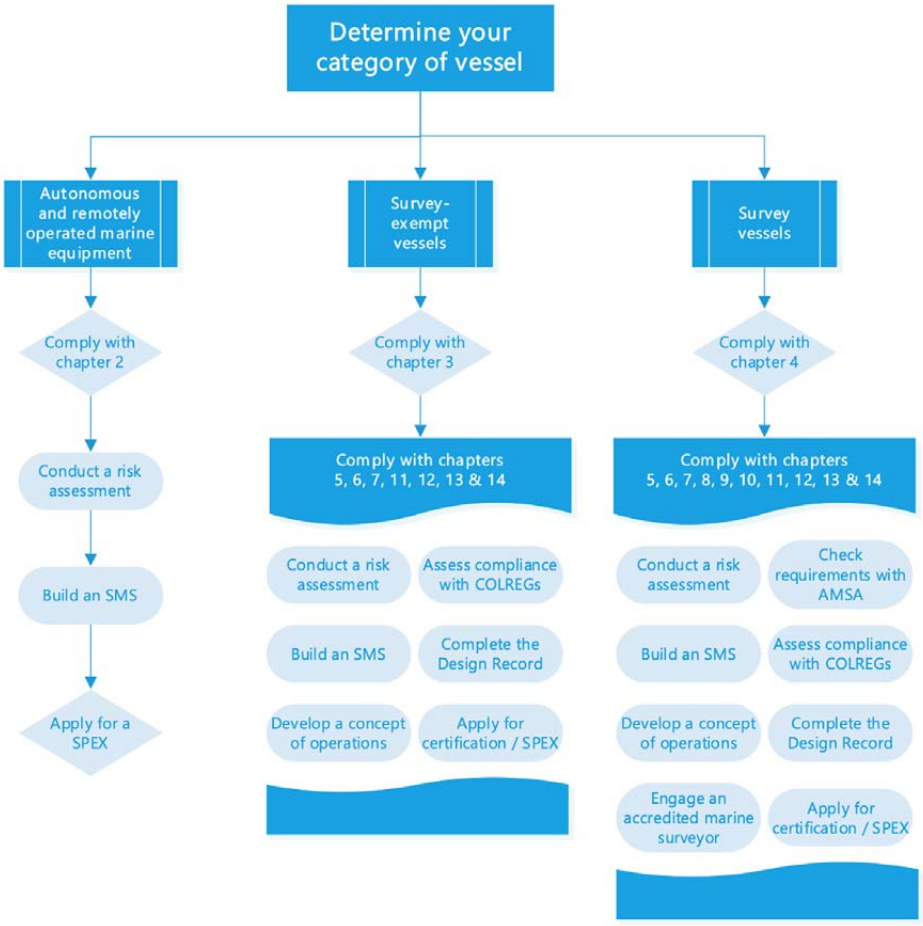

Figure 3. Diagram identifying requirements for each category, *Guidance Materials for Australian Code of Practice*, March 2022

which identifies the risks to the safety of the vessel, the environment and persons on or near the vessel; includes procedures to eliminate or minimise the identified risks so far as is reasonably practicable; is documented and readily-accessible for a person who uses the system; and is kept in the control station for the vessel. There are specific requirements for what the safety management system addresses, such as the need for a support vessel, means to alert other waterway users, control and monitoring arrangements, communication, emergency response planning, and visibility of the vessel for other waterway users.

Other Requirements

The Australian Code of Practice also requires the vessel to be operated in accordance with an appropriate crewing assessment undertaken by the owner or operator in accordance with Marine Order 504; not have the potential to leak fuel or other matter which may pose a risk to the environment should the vessel be lost or become irretrievable; not contain hazardous materials that may pose a risk to the environment or third parties should the vessel be lost or become irretrievable; be collected within a reasonable period if it stops operating; not pose a significant danger to persons in the water; and comply with the applicable light requirements of COLREGS when on the surface.

COLREGs (Collision Avoidance Requirements)

Small autonomous marine equipment will be likely to be classified as an 'inconspicuous vessel' under COLREGs and as such are required to display a white all-round light that is visible for 3 miles. There are also light requirements in COLREGs for vessels restricted in their ability to manoeuvre. Unless the vessel has the capabilities to comply with the requirements of COLREGs that apply to these scenarios, the vessel must: avoid narrow channels and fairways; avoid using or approaching traffic separation schemes; avoid inshore traffic zones; not cross a traffic separation scheme; and if a sailing vessel, avoid other sailing vessels. The Australian Code of Practice contains guidance on how these requirements are met. In addition, many chapters (which apply to survey-exempt vessels and vessels in survey) will be informative for the design and operation of the REMUS 100, including Chapters 5-14.

It is evident from the regulatory analysis that identifying the exact regulatory requirements that apply to the REMUS 100 under the Australian Code of Practice is quite straightforward, although the operator must still apply for a specific exemption from AMSA to enable operation. Where previously the operator needed to consider multiple flexibility mechanism options, which were all drafted for traditional crewed vessel, they are now presented with a clear path and supporting information. Operators can also access information on how to prepare the documentation required, including examples, in the Guidance Materials, which aids understanding and certainty, and lowers the resource burden on operators and AMSA.

In assessing the impact that the draft voluntary Australian Code of Practice could have, the main factors which stand

out are certainty in the applicable requirements, certainty of available flexibility mechanisms, lack of decision points for operators, and availability of resources to aid understanding. These factors point towards a conclusion that the draft Australian Code of Practice could address the challenges raised by autonomous vessels operating in Australia, including lack of tailored standards, lack of a benchmark for best practice, and lack of resources available to support stakeholders. Once the Australian Code of Practice is publicly released and has been used by operators, it will be possible to identify the practical differences made by the introduction of the Code, and the degree to which it has resolved the challenges identified in this paper.

CONCLUSION

The Australian maritime regulatory framework was created for vessels with crew on board, not for autonomous vessels and remotely-operated vessels. The differences in design, construction, survey and operation between traditional vessels and autonomous vessels means that it can be hard for an autonomous vessel operator to identify the applicable requirements, standards and processes in the current regulatory framework, and to understand how to use existing flexibility mechanisms to achieve more suitable regulatory treatment. These difficulties can lead to additional expenses and delay and can act to discourage the development and use of autonomous vessels in Australia. These challenges necessitated the development of the draft voluntary Australian Code of Practice, which is intended to represent best practice in Australia. While the case study provided in Part 3 reflects positively on the capability of the draft Australian Code of Practice and accompanying Guidance Materials to alleviate the challenges identified, no firm conclusions can be drawn until the Code is published and used. Further assessment should be made after the first 12 months of use, to determine the degree to which it has addressed the challenges identified in this paper, and where it could be further improved. At the very least, the draft Australian Code of Practice Code will be useful for operators and AMSA in benchmarking current best practice consistent with the approaches taken internationally, and in identifying consistent documentation requirements to support applications for certification.

Further regulatory change by AMSA is needed to ensure that operators can use the Australian Code of Practice more seamlessly, with a view in the future to incorporating it as a formal part of the Australian maritime regulatory framework. Ultimately, a new category in the NSCV for autonomous vessels, an operational area designator for sub-surface operations, and tailored qualifications requirements, will also help operators and AMSA to better tailor regulatory requirements and to simplify the process required to achieve certification. Many operators will be watching with interest to see what regulatory initiatives are in store in Australia for 2022 and beyond.

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This paper was presented at the Indo Pacific 2022 International Maritime Conference (IMC2022) and was a runner-up for the Bob Campbell Award for the best written paper and presentation at the conference.

EDUCATION NEWS

UNSW Canberra

New Program

We have just concluded and celebrated the first year of teaching our new program. The score reveals that five new Year 3 courses have been delivered and completed successfully by staff and students (ZEIT3750 Naval Architecture Practice, Ship Hydrostatics and Stability, ZHSS3750 Building the Fleet: History, Politics and Naval Technology, ZEIT3751 Hydrodynamics of Ships and High-speed Craft, ZEIT3752 Ship Structures and ZEIT3753 Design of Ships and High-speed Craft), and the three remaining new Year 4 courses (ZEIT4750 Ship Design Project A, ZEIT4752 Ship Propulsion and Marine Engineering, and ZEIT4751 Ship Design Project B) are being readied for their maiden delivery in 2023. Thus, next year we will be teaching the complete program and anticipating our first graduate in December. As the first potential graduate, SBLT Cooper Woods has accepted the mantle and challenge as our willing student pathfinder. He has fully engaged and is excelling within the program. He has also been contributing significantly to the development of the program with some valuable feedback and student perspectives, which we will integrate into our continuous improvement program.

What has also led to a successful first year of delivery are the contributions of guest lecturers in specific domains. We would like to recognise and thank them for what they have shared enthusiastically with us this semester. The presentations have included:

CDRE Colin Dagg	Naval Rules, Regulations, Codes and Standards
Joe Cole	Navy Capability Development, Acquisition and Through-life Support
Peter Hayes	Naval Ship Stability Criteria
Phil Helmore	Ship Propulsion and Propeller Design
Frank Ryan	DNE Perspectives of Ship Structural Design and Construction
Paul O'Connor	Structural Design and Designing with Class
Paolo Orefice	Survivability and Vulnerability Topics in Naval Ship Design
Martin Renilson	Submarine Hydrodynamics and Design

Theses

As indicated in previous issues, Year 4 thesis students in 2022 have been working on projects associated with our flume: establishing and setting to work wave-making and measurement capabilities, and undertaking carriage design and instrumentation developments. These activities will continue for some time, but positive prototyping steps have been taken in developing the facilities. Further characterisation of wave making will be the focus of another project in 2023. As this report is being written, the current Year 3 students are making decisions and choices about their chosen projects, so others may yet join in our naval architectural facilities development.

Social Functions

The first of a series of quarterly social functions was held on 11 August for all students enrolled in the naval architecture programs and courses. The motivation is to encourage a sense of community within the student and staff body, supported by a Microsoft Teams site, The Hub, of which all of the community are members. A guest in James Cowie from Navantia attended the first gathering. Navantia was keen to publicise internship opportunities to the students. We will hold another gathering in late November.

Field Trips

Planning is underway for all our field trips in 2023. The month of April will be quite busy with a trip to AMC (towing tank experience and tours of other facilities) and industry visits in Hobart, a training cruise potentially out of Brisbane, and a trip to Sydney for an inclining experiment and other industry visits.

Naval Architecture Pathways

Finally, I wish to highlight some student pathways, for those considering a career in naval architecture and for those looking for naval architecture graduates. There are currently three cohorts of undergraduate students on the UNSW Canberra campus: those in uniform training as officers at ADFA, and two groups of civilians. The civilians are either sponsored already by CASG under the Defence Civilian Undergraduate Scheme (DCUS), or they are unattached regular fee-paying students. These possibilities can expand to other scholarships and sponsorships, including those provided by industry. However, the following existing pathways could lead a successful applicant to a naval architecture degree with us.

As a civilian, with the requisite entry requirements met, you can study with us as

1. a regular fee-paying student;

or, if looking for support via Defence sponsorship or scholarship,

2. There is the DCUS (https://www.defence.gov.au/jobs-careers/student-pathways/civilian-undergraduate-sponsorship),

   but it is too late for students not already in the DCUS system to join us in 2023 under that scheme; and
3. The Defence Nuclear Science and Engineering Undergraduate Scholarships (https://www.defence.gov.au/jobs-careers/student-pathways/nuclear-science-and-engineering-undergraduate-scholarship) are possible, with the later opening applications for 2023 being in December 2022.

The uniform pathways include

4. ADFA (https://navy.defencejobs.gov.au/students-and-education/australian-defence-force-academy); and

5. by joining Navy under Defence University Sponsorship (https://navy.defencejobs.gov.au/students-and-education/defence-university-sponsorship).

Options 1, 3 and 5 covering both civilian and uniform pathways could allow a student to study with us in their third and fourth years, taking advantage of the "2 + 2" nature of our degree, one that facilitates students transferring to UNSW Canberra after having undertaken the first two years of an accredited Mechanical or Aeronautical Engineering four-year degree program at another Australian tertiary institution.

Queries and Comments

We welcome enquiries and comments. Please do not hesitate to contact me via email (w.smith@unsw.edu.au, or navarch@adfa.edu.au) or by other means if you have any questions or would like to contribute to or join our enterprise.

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

Incat wins Tasmanian Training Award

In September Incat's training program was recognised by winning the Large Employer category in the Tasmanian Training Awards. Incat Training Manager, Guy Gibson, accepted the award at the ceremony in Hobart. Incat will now progress as the Tasmanian Large Employer finalist in the National Awards later this year.

Incat Training Manager, Guy Gibson, accepting the award at the ceremony in Hobart
(Photo courtesy Incat Tasmania)

Incat metal-trades apprentice Nick Tilyard was also recognised at the Tasmanian Training Awards as one of six finalists for Apprentice of the Year.

The Tasmanian Large Employer Training award, for organisations with over 100 full-time equivalent employees, is judged on the extent and quality of training conducted throughout the organisation. During the 2021–22 year 75% of Incat staff attended some form of training. The company had 74 apprentices, and as many of those graduated through the year, a further group has recently commenced new apprenticeships.

Apprentice training at Incat is a blend of attending TAFE and rotating through different areas of the shipyard to ensure that apprentices have experience and knowledge of various aspects of shipbuilding. Continuous safety and skills on-the-job training is also incorporated across the workforce for new and longer-term employees to ensure that workplace standards are met across the range of skill sets.

Two years ago Incat introduced a mentoring program where completing apprentices have the opportunity to mentor those just starting an apprenticeship. The program has the benefit of reinforcing their knowledge and at the same time making the path easier for the new starters.

Although the ships are built in Tasmania they operate globally which provides opportunity for experienced tradespeople to work overseas on vessel annual dry-dockings. With overseas travel now available again, Incat welders, fabricators and electronics staff recently travelled to Trinidad and South Korea. More overseas support is planned with teams travelling to Spain and Malta in the next few months.

ESI Virtual Performance Solution Models Free Surface Flows around a Ship with FPM

Accurate prediction of ship seakeeping performance in ocean environments is a fundamental requirement in naval architecture. Ship hydrodynamics modelling presents major challenges due to rough sea conditions in which ships are constantly stressed with unsteady boundary layers, large separation, breaking waves, and large deformations are likely to happen in oceans which are challenging flow conditions for conventional CFD methods in the convergence to a solution. However, meshless techniques such as the Finite Point Method (FPM) can handle more complicated free-surface flows.

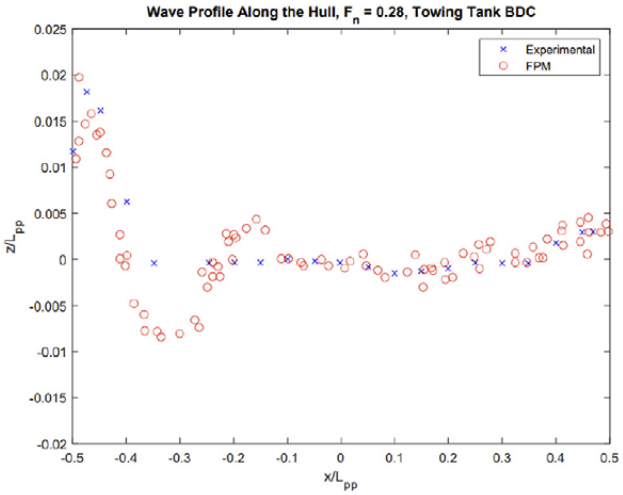
Numerical modelling not only serves as an important design tool but also helps to cut costs and increase efficiency rather than conducting physical tests in towing tanks which can be costly.

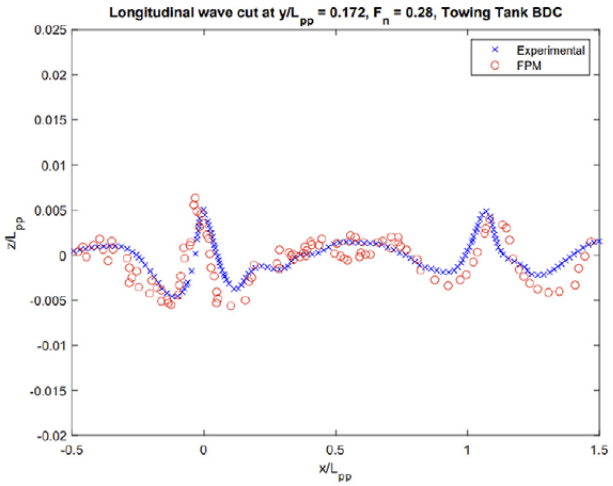
Aaron Mai is a final year Aerospace Engineering student studying at UNSW Sydney, with a keen interest in naval architecture. Aaron was excited to receive an opportunity to work with the recently-developed incompressible FPM mesh-free solver within the Virtual Performance Solution (VPS) by ESI Group for his industrial training.

Aaron was appointed two industrial supervisors, Bruce Cartwright and Allen Chhor of ESI Group, Sydney, to assist in the steep learning curve with the VPS high-end software.

Aaron conducted a literature review to bring himself up to speed with the concepts in naval architecture and mesh-free techniques. He found that the free-surface flow around a ship in calm water was a commonly-used benchmark for analysis and numerical methods, but that there was almost no work published on the use of FPM for maritime studies. Either FPM wasn't suitable, or Aaron was going to become a trailblazer.

With the help of Aaron's Sydney supervisors, and Matthias Schaefer of ESI Germany, a numerical simulation of the DTMB5415 hull moving through a towing tank in calm water was developed. Countless simulations were run at the workstations in the Sydney office of Pacific ESI. Working both in-person and virtually, models were developed until





Numerical (FPM) and experimental wave profiles at Fn = 0.28, Location of x/Lpp = -0.5 is the bow and x/Lpp = 0.5 is the transom.

a good correlation between the experimental and numerical results for wave-wake profiles were obtained.

Typical results are shown in the graphs, where the colour contour is the water elevation due to the DTMB5415 model hull travelling at a Froude number (F_n) of 0.28. The graphs compare the wave profile from experiment and the FPM technique, along the hull and at a distance away from the centreline of y/L_{pp} = 0.172 (experimental results by Olivieri et al. (2001) for F_n = 0.28).

Aaron is now finalising his trailblazing calm-water runs which will be the basis of his final year engineering thesis. Aaron may continue this work as a PhD candidate, extending this work to study the response of a flexible ship in a seastate, by FPM within VPS. This work was supported by the Australian Research Council Grant LP190101283 and Prof. Garth Pearce of UNSW Sydney.

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INDUSTRY NEWS

Birdon selects Siemens' Software for Digital Shipyard

The Australian-owned Birdon Group, which has its headquarters at Port Macquarie in New South Wales, has selected industry-leading software from the Siemens Xcelerator portfolio to support its ongoing strategy to develop a digital shipyard to service both Australian and international shipbuilding customers. The software will be used for advanced engineering design and project data management across Australia, the United States and other global operations as the company continues to grow.

Birdon will use Siemens' Teamcenter® software for product lifecycle management (PLM), integrated with NX™ software for computer-aided design to streamline product design data development by creating a digital thread — a single source of truth, throughout the design process.

Providing solutions to the maritime, defence and resource sectors, Birdon is one of a handful of Australian defence contractors to contract directly to the US Army. In choosing Teamcenter, Birdon joins other leading global shipbuilders using Siemens' software in the US, UK, Europe and Asia.

Sarah Yuen, Birdon's General Manager Maritime, said that the software is a key step towards a fully-digital shipyard which will enhance Birdon's approach to integrated working and sharing secure data across the business.

"As Birdon's portfolio of commercial and defence shipbuilding contracts grows within Australia and the US, leveraging hi-tech design and product lifecycle management methodologies, such as those provided by Siemens, is critical to providing complete product traceability, oversight and data-trust for high-security industries such as Government and Defence. Our ability to integrate our product modelling using digital twins and 3D technologies with robust PLM systems will help to ensure the performance of our products and their ongoing supportability and capability. Simply put, Teamcenter enables Birdon to focus on building a digital shipyard capability by making design information easier to share within a robust configuration management system, standardising the design process. This, in turn, leads to better management of design changes and reduced ongoing costs related to expensive design iterations."

Teamcenter integrates PLM, digital twins, 3D modelling, material and asset management practices from conceptual design to production and through-life support.

Samantha Murray, Vice President and Managing Director Australia and New Zealand, Siemens Digital Industries Software, said that she is pleased that Siemens' software will be an important part of Birdon's digitalisation journey and support their business growth and competitiveness into the future.

"It is great to work with Australian companies such as Birdon, who are revolutionising the global maritime landscape. In the maritime industry, hi-tech software is the key to increasing productivity through sustainable design and manufacturing processes and maintaining agility. We are

excited to see our technology being used to help shape not just design and product workflow processes, but also play a key role in Birdon's journey towards a digital shipyard capability," Ms Murray said.

Both Teamcenter and NX are part of the Siemens Xcelerator portfolio which brings together and integrates the entire Siemens Digital Industries Software portfolio with technologies, solutions and services which connect to existing Information Technology, Operational Technology and Engineering Technology environments. It covers and integrates mechanical, embedded software, electronics, simulation, manufacturing, operations, app development and IoT.

VEEM to make Prototype Propeller Blades for Hunter-class Frigates

Propellers for Australia's elite submarine-hunting warships are one-step closer to being made in Australia, delivering a critical local capability which will be able to be used in future naval shipbuilding programs.

BAE Systems Australia has awarded the WA-based company, VEEM, a $1.76 million contract to manufacture two prototype propeller blades and a propeller hub under the guidance of OEM Kongsberg Maritime.

This is the final test of VEEM's capability to manufacture to the Hunter-class frigate's stringent requirements and is a significant milestone for the Perth-based marine technology company, as it endeavours to become a Defence-qualified warship propeller manufacturer for the Hunter-class program.

Since 2020, VEEM has been supported by marine technology company Kongsberg Maritime, which is the propeller supplier for BAE Systems' Type 26 frigates currently under construction in the UK. The Hunter-class frigate design is based on the Type 26.

Should VEEM's prototype propellers meet requirements and pass Kongsberg Maritime's quality approvals, it will pave the way for VEEM to be down-selected for the next phase — propeller manufacture for the first batch of three Hunter-class frigates.

VEEM is expected to commence work on the prototype propeller blades at its Canning Vale facility in November 2022, and will complete the work by March 2024. The blades will be the same mass and size of those on the Hunter class, but they won't be used on the first warship as they will be subject to destructive testing to verify procedures which will be used in the manufacturing process.

BAE Systems Australia Managing Director — Maritime, Craig Lockhart, said "I am delighted that VEEM is progressing with its journey to join the Hunter-class frigate supply chain, and congratulate Kongsberg Maritime for supporting VEEM and our efforts to grow Australian industry capability (AIC).

"Building AIC is more than just spending money in Australia — it is about working with small and medium local companies to ensure that they have the right cyber-security systems in place, the right equipment and tools, and the right workforce to manufacture and assemble parts of what is arguably the most complex warship on earth.

"We have already placed contracts with more than 50 Australian businesses to support the Hunter program's prototyping phase, and we are close to contracting more local companies for equipment and parts manufacture, supply and assembly for the first three Hunter-class frigates. Building a sovereign industrial capability brings local jobs, prosperity, intellectual property and security for the nation — for Hunter and naval shipbuilding programs beyond."

Kongsberg Maritime (KM) Country Manager, Jamie Kilsby, said "KM recognise that AIC is a fundamental and essential component of Australian Defence-related shipbuilding and sustainment. Nothing painted a brighter light on the need for domestic capability than the extensive travel restrictions COVID placed on all of us. We quickly learnt during COVID lockdowns that if the capability wasn't here, it wasn't getting here.

"Not only are we very happy with the casting and machining capabilities of the VEEM organisation but, culturally, they have been excellent to work with and are testament to the Australian 'can do' attitude.

"We are very much looking forward to developing this relationship with VEEM through the Hunter program and other Commonwealth shipbuilding and sustainment programs."

VEEM Managing Director, Mark Miocevich, said "We are excited that the project is moving closer to full production. This project brings with it immense challenges which, to date, our team, working collaboratively with all partners have successfully met.

"I am very proud of our team working on this project and am delighted that the sharing of VEEM's and Kongsberg's decades of knowledge can be put to use on what is a highly specialised application. We are particularly excited about the possibility of also supplying to other Type 26 programs around the world.

"The project will bring investment, employment and key sovereign industrial capability into Western Australia at a time where it is evident how easily global supply chains can be disrupted."

Naval Group and PT PAL to Collaborate on Submarine Propulsion Systems

The French shipbuilder Naval Group and its Indonesian counterpart PT PAL have signed a Memorandum of Understanding to start the creation of an Indonesian Energy Research Lab and cooperate on energy and propulsion solutions in the naval field.

Naval Group and PT PAL, together with other Indonesian industry and research partners, are working on an ambitious R&D collaboration project to prepare the future of naval technologies.

This project consists of the creation of the Indonesian Energy Research Lab to develop, in Indonesia, the next generation of submarine energy solutions. This network will bring together industry and research partners as well as universities.

Several key Indonesian stakeholders (academics, industrial partners, scientists) have been identified to develop the next generation of submarine energy solutions. They will work together on various research and development topics such

as embedded electrical networks, new energy storage or new generation Li-ion battery.

On 2 November, Naval Group and PT PAL also signed a Memorandum of Understanding with PT Garda which will develop and maintain lead-acid batteries in Indonesia, in the framework of the Energy Research Lab, thanks to a transfer of technology and knowledge from Naval Group.

Periscope Contract for BAE Systems

BAE Systems Australia has secured a three-year contract extension with the Commonwealth of Australia to provide in-service periscope support for the Royal Australian Navy's six Collins-class submarines.

The $45 million contract extension will see the continuation of maintenance and logistics services, engineering and supply support and program management of 16 periscope systems. The work will be performed at BAE Systems' Mawson Lakes facility in South Australia and HMAS *Stirling* in Western Australia.

Each Collins-class submarine has an attack and a search periscope and these are extensively overhauled every seven years to ensure their materiel readiness and continuing structural integrity.

Under its contract, BAE Systems has developed a local and global supply-chain network, delivering support to the RAN's submarine force.

The company has manufactured, sustained and upgraded the periscope systems for the Collins fleet for the life of their service to the RAN. During the build phase, the firm used the local manufacture of optics, electronics, cables and mechanical parts, in collaboration with an initial supply chain.

The Collins-class submarines will also receive a new "cutting-edge optronics system". The $381 million investment into optronics will essentially replace an aged technology on the submarines.

Raytheon to Provide Combat System Support for Australia's Collins-class Submarines

The Australian Government has signed a five-year contract with Raytheon Australia to continue to invest in the capability of the Royal Australian Navy's fleet of Collins-class submarines.

The $322 million contract will provide in-service support for the Collins-class submarine combat system during Australia's transition to nuclear-powered submarines.

Deputy Secretary Naval Shipbuilding and Sustainment, Tony Dalton, said that the support would include a life-of-type extension, starting in 2026, ongoing sustainment, and selected capability enhancements.

"The ongoing sustainment and upgrade of these boats will help maintain a capability advantage and ensure that our fleet is ready to meet the challenges across our strategic environment," Dalton said.

"We are committed to working closely with industry to sustain our Collins-class submarines, an important task which currently supports over 1600 jobs across South and West Australia."

The Hon. Kim Beazley AC joins Luerssen Australia's Board

Luerssen Australia has announced that the Hon. Kim Beazley AC is joining the Board of Luerssen Australia.

Mr Beazley has unrivalled knowledge of defence issues after an outstanding career as a politician, diplomat, academic and the 33rd Governor of Western Australia.

He held various portfolios in the Hawke and Keating Labor Governments including Defence, Finance, Transport and Communications, Employment and Education, Aviation, and Special Minister of State. He was also Leader of the House.

From 1995 to 1996, he was Deputy Prime Minister and was twice Leader of the Opposition, first from 1996 to 2001 and then from 2005 to 2006.

After retiring from politics, Mr Beazley was appointed a Winthrop Professor in the Department of Politics and International Relations at The University of Western Australia, and in 2008 he was appointed Chancellor of the Australian National University.

He was then appointed Australia's Ambassador to the United States of America and served in that position from 2010 until 2016.

He was appointed WA Governor in 2018 and finished in June this year.

Chairman of the Luerssen Australia Board, Tim Wagner, said that it is a coup for the company to have Mr Beazley join the Board.

"We are delighted to welcome Kim to the Board. He will provide invaluable advice to us and be critical as we continue to build the company in Australia," said Mr Wagner.

"His knowledge of defence and security issues is internationally recognised and we are extremely happy that he wants to be part of our journey."

CEO of Luerssen Australia, Jens Nielsen, says that he is looking forward to the engagement and the contribution Mr Beazley's experience will add to the strategic development of the company.

Mr Beazley says he is looking forward to helping guide Luerssen Australia over the coming years.

"Luerssen Australia is a fantastic company, with so much to offer. They have a great team and are well positioned to provide the Navy with the capability it needs for the future," said Mr Beazley.

"Australia faces uncertain times and we need get the right capability, using as many local suppliers as possible, as fast as we can. Luerssen Australia is part of the solution."

"Luerssen Australia is a trusted partner and is delivering the Navy 12 Arafura-class offshore patrol vessels. I believe there is much more the company can deliver in the national interest."

Mr Beazley joins former Chief of Navy, VADM Chris Ritchie AO RAN (Rtd), and the Hon. John Sharp AM, a former Howard Government Minister, on the Board.

HydroComp PropExpert® 2022 Released

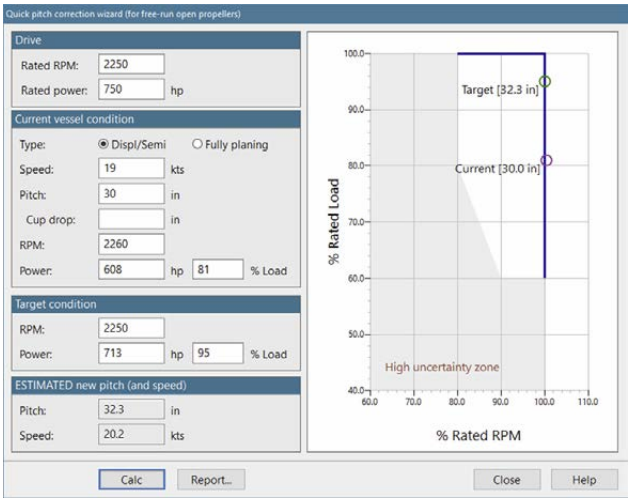
Ducted Propeller Enhancements, Pitch Correction Utility, and other technical updates

Development in 2022 for HydroComp PropExpert offers updated capabilities for sizing and analysis of ducted propellers, as well as a new pitch correction utility.

New *Quick Pitch Correction* Utility

A service frequently conducted by propeller shops is to correct the pitch of a propeller which is not meeting operational performance objectives. This might include a propeller with too much pitch which is overloading the engine so that it does not reach rated RPM, or one with too little pitch where RPM is restricted by the engine's governor and not being allowed to absorb full engine power.

While a more analytical approach is to utilise PropExpert's *Prior Trial* analysis, PropExpert now provides a *Quick Pitch Correction* utility to estimate a new pitch for free-running (transit) vessels with open propellers running at RPM and power near an engine's rating.



A screen shot of the Quick Pitch Correction wizard

New Performance Model for 4-bladed Kaplan19A

The original Kaplan propeller series tests in 19A and 37 nozzles were limited to just a few specific variations of Expanded Area Ratio (EAR). In fact, only one EAR was developed and tested for the three- and five-bladed Kaplan models in the 19A propeller, and two EAR for the four-bladed models. This restricted the ability to solve for EAR as part of the sizing process.

This limitation has now been overcome for the 4-bladed 19A propellers. A new R&D effort has generated a new algorithm for a smooth distribution of the influence of EAR on performance. The best outcomes are with EAR from 0.55 to 0.85, but also offering acceptable predictions for as high as 1.00 EAR.

NavCad® Electric Motor Features: FAQ

About NavCad's electric drive motor features for propulsion simulation

Q: What can NavCad tell me about performance of a vessel driven by an electric motor?

A: NavCad is a tool for hydrodynamic and propulsion system simulation. It is built around the *Vessel-Propulsor-Drive* system, and NavCad now supports DC and AC electric motors as a *Drive* option. For all *Drive* types, NavCad predicts the mechanical shaft power for the simulation objectives and components. However, whereas NavCad predicts fuel rate for IC engines, it predicts electrical power, current draw, and motor-specific efficiencies with an electric motor — all of which can be used for battery budget or range predictions.

Q: What types of electric motors are currently supported in NavCad?

A: NavCad natively supports DC motors and three-phase AC motors of induction type (NEMA AB) or permanent magnet type (PMAC).

Q: Why are electric drives handled differently to internal combustion (IC) engines?

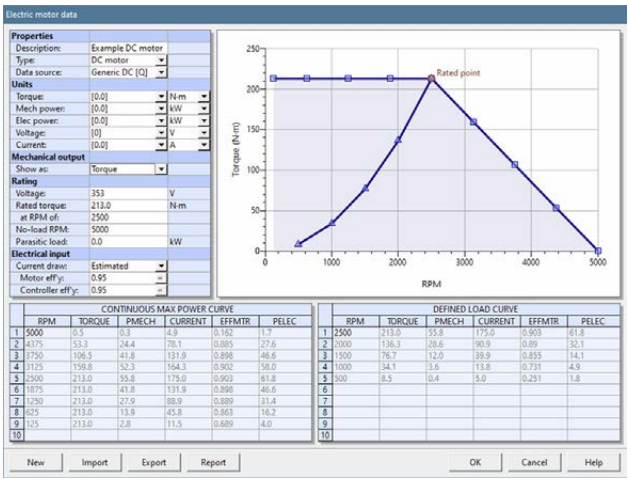
A: Aside from the obvious differences in their "fuel", electric motors have torque and power curves significantly different from those of IC engines. Further, the way electric motor and IC engine performance data is communicated is also typically very different, and NavCad provides data forms which are specific to the way motor curves are presented. It also provides "generic" models and estimates for things like torque curve shapes and partial load efficiency for popular model types (such as the "constant torque, constant power" type which employs phase advance or field weakening).

Q: How does the use of an electric motor drive affect propulsor design?

A: While the use of an electric motor drive doesn't directly impact propeller design, proper consideration should be taken in the selection of the design point, to ensure that the unique properties of electric motors are being used to advantage.

Q: How much data do I need to define an electric motor in NavCad?

A: Very little, in fact! While a full set of motor data can be explicitly defined, NavCad also provides "generic" data builders for popular models (PMSM, PMAC, NEMA AB). These help to define torque and power curves plus their motor-specific efficiencies based on a few data items: generic type, voltage, rated torque/power and RPM, no-load RPM, and appropriate peak efficiencies. NavCad handles everything else!



A screen shot showing electric motor data in NavCad

Q: How can NavCad be used to aid in retrofitting an existing vessel with an electric motor?
A: NavCad can be used for several essential calculations when retrofitting a vessel with an electric motor, including prediction of resistance for a new displacement, propeller sizing for a new design point, and calculation of motor load and current demand.

Alfa Laval Test and Training Centre receives Approval for Testing with Ammonia

Authorities have granted approval for testing with ammonia at the Alfa Laval Test & Training Centre. When installation of the testing setup is completed by the end of 2022, the centre will be able to work with all fuels in consideration as the marine industry decarbonises.

Alfa Laval plans to serve marine customers at all stages of their decarbonization journey, no matter which fuels they choose. As part of that strategy, the Alfa Laval Test & Training Centre will soon begin testing with ammonia. Just as it has for LNG, biofuels and methanol, the centre will deepen the knowledge of ammonia combustion and lead the development of needed onboard technologies.

The testing setup includes a double-walled ammonia tank at a safe distance from other fuels, as well as double-walled piping with encapsulated welds for all pipes to and from the centre. These barriers reflect the safety measures which will likely be required for ammonia on future vessels. Initially, the testing itself will take place in a dedicated enclosure, using quantities small enough for emergency venting without risk to the environment or the engineers involved. At a later stage, full-scale testing will commence using both boilers and fuel cells.

With the setup approved, Alfa Laval will move swiftly to begin ammonia testing in early 2023.

The Alfa Laval Test & Training Centre
(Photo courtesy Alfa Laval)

Wärtsilä to supply Propulsion Package for World's Largest Aluminium Catamaran

Wärtsilä is to supply the engines, waterjets, and fuel storage and supply system for a new high-speed catamaran ferry being built at the Incat yard in Tasmania for the Argentinian ferry operator, Buquebus. Having an overall length of 130 m, a beam of 32 m and the capacity to carry 2100 passengers and 226 cars, it will be the largest aluminium catamaran ever built by Incat. The order with Wärtsilä was placed in July 2022.

The vessel will operate between Argentina and Uruguay with Wärtsilä's 31 dual-fuel engine technology using primarily LNG fuel produced at Buquebus, own LNG plant. The vessel will also incorporate shaft e-motors powered via the main engine gearboxes, taking further advantage of Wärtsilä's LNG technology. With LNG, the minimised emissions of CO_2, nitrous oxides (NOx), sulphur oxides (SOx) and particulate matter will make the ferry Tier III compliant and able to operate in emission control areas.

"We have selected Wärtsilä waterjets many times in the past, and have always been extremely satisfied with their performance," said Tim Burnell, Incat's CEO. "This, though, is the first time we will include Wärtsilä engines, and we are excited about the potential they provide. This will be the world's largest and greenest vessel of its type, and we are very happy to be working with Wärtsilä to make the project a huge success."

"This is indeed an exciting project. Our latest WXJ generation axial-flow waterjets reduce the installation footprint on average by approximately 25 percent, compared to non-axial flow jet designs. They also give a higher power-to-weight ratio, and come with an advanced propulsion control system. Combining this with our highly-efficient fuel-flexible engines, means that it is a truly future-proof investment," added Mikko Mannerkorpi, General Manager, Sales, Wärtsilä Marine Power.

The full scope of supply comprises four Wärtsilä 31DF dual-fuel engines, four Wärtsilä WXJ1500SR waterjets, and two Wärtsilä LNGPac fuel storage, supply and propulsion control systems. The equipment will be delivered to the yard commencing in mid-2023.

Wärtsilä has a long-standing relationship with Incat, a global leader in aluminium ship technology. Incat provides optimal lightweight ship solutions for ferry operators, special service providers, and military applications.

The Wärtsilä 31DF is the most powerful engine in its class. It has a power output ranging from 4.6 to 9.6 MW at 720 and 750 rpm. It features exceptional fuel economy while maintaining outstanding performance across the entire operating range. The higher output per cylinder provides a compact footprint and a cost-efficient installation. The diesel version of the Wärtsilä 31 has been recognised by Guinness World Records as the world's most efficient four-stroke diesel engine.

The new high speed catamaran ferry will be the world's largest and greenest vessel of its type
(Image courtesy Incat Tasmania)

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 November 2022 e-Newsletter included:

- Audits and application assessments
- Certificate of survey refusal reasons
- Understanding the surveys required notice letter
- How to apply for a periodic survey extension
- Navigation light supply
- Novel vessel policy
- Relevant reading

The article on *Novel Vessel Policy* is reproduced below.

Phil Helmore

Novel Vessel Policy

AMSA's novel vessel policy statement is now available on the AMSA website. The policy statement identifies the types of vessels which AMSA considers to be 'novel' and clarifies what standards vessels must comply with for design approval. It also provides additional pathway information for novel vessels to gain certification.

The policy is available on the National Standard for Commercial Vessels webpage under Section F3 Novel vessels.

Anyone planning to design or build a 'novel' vessel can email nscvfeedback@amsa.gov.au for further advice on classification and certification.

Survey Matters, November 2022

PACIFIC NEWS

Decarbonisation of Shipping — Coming Ready or Not

Rob Gehling
Vice President, RINA Pacific Region

This article has been prepared to inform readers of current developments on this subject, with a particular view to the concerns expressed by Pacific Island nations with regard to climate change and the potential effect on those nations whose economies are dependent on the maintenance of affordable and reliable shipping services.

As a member of RINA's Maritime Safety Committee, I was privileged to virtually attend the International Maritime Organisation's recent Second Symposium on alternative low- and zero-carbon fuels for shipping to get a feel for international legislative developments on this subject. While interested readers may no longer view the full seven-hour symposium on the IMOHQ YouTube channel, a full summary is available on the IMO website. The symposium paid particular attention to the needs of small island developing states (SIDS), a group which includes many Pacific countries and, in this regard, one panel session was chaired by a Tongan representative while a Marshall Islands speaker was prominent on another panel.

A summary of the take-away points which I took from the symposium is given below, together with explanatory information and comments developed from personal communication with Edwin Pang (thanks Ed!) who chairs RINA's IMO Committee. I apologise in advance for any basic chemistry errors which may have found their way into the text.

1. Decarbonisation of shipping to the maximum extent practicable (>80%) by 2050 is non-negotiable

This is the line taken by adherence to the Paris Agreement, mainly the 1.5°C degree climate change target, which in reality is already out of reach, but overshoot needs to be minimised.

2. Fuels under consideration included hydrogen, ammonia, battery-electric, LNG, biofuels

LNG is seen as an interim partial solution for CO_2 reduction but is viewed with scepticism by the environmental lobby due the amount of, and impact of, methane slip and leaks — both from production and from use. Although methane is only about 30 times worse than CO_2 on a 100-year basis, on a 20-year basis it is about 86 times worse than CO_2 in terms of global warming potential. They see it as also risking stranded assets. This factor may underlie the apparent dumping of Woodside proposals several years ago to provide LNG bunkering in north-west Australian ports. LNG supporters suggest that methane slip on ships can be reduced (much work has been ongoing with reasonable results), and that there could be a transition to bio-LNG or e-LNG. LNG has, of course, substantial local air quality benefits (one of the main reasons for its introduction in the first place).

The environmental lobby champions ammonia primarily; however, they are somewhat inconsistent because combustion of ammonia produces both ammonia slip (which is highly toxic) but also N_2O slip (laughing gas) which has a GWP of 298 times that of CO_2. Ammonia combustion engines were promised around 2024, but development has been challenging, and the date keeps being pushed back, current test engines need substantial amounts of pilot fuel — circa 20% in order to get the ammonia to burn — meaning that substantial amounts of low-carbon pilot fuel (i.e. e- or bio-derived diesel) would be required.

There are some outlandish claims for battery-electric, such as a recent study claiming that large container ships could be battery powered, with chargers around 200–300 MW — i.e. a whole dedicated power station to charge a ship! However, there are battery-electric tug fleets already in service (e.g. built and operating in Turkey) where extended range is not required.

Hydrogen is seen by some as a potential replacement for diesel, but its safe carriage at sea is at the early trial stage and safe use as a fuel is some way off. It will be useful for small, short-distance routes due to the poor volumetric energy density. Production costs are high for "green" hydrogen (from electrolysis), while there are environmental concerns about producing "grey" and "blue" hydrogen. Efficient transport of hydrogen in energy-density terms is also a problem which needs to be addressed — liquid hydrogen is one particularly-hazardous option (recall the recent issues which NASA had, while significant amounts of energy are also required to liquefy hydrogen to –253 degrees C). Another somewhat safer option is conversion of hydrogen to ammonia for transport purposes.

Drop-in biofuels (as advocated by Brazil in the symposium) are a potential solution and their production from waste streams (crop residue, sawdust, used cooking oil, etc.) is sustainable. However, the scalability of production is questioned, the resulting fuels are still hydrocarbons which result in CO_2 and NOx when burned (though they are considered net zero fuels — that is the CO_2 is first removed from the atmosphere when the biomass is growing) and there will be competition for their use. The other side is that, as much as we want to ensure sustainability, we know that these fuels often drive things like illegal logging and competition for food crops (particularly if industry will pay a higher price). One such fuel is methanol which is gaining ground — it can be produced as a biofuel or an e-fuel, may be stored at room temperature and pressure as a liquid, is much less toxic than ammonia, and may even be stored in structural tanks, and the engine technology is already here.

Nuclear power was not mentioned in the symposium, but was advocated in the President's Invitation Lecture of 2021 to be a potential viable solution such as for large containerships. Of course, its use needs to be subject to adequate safety and non-proliferation measures, including crew qualifications, which are not yet codified by international agreement.

3. Decarbonisation efforts were much more efficiently applied to land industries (such as in the electric power industry) than to shipping

Shipping is considered a hard-to-abate sector due to high energy requirements, on-board space constraints, safety issues relating to shipboard habitability and working spaces, and the need to have refuelling facilities readily available at ports. It is therefore somewhat challenging, and also not really considered in most national policymaking as it is not terribly visible and has also no votes in it.

One speaker at the symposium indicated that a dollar amount spent in carbon abatement in the shore-based power industry was four-times more effective than the same amount spent in reducing shipping emissions.

4. Safety issues regarding hydrogen and ammonia in particular need to be addressed

Safety issues are considerable but work on them is ongoing at IMO's CCC Sub-committee. Experience of feedback into regulatory development is also necessary. Everyone is rushing to order ammonia-ready ships, but the reality is that with every new HAZID that is done, they are learning new things and changing the requirements.

5. Cost factors would determine which fuels are most suitable for individual trades

Cost is going to be an issue for all alternative fuels hence the market-based measures; however, there may be significant disparities between different production methods e.g. between bio- and e-versions of methanol, or grey/blue/green hydrogen. Most e-fuels start with hydrogen, meaning electrolysers and lots of power unless the hydrogen is less environmentally-friendly grey or blue, so cost of energy is a major factor. However, availability and industry bets on technology are probably equally important, as are route distance/operational profile.

6. Wind and solar energy may be applicable to at least supplement fuels in some trades

Wind holds great promise, however the actual impact is still uncertain and requires different operational thinking/routing and crew trained to exploit it properly, as well as eventual evolution of ship design. Some risks are also unexplored, e.g. stability and manoeuvring in confined waters, though many are mitigated if the wind technology can be stowed. One of the advantages is that we do not need to wait for corresponding fuel infrastructure and in fact a sail-assisted ship is now operating on the Newcastle NSW — Japan route.

Solar's contribution is limited, so dependent on overall energy demand and available space.

7. Market-based incentives would be necessary for ships using low-and zero-carbon fuels to be competitive in the market

A shipbroker informed the symposium that, in the absence of market-based measures, ships using low- and zero-carbon fuels would invariably be undercut in charter rates by legacy vessels using high-carbon fuels. Without incentives, shipping services to SIDS may be disrupted or restricted to using legacy vessels.

Any market-based measures would have to be administered on an international basis for reasons of fairness across flag jurisdictions. This may be a problem in itself.

The shipping industry has indicated its support for market-based measures, and indeed has offered a fund of hundreds of millions of dollars for research into alternative fuels.

8. One possible market-based incentive was a carbon tax of say $100/tonne, which could be accommodated by the mainstream market

There are several possible market-based measures.

A carbon tax of $100 per tonne works out at $311.4 per tonne of HFO which is both within the volatility experienced by the market, and likely not sufficient on its own to close the cost gap between fossil fuels and alternative fuels.

9. Current uncertainty on future regulatory decarbonisation requirements was leading to a potentially damaging delay in fleet renewal

The shipbroker speaker informed the symposium that shipowners were delaying decisions on fleet renewal because of uncertainty of future rules, particularly until IMO's Marine Environment Protection Committee decides on an action plan scheduled to be at its meeting in mid-2023. Therefore, once that action plan is set, orders of new ships tailored to that plan are likely to flow relatively quickly.

Many countries are also not really doing anything about ensuring adequate quantities of low/zero carbon energy and fuels in the 2030s….so with no guarantee of any fuel availability, most regulations alone will accomplish very little. On the other hand, Egypt informed the symposium that they had established a low- and zero-carbon fuels "hub" at the Suez Canal. So it appears that where a potential demand exists the market will find a way of satisfying it but, otherwise, fuel availability needs to be assessed on a route-by-route basis.

10. Any funds raised by a tax would need to be redistributed both within and external to (e.g. production of fuels by landlocked nations) shipping to ensure a just and equitable outcome for SIDS and LDCs

The symposium considered how any funds generated by market-based measures might be used. A World Bank speaker suggested that some land-locked less-developed countries (LDCs) might be ideally suited for production of low- or zero-carbon fuels and should be supported to do so. On the other hand, Pacific islands SIDS want support to avoid having their shipping services being sidelined in the decarbonisation process through the availability of either appropriate ships or bunkering facilities. The conclusion seemed to be that the funds would need to be shared both within and outside shipping to facilitate not only a just and equitable transition but also the widespread availability of fuels.

SIDS and LDCs would need to have some natural resource (e.g. wind, solar etc.) to produce the fuels in the quantities required. However, transport costs would potentially skew things so that what little they produce would be uncompetitive in the market. Scale counts, even in a decarbonised world

11. Training of crews need to be considered in relation to the alternative fuels to ensure adequate skilled labour

We have a long way to go to train all crews to the standards required for most of the low- and zero-carbon fuels. For example, the knowledge and skills of those on LNG carriers would need to be upgraded by an order of magnitude if liquid hydrogen is to be carried or used as a fuel. Nuclear ships will require further upgrades. This training should be additional to and not replace that required to operate ships efficiently.

12. Some of the relevant technologies are already being offered by shipbuilders, particularly for (near-coastal) short routes (e.g. electric tug fleets)

The challenge is to demonstrate that the technology is not only available but scalable and replicable. The idea of battery-powered vessels makes a lot of sense, but shore-side grid connections, especially when either the power demand is large, or there are many vessels, make it challenging, and in many cases there is no business case for the port if there is insufficient utilisation. It is worth noting that the shore-power facilities on the US West Coast and in the French Mediterranean had to be paused during the extreme high temperatures in the summer as there was insufficient grid capacity due to the consumer demand for AC, reduced efficiency at power plants and lack of cooling water for nuclear power plants in France due to drought.

13. Without wanting to be negative, I found a couple of the presentations on what progress had been made on a national basis to be less than convincing

There is a lot of greenwashing — there is progress, but at a rate and scale very far from where we need to be, and it is a highly political discussion, not a technical one.

We live in interesting times!

THE INTERNET

RINA Webcasts

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

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

Bookmark this website and keep your eye on it!

Video recordings of presentations should be sent to Jaime Perez Martinez <jmartinez@rina.org.uk> at RINA HQ for uploading.

Click on *Playlists*. Under Branch and Section Presentations click on *View full Playlist* to see the list, or click on the search function to the right of *About* in the menu bar, type the title of the presentation you are looking for (or at least the first few words thereof) and press Enter.

ACT Section Webcast

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

- *Development of the Atlantic Escort in the Second World War*, presented by Tim Lyon at an in-person meeting at UNSW Canberra at the Australian Defence Force Academy in Campbell, and streamed live via RINA's Zoom platform on 28 June 2022.

Jordan Rayson

NSW Section Webcast

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

- *Submarines for Australia—Going Nuclear,* presented by John Jeremy, Royal Institution of Naval Architects, as a webinar hosted by RINA on 3 August 2022.

Phil Helmore

Victorian Section Webcasts

The Victorian Section webcasts recorded and uploaded within the last three months are:

- *Portable Active Heave Compensation — A Story of Australian Innovation*, presented by Ben Healy of Thrust Maritime, as a webinar hosted by RINA on 10 March.
- *CAD/CAE Workflow: Capturing, Validating and Optimising Foundation Structural Design in Shipbuilding*, presented by Angus Houston, Naval Architect/Structural Engineer Consultant with Houston Engineering, Simon Crook, Senior Solution Specialist with ShipConstructor Software Incorporated, and Alexander Quirk, Technical and Sales Manager Australia and New Zealand with Altair Engineering, as a webinar hosted by RINA on 26 July 2022.
- *Metocean Engineering in the Context of Naval Architecture and Marine Infrastructure* presented by Alexander Babanin as a webinar hosted by RINA on 24 August 2022.

Keegan Parke

WA Section Webcasts

The WA Section webcasts recorded and uploaded within the last three months are:

- *Ocean Waves in Conventional and Renewable Applications*, presented by Wenhua Zhao at an in-person meeting at Engineers Australia in Perth, and streamed live via WebEx on 9 December 2021.
- *Wave Energy: History, Fundamentals and Challenges,* presented by Adi Kurniawan at an in-person meeting at Engineers Australia in Perth, and streamed live via WebEx on 9 December 2021.

Ken Goh

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

VICTORIAN ENGINEER REGISTRATION

The *Professional Engineers Registration Act 2019* enacted by Victoria provides for mandatory registration of persons providing professional engineering services in the following areas of engineering:

(a) structural engineering;
(b) civil engineering;
(c) mechanical engineering;
(d) electrical engineering;
(e) fire safety engineering; and
(f) any other prescribed area of engineering.

With regard to (f), the *Professional Engineers Registration (General, Exemption and Assessment Scheme Fees) Regulations 2021* do not prescribe any other areas.

Mandatory registration for engineers working in Victoria is being progressively introduced according to areas of engineering as follows:

- Fire safety engineer, 1 December 2021
- Civil engineer, 1 October 2022
- Structural engineer, 1 October 2022
- Electrical engineer, 1 June 2023
- Mechanical engineer, 1 December 2023.

Victoria advises that registration applications should be lodged at least 3 months before the applicable date.

Immediately following the adoption of the Act, RINA's then Chief Executive wrote to Victoria requesting that the Institution be appointed as an assessment entity to administer an approved assessment scheme in the area of mechanical engineering on the assumption that our profession is a sub-set of mechanical engineering. That letter received a holding response which was not followed by any further information until RINA pursued the matter earlier this year.

Matters in contention included whether naval architects were in fact intended to be included in the application of the Act (i.e. whether the assumption of being a sub-set of mechanical engineering was correct) and whether the exclusion of 'an engineering service that is provided only in accordance with a prescriptive standard' from the definition of ***professional engineering service*** meant that naval architects whose work related directly to compliance with standards such as statutory requirements and class rules were excluded from the registration requirement.

The answer received indirectly through Tom Dearling in relation to these matters is an expectation that **naval architects do need to register**, and most will probably do so under the area of mechanical engineering. However, the BLA recognise that naval architecture is a broad discipline (which they admit they don't have a good understanding of) which overlaps with other engineering disciplines. They emphasised that there is a degree of responsibility on the individual to determine and justify which area of engineering they best fit into, and **the individual is free to apply in the area of engineering which they believe best fits their primary area of work**. This aspect may be of particular interest to naval architects whose work might involve parts of fire safety engineering, structural engineering or electrical engineering and thus may be subject to one of the earlier implementation dates referred to below.

Defence has, no doubt, obtained its own legal advice on whether naval architects engaged solely in Defence work are covered by the Act.

The basic standard of qualifications and experience required for registration is to be certified as a practitioner in accordance with the requirements of the Washington Accord, in RINA's case MRINA CEng. Unregistered practitioners need to work under the direct supervision of a registered professional engineer.

A mutual recognition clause (ss. 68(5) of the Act) provides for acceptance of engineers having equivalent registration in another State or Territory or New Zealand. Accordingly, naval architects who are RPEQ are not required to be additionally registered in Victoria.

As this issue goes to press, RINA HQ is lodging a detailed submission to Victoria for acceptance as an assessment entity. Processing of the assessment entity application may take up to three months and further delays will be involved in the processing of individuals' applications by both RINA and then by BLA Victoria for whom a further three months is mentioned above. From a RINA perspective, applications must be reviewed by the Membership Committee at one of its periodic meetings and may also be subject to delays relating to the Professional Review Interview. **The need for members to act well before the relevant Victorian deadline cannot therefore be over-emphasised.**

For the meantime, **members impacted by the *Act* should <u>immediately</u> commence action as follows, noting the time mentioned above before the December 2023 deadline that may be taken up with administrative delays:**

- **apply as soon as eligible to upgrade their membership to MRINA CEng if not already at that grade; and/or**
- **consider whether to apply for RPEQ through RINA (which should be done without delay) or wait until RINA becomes an approved assessment entity under the Act.**

As can be seen from the preceding paragraph, there is no need for members to consider joining other bodies such as Engineers Australia or Professionals Australia to secure registration.

Finally, members should note that the Victorian requirements for Continuing Professional Development of registered engineers exceed those that would otherwise be applicable to members of MRINA CEng grade. Our application as an assessment entity recognises this difference and undertakes to apply the more severe requirements to engineers registered through RINA.

Of course, I will provide whatever assistance I can to members having queries (send to email rinaaustraliandivision@iinet.net.au, or phone 0403 221 631) on this subject.

Rob Gehling
Australian Division Secretary

MEMBERSHIP

Australian Division Council

The Council of the Australian Division of RINA met on the afternoon of Wednesday 21 September 2022 by Zoom conference under the chairmanship of our President, Jim Black, in Perth with links to Cairns, Airlie Beach, Gold Coast, Sydney, Canberra, Melbourne, Hobart, Adelaide and Perth. In opening the meeting, the President welcomed Vice President Belinda Tayler who was attending her first Council meeting.

Among the items discussed were:

Formation of Improvement Committee

Council confirmed the terms of reference for the Committee, led by Vice President Tayler and looked forward to considering its report at the December meeting. The Secretary was instructed to obtain information from RINA HQ to inform the work of the Committee.

Independent Review of Domestic Commercial Vessels Legislative Framework

Council noted that a draft report had been issued. The extensive recommendations appeared to be at a high level and did not directly address many of the issues contained in the RINA submission. Members' comments were invited to be coordinated into a response by the required lodgement date of 30 November.

Investment Policy

Following the Division's registration with the Australian Charities and Not-for-profits Commission, Council adopted an investment policy which would provide improved return on the Division's assets consistent as far as practicable with the policies adopted by the broader Institution.

Walter Atkinson Award 2022

Council received the report by the assessment panel led by Mike Squires and, in accordance with the panel's recommendations confirmed that the Award would be presented to Richard Dunworth for his paper *Scaling the Wall: Inclining Experiment Analysis on Vessels with Chines, Hull Discontinuities or Asymmetry* at an appropriate occasion.

Rob Gehling presenting the Walter Atkinson Award 2022 to Richard Dunworth on 3 November (Photo courtesy Rob Gehling)

London Council Meeting 13 July

Council received an extensive report of this meeting, which was the last chaired by outgoing President Maurizio D'Amico. In handing over to Prof. Cat Savage, Mr D'Amico provided an extensive report of progress made by the Institution during his term and how he saw the futures of the shipping industry and the Institution. Members would see many changes across the Institution, on the website and elsewhere, during the remainder of the year.

Another feature of the meeting was the efforts being made by the technical committees to tap into the expertise of the broader membership. I would be happy to provide information to any members who are interested in joining one or other these committees.

Joint Board on Naval Architecture

Council noted that the Board had met on 28 July and was scheduled to meet again in December.

Annual Membership Report

Council noted a relatively small decline in membership numbers in the past year, which was largely attributed to the expiry of a number of free (initial) memberships and a concerning reduction in the number of students at UTas-AMC. The medium term trend was, however, one of continued satisfactory growth.

Victorian Engineer Registration

The Secretary provided a report on this issue, in relation to which more information is provided elsewhere in this issue of *The ANA*. Council noted the December 2023 deadline for naval architects covered by the Act to achieve registration, but that naval architects who were registered interstate (e.g. Queensland) would not be required to also register in Victoria.

Next Council Meeting

The next meeting of the Council of the Australian Division is tentatively scheduled for Tuesday 6 December 2022 at 1400 AEDT (1100 WST).

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

Rob Gehling

Secretary
ausdiv@rina.org.uk
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 Head Office publications, *The Australian Naval Architect*, or Section notices.

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

RINA London	hq@rina.org.uk
Australian Div.	rinaaustraliandivision@iinet.net.au

Section	ACT	rinaact@gmail.com	Tas	tassec@rina.org.u
	NSW	rinansw@gmail.com	Vic	vicsec@rina.org.uk
	Qld	rinaqlddiv@gmail.com	WA	wa@rina.org.uk
	SA/NT	rinasantdiv@gmail.com		

Phil Helmore

NOMINATIONS FOR DIVISION COUNCIL

Nominations are invited from Corporate Members (MRINA or FRINA) and Associate Members (AMRINA) for election to Division Council for a term of two years from March 2023. The majority of these elected members must be Corporate Members.

Nominations, which must be in writing and include the signatures of the proposer, seconder and nominee, should be received by the Secretary no later than Saturday 31 December 2022.

Rob Gehling
Secretary, Australian Division
PO Box 462, Jamison Centre, ACT 2614
ausdiv@rina.org.uk
0403 221 631

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NAVAL ARCHITECTS ON THE MOVE

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

Annette Hill has moved on from Lloyd's Register and has taken up the position of **S**enior Naval Architect with the Vessel Safety Unit of the Australian Maritime Safety Authority in Brisbane.

Elliot Thompson has moved on within DNV and has taken up the position of Senior Consultant in Sydney.

Alex Walter has moved on from BMT Design & Technology and has taken up the position of Capture Manager Maritime with Saab Australia in Adelaide

Jiong Wang has moved on from CSL Group and has taken up the position of Field Service Engineer with Wärtsilä in Sydney.

Yun Wang has moved on from One2three Naval Architects and has taken up the position of Naval Architect with the Naval Shipbuilding and Sustainment Group of the Department of Defence in Canberra.

Stephen Watt has moved on from MMA Offshore and has taken up the position of Lead Engineer with Fugro in Perth.

Ryan Watts has moved on within Ocean Installer and has taken up the position of Project Engineer in Stavanger, Norway.

Cameron Whitten has moved on from Sea Transport Solutions and, after some time at Qinetiq Australia, has taken up the position of Technical Advisor Naval Architect with Gibbs & Cox Australia in Canberra.

Tristan Williams has moved on from Heesen Yachts and, after some time at De Keizer Marine Engineering, has taken up the position of Managing Partner with Venture Skipper in Leeuwarden, The Netherlands.

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

Phil Helmore

FROM THE ARCHIVES

HMAS *Castlemaine* — 80 Years

As the prospect of war loomed in the late 1930s, a need was identified for small warships for the Royal Australian Navy to provide for local defence which would be capable of construction easily in non-naval shipyards from material and equipment which could be sourced in Australia.

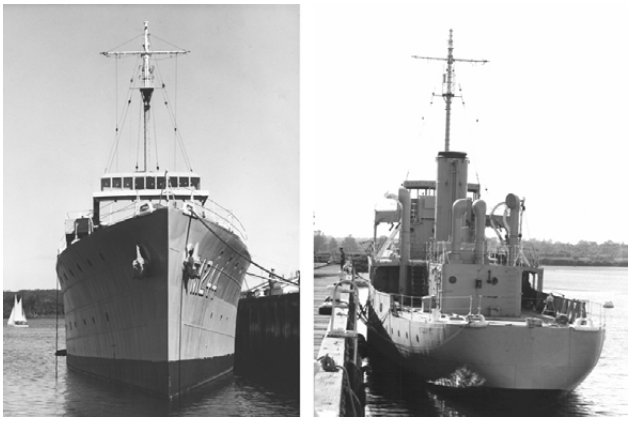
By early 1939 the preliminary design of an Australian Local Defence Vessel (LDV) was largely complete. The design was wholly developed in Australia under the supervision of RADM P. E. McNeil, the Director of Engineering (Navy). The LDV was quite a small ship of about 690 t, a length of 56.4 m and a speed of 15.5 kn. The range was about 2850 n miles and the complement 85 men. Approval to build the first seven ships was given in September 1939 and the order for the lead ship was given to Cockatoo Dockyard in Sydney in December 1939 at a contract price of £139 500 (equivalent to about $13.7 million today). Orders were also placed with the Melbourne Harbor Trust in Williamstown, Victoria, Mort's Dock in Sydney and Walkers in Maryborough, Queensland.

Ultimately sixty of these small but useful ships were built — including 20 to British Admiralty account (although commissioned as RAN ships) and four for the Royal Indian Navy. The LDV classification apparently caused misunderstanding in Britain and they redesignated Australian Minesweepers (AMS) — Bathurst Class. Despite this official description they became commonly known as corvettes.

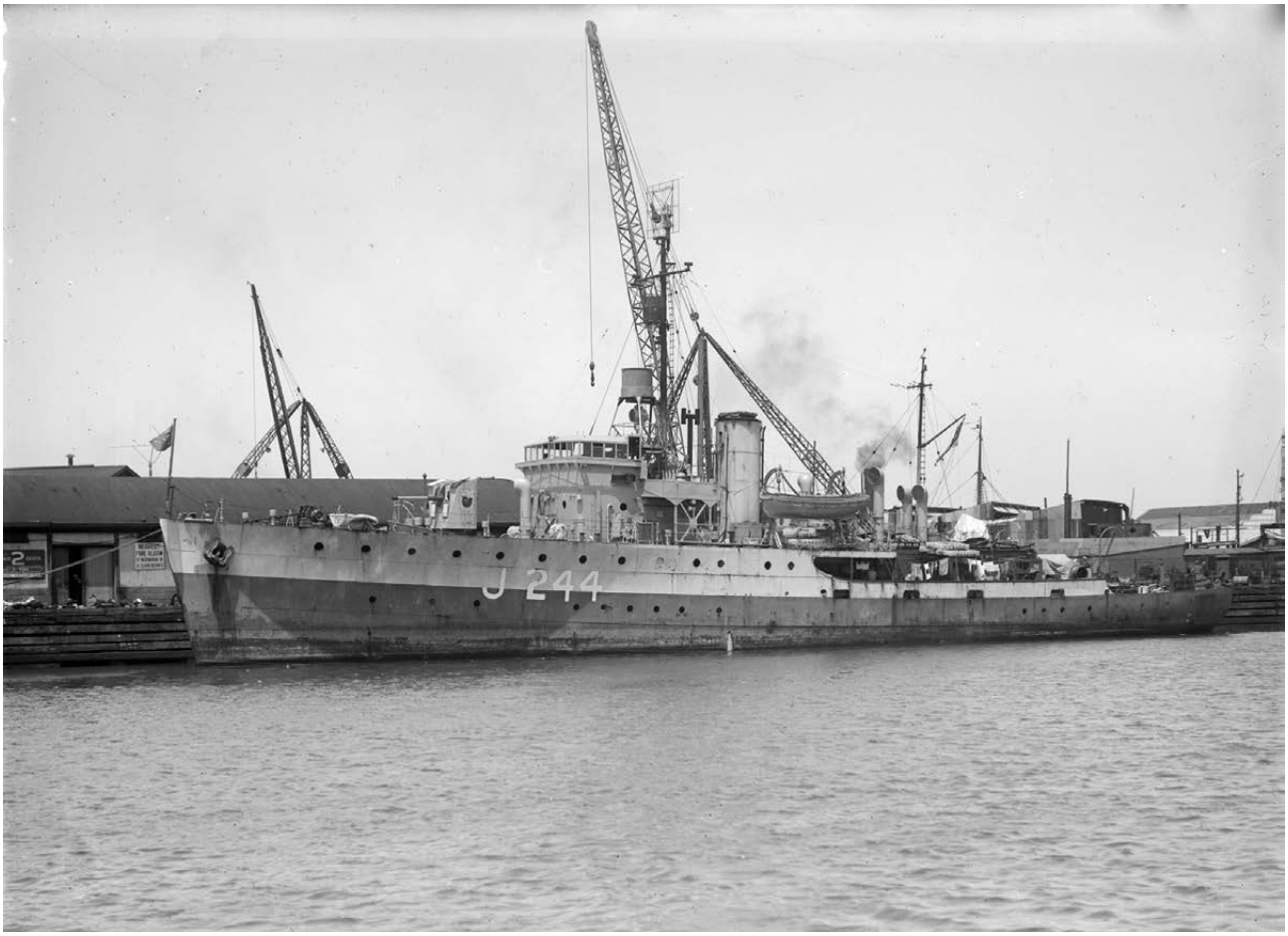
Two of these small ships survive today. HMAS *Whyalla*, the first ship built by BHP at the new Whyalla shipyard in South Australia, is now ashore some 2 km from the water as the centrepiece of the Whyalla Maritime Museum. The other is HMAS *Castlemaine*, well preserved by the Maritime Trust of Australia, Victoria, alongside the Gem Pier in Williamstown.

Castlemaine was built at the Williamstown Naval Dockyard, being laid down on 17 February 1941 and launched on 7 August that year. She was commissioned on 17 June 1942, just over 80 years ago. After busy war service, *Castlemaine* was decommissioned on 14 December 1945. After a long period in reserve, she was refitted in 1958 and transferred to HMAS *Cerberus*, Westernport, Victoria, for use as a stationary training ship. That service ended in 1971 and she was presented to the Maritime Trust of Australia for preservation as a museum ship. Today, at 80 years old, she is a fine example of a small warship built in a hurry to meet the urgent imperatives of war. One might say that she represents the 1940s equivalent of today's offshore patrol vessels.

John Jeremy



HMAS *Castlemaine* during her service as a stationary training ship at HMAS *Cerberus* in Victoris
(RAN photograhh)



HMAS *Castlemaine* alongside in Melbourne in 1945
(Alan C Green collection, State Library of Vistoria)

Celebrating 80 years — HMAS *Castlemaine* dressed overall for Navy Day, Victoria in 2022
(RAN photograph)

Sir James Hardy's beautiful gaff cutter *Nerida* was a spectacular participant in the Sydney Amateur Sailing Club's Gaffers Day on 16 October (Photo John Jeremy)