THE AUSTRALIAN NAVAL ARCHITECT

Volume 18 Number 1
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The Ferrython is always a popular part of the Australia Day celebrations on Sydney Harbour. The grey and damp conditions in the morning kept the spectator fleet down but it was still a great sight. The P&O liner *Pacific Jewel* is moored in Athol Bight in the background
(Photo John Jeremy)

THE AUSTRALIAN NAVAL ARCHITECT

Journal of
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Cover Photo:

Wild Oats XI, line honours winner in the Rolex Sydney to Hobart yacht race, manoeuvring before the start on Boxing Day 2013
(Photo John Jeremy)

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RINA Australian Division
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From the Division President

I am writing this column in the brilliant sunshine of an Australia Day long weekend; many of us have been back at work for a few weeks of this new year already, and others will be back shortly as we all resume or take up new positions in this great profession of ours. My very best wishes to you all for an exciting and challenging 2014.

As I noted in my last column, there is much to be done, not just for naval architects but for all professional engineers, in the fields of mutual recognition, registration, and broader acceptance of the essential place of engineers in modern society and this is a task for every one of us. May I suggest that a suitable and practical new year's resolution for most of you should be to ensure that, during the course of this year, you enhance your position in the profession. For some that may be simply ensuring that your CPD is up to date and suitably recorded, for others it may be taking positive steps towards the next grade of membership and the relevant chartered status. The statistics for our Division show a fairly static picture with only a handful of members completing the progression to MRINA CEng throughout the year. I know that many more of you are eligible or well on your way to being so. If you have any doubts or questions about these steps in your professional career path, then there are many experienced colleagues around you who can provide you with guidance.

I am aware that some of you here in Australia are faced with the question of whether to follow the RINA CEng path to chartered status or to consider the Engineers Australia CPEng path because it is CPEng with which many of your employers are most familiar. I would draw your attention to the Agreement of Cooperation between the Institution of Engineers Australia and the Royal Institution of Naval Architects which states, in part: "The RINA recognises that Engineers Australia is the paramount institution for engineers in Australia. For its part, Engineers Australia recognises that the RINA is the paramount international professional institution for naval architects. Engineers Australia further recognises that, in Australia, the RINA is carrying out member services, professional development, expert and policy advising and other important functions." Although either path is professionally acceptable, I strongly encourage you to consider the RINA CEng path because you will be professionally assessed as a naval architect by naval architects, and that has to be good! Should you later require CPEng then, through the Agreement and the various international accords, reciprocal recognition for membership and facilitation of registration as a competent practitioner is provided for.

Although I have only mentioned CEng/CPEng above, the same, of course, applies to those working towards IEng/CEngT or EngTech/CEngO.

Of direct relevance to this topic, I am pleased to advise that the Joint RINA/Engineers Australia Board for Naval Architecture (JBNA) has just been reconvened and will now meet six-monthly to consider and progress matters of joint interest, such as mutual recognition, review of the Naval Architecture General Area of Practice on the National Professional Engineers Register, the Queensland Professional Engineers Act and how it affects our members, and other topics of mutual interest.

This brings me to AMSA's recently-released *Public Consultation of the Marine Safety (Domestic Commercial Vessel) Amendment (Surveyor Accreditation) Regulation 2014*, inviting comment on their proposal for accreditation of surveyors throughout Australia for both plan approval and vessel surveys under the NSCV, closely following what we think of as the "Queensland model" currently in practice in that state. This consultation phase closes on 16 March 2014. It is most likely that the Division will be making a submission and I would encourage those of you likely to be affected by this legislation to participate in the consultation process, either by submitting your comments to the Division or by responding directly to AMSA or both! I am well aware that not all of you will be of the same opinion about these proposed legislative changes, and I can well understand that those of you who are currently working for State marine authorities are hardly likely to view this through the same coloured glasses as those of you in private practice — I expect some healthy debate! Wherever you sit, please do try to take part in the process.

Finally, as always, I am available for discussion and comment on any topic of relevance to Australian naval architects, by email at jimb@austal.com or telephone (0418) 918 050.

Jim Black

Editorial

Deep in my storeroom I have a pile of paper — copies of papers presented to the Australian Branch (mostly)/ Division over the last fifty years. The pile contains a wealth of information but very few of the papers are recent. In this age of PowerPoint, very few real papers are presented. There is either no record of the presentation or, perhaps, if it was given to the NSW Section, an excellent summary by Phil Helmore in the pages of *The ANA*. Because of the lack of written papers, the Division's Walter Atkinson Award went into hibernation for too many years.

It is pleasing that the Walter Atkinson Award has finally been presented again, to four authors for a paper presented at Pacific 2012.

We are also pleased to be able to publish, in this edition, an updated version of a paper presented to the Pacific 2013 IMC by Richard Dunworth. Now titled *Back to the Wall*, it presents a new method for interpreting inclining experiment results. Following the Pacific 2013 IMC, delegates were invited to respond to a survey which sought their views on a range of topics including their assessment of the most memorable presenter at the conference.

The most memorable speaker nominated by the respondents to the survey was Richard Dunworth for *Up Against the Wall*. Well done Richard!

So, members one and all, there is the challenge. Write and present proper papers to the meetings of this Institution in Australia — not necessarily just for the Pacific 2016 IMC (although we are hoping for excellent papers for that event) but every year. You never know, you might find that you could win the Walter Atkinson Award and have another certificate to grace the walls of your office or home.

John Jeremy

LETTERS TO THE EDITOR

Dear Sir,

I have admired submarines since I was young. I remember reading about the first one-man military submarine designed by the American, David Bushnell. It was a wooden, hand-powered acorn-shaped submarine named *Turtle*, which tried to sink the British warship, HMS *Eagle*, in 1776, but it was a failure. Since then, submarine technology has rapidly evolved from having a one-man crew, equipped only with a drill, and only being able to stay underwater for a couple of hours, into the Typhoon-class submarine, which is nuclear powered, 175 m long, can accommodate over 120 personnel and remain underwater for months or until the food supplies run out. There are three main types of submarines: those for recreational, scientific, and military purposes. Becoming involved in designing any of these types of submarines as a naval architect would be very interesting.

The most impressive submarine is DSV *Alvin* which is used for scientific purposes. It is a 16 t deep-submergence vehicle which can carry a pilot and two scientists. It can dive to the impressive depth of 4500 m, and was made possible by the development of syntactic foam, a composite material which consists of tiny hollow microspheres embedded in a larger structure. The microspheres decrease its density while maintaining strength, allowing deeper dives. Even the hull of this submarine was made using titanium. It is a very challenging task to the engineers designing this submarine to maintain its stability underwater while the crew is moving around inside and using two hydraulic manipulator arms which can lift up to 90 kg each and are mounted on the forward end of the submarine. These arms are used to collect live biological and geological samples which are then stored in an external basket. A hydrogen bomb was located and retrieved after it was lost when an American B-52 and an aircraft tanker collided over the Mediterranean Sea.

I really hope that, in the future, there will be a naval architect who can work on a submarine like DSV *Alvin*, but turn it into a recreational submarine so that many people can enjoy the beauty of the deep sea from a real submarine.

Asiff Sabri
UNSW Student

Dear Sir,

With great delight I learned that the Australian businessman, Clive Palmer, intends to create a replica of RMS *Titanic*. Personally, I am really excited. The 1997 movie impressed me a lot when I was a child, and it is ultimately what led me into naval architecture.

Titanic was considered unsinkable in 1912, and so had only had one-third of the lifeboats necessary for all the people on board. Captain Smith said that he could not "imagine any condition which would cause a ship to founder. Modern shipbuilding has gone beyond that." Although *Titanic* received a number of iceberg warnings before the wreck, the ship was still speeding up. As a consequence, human ego cost us 1500 lives to learn to respect the power of nature.

The sinking of *Titanic* is one of the most memorable tragedies in history, because it made people start to question themselves: "Can man outwit nature?" The International Convention for the Safety of Life at Sea and new wireless regulations were then established to prevent more disasters. People learned more from this failure than from past success.

A hundred years later, when asked if *Titanic II* will be unsinkable, Clive Palmer answered "Anything will sink if you put a hole on it." *Titanic II* not only brings the original design back, but also improves on some of the details to keep it in line with current maritime regulations. It will also have more than enough lifeboats for everyone on board, even if it is "the safest cruise ship in the world".

Titanic II is a great example showing that previous failure is not a definite end, but a new beginning of the exploration. I wish *Titanic II* all the best and salute those people who are determined to progress.

Renjie Zhou
UNSW Student

THE AUSTRALIAN NAVAL ARCHITECT

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

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

Photographs and figures should be sent as separate files (not embedded) with a minimum resolution of 150 dpi. A resolution of 300 dpi is preferred.

NEWS FROM THE SECTIONS

New South Wales

Committee Meeting

The NSW Section Committee met on 18 November and, other than routine matters, discussed:

- SMIX Bash 2013: Tickets have been selling well, although the Company of Master Mariners has had a hiccough in advising their members of where to obtain tickets, and the model for the silent auction has been delivered.
- Technical Meeting Program for 2014: RINA presentations for the first half of the year have been confirmed, with proposals for the second half yet to be confirmed. IMarEST presentations are also under way.

The NSW Section Committee also met on 3 February and, other than routine matters, discussed:

- SMIX Bash 2013: The 14th SMIX Bash was generally regarded as successful, although there were slightly fewer registrations and sponsorships; accounts have yet to be finalised, with some payments still to be made, but projections are for about break-even, with proceeds of the raffle being kept in consolidated revenue rather than donated as usual.
- SMIX Bash 2014: Thursday 4 December has been pencilled in for this year's SMIX Bash.
- Technical Meeting Program 2014: A last-minute change has had to be made to the presentation for February, and the presentation scheduled for March has had to be moved to later in the year due to commitments of the presenter, so we are busy re-arranging the presentation for March. The presentation for September has yet to be finalised.
- Accreditation of Surveyors for the National System: AMSA has circulated an email with an attachment *Marine Safety (Domestic Commercial Vessel) Amendment (Surveyor Accreditation) Regulation 2014*, requesting comments to be received by AMSA by 1 March, so the timescale is short. For more detail, see *The Profession* elsewhere in this issue.

The next meeting of the NSW Section Committee is scheduled for 18 March 2014.

SMIX Bash

The fourteenth SMIX (Sydney Marine Industry Christmas) Bash was held on Thursday 5 December aboard the beautifully-restored *James Craig* alongside Wharf 7, Darling Harbour, from 1730 to 2130. The Bash was organised jointly by the RINA (NSW Section) and the IMarEST (Sydney Branch). About 200 guests came from the full spectrum of the marine industry, including naval architects, marine engineers, drafters, boatbuilders, machinery and equipment suppliers, regulators, classifiers, surveyors, operators, managers, pilots, navigators, researchers, and educators. Equally importantly, the full spectrum of age groups was represented, from present students to the elders of the marine community.

James Craig at Wharf 7, Darling Harbour
(Photo Phil Helmore)

The registration desk at the gangway
(Photo Graham Taylor)

It was also great to see intrastate, interstate and international visitors in the throng, including Rob Gehling and from the ACT, Jim Black from WA, and Gregor Macfarlane and Jon Duffy from Tasmania, among others. All tickets were sold before the event — you really do have to be early!

Sydney turned on a beautiful evening after some isolated showers earlier in the day, and many partners in attendance enjoyed the view from the decks of *James Craig.* Drinks (beer, champagne, wine and soft drinks) and canapés (chicken kebabs, rolls, quiches and smoked salmon) were provided. A delicious buffet dinner was served in the 'tween decks, followed by trays of sweet afters with tea and coffee, and then and mini-cones of gelati, and many tall tales and true were told.

Some of the crowd enjoying drinks and canapés
aboard *James Craig*
(Photo Phil Helmore)

Dianne Bixley (L), Sue Taylor and Helen Wortham enjoying drinks and canapés aboard *James Craig*
(Photo Graham Taylor)

Some of the crowd enjoying dinner in the 'tween decks aboard *James Craig*
(Photo Graham Taylor)

Formalities were limited to one speech by Adrian Broadbent, Treasurer of the SMIX Bash Organising Committee, who welcomed the guests and thanked the industry sponsors, and one by Jim Black, President of the Australian Division of RINA, who presented the Walter Atkinson Award for 2013 to Gregor Macfarlane and Ross Ballantyne for their paper (co-authored with Tim Lilienthal) *The Floating Harbour Transhipper—an Operationally Effective Solution for Military and Emergency Response Duties*, which was presented at Pacific 2012.

Gregor Macfarlane (L) and Ross Ballantyne receiving the Walter Atkinson Award 2013 from Jim Black and Rob Gehling
(Photo courtesy Graham Taylor)

The lucky-door prize was drawn by Hannah Flint, ANZSPAC Divisional Manager for the IMarEST. The winner was Peter Cundall who won a $50 gift voucher to the Australian National Maritime Museum shop.

The raffle was drawn by Roland Briene of Damen Shipyards Group, and the winners were:

First	Chris Taylor	$100 ANMM shop gift voucher
Second	Lyndel Wackett	$75 ANMM shop gift voucher
Third	Craig Boulton	$50 ANMM shop gift voucher

Roland Briene (L) drawing the Lucky Door Prizes and Adrian Broadbent announcing
(Photo courtesy Graham Taylor)

Bill Bollard had built a magnificent half-block waterline model of the Sydney Heritage Fleet's vessel, *John Oxley*, from laminations of Australian cedar and white jellutong, mounted on a jarrah backboard, and the model was put up for silent auction. Jim Black submitted the winning bid and the model was presented to him by Adrian Broadbent. Our thanks to Bill for his expertise in building and generosity in donating this model.

Bill Bollard's beautiful model of *John Oxley*
(Photo Phil Helmore)

This year's event was sponsored by the following organisations:

Platinum

- Teekay Shipping (Australia)
- Damen

Gold

- AMC Search
- Ausbarge Marine Services
- Det Norske Veritas–Germanischer lloyd
- Electrotech Australia
- Energy Power Systems (Caterpillar)
- International Paints
- Jotun
- Lloyd's Register Asia
- PB Towage
- Svitzer Australasia
- Thales Australia
- Wärtsilä Australia

Silver

- AMD Consulting
- Burness Corlett Three Quays
- ASO Marine Consultants
- Cummins South Pacific

Bronze

- Ayres Lightweight Panel Systems
- Edwards Marine Services
- One2three Naval Architects
- Shearforce Maritime Services
- Twin Disc (Pacific)

Our thanks to them for their generosity and support of SMIX Bash 2013, without which it could not happen.

Some of the stayers, who were shown the gangplank late in the peace, rocked on to other venues and continued to party until the wee small hours.

Advances in Slow-speed Marine Diesel Engines

Eric Clarke of MAN Diesel & Turbo Australia Pty Ltd gave a presentation on *Advances in Slow-speed Marine Diesel Engines* to a joint meeting with the IMarEST attended by 9 on 5 February in the Harricks Auditorium at Engineers Australia, Chatswood.

Introduction

Eric began his presentation by saying that there are exciting developments taking place in the slow-speed marine diesel market. These include the development of liquid gas injection, ultra-long stroke engines, slide fuel valves, and lowering of engine RPM. These developments mean that the engine manufacturer has to become involved in the design of the vessel at an earlier stage than previously, because the engines influence the shape of the aft end and the diameter of the propeller for example. Further, the days of buying engines off-the-shelf are numbered as, more and more, engines are being designed to suit each particular vessel or series of vessels. There is a compromise between power and speed, and the fuel consumption varies a lot, so the engine manufacturer becomes involved in the design.

Liquid Gas Injection

MAN Diesel & Turbo has announced the development of a new ME-LGI dual-fuel engine. The engine expands the company's dual-fuel portfolio, enabling the use of more-sustainable fuels such as methanol and liquefied petroleum gas (LPG).

MAN has subsequently signed a letter of intent with Vancouver-based Waterfront Shipping for the use of four ME-LGI engines on its ships. The engines will run on a blend of 95% methanol and 5% diesel fuel. The four G50ME-LGI units are slated for the end of 2014, with engine delivery to follow in mid-2015.

Ultra-long Stroke Engines

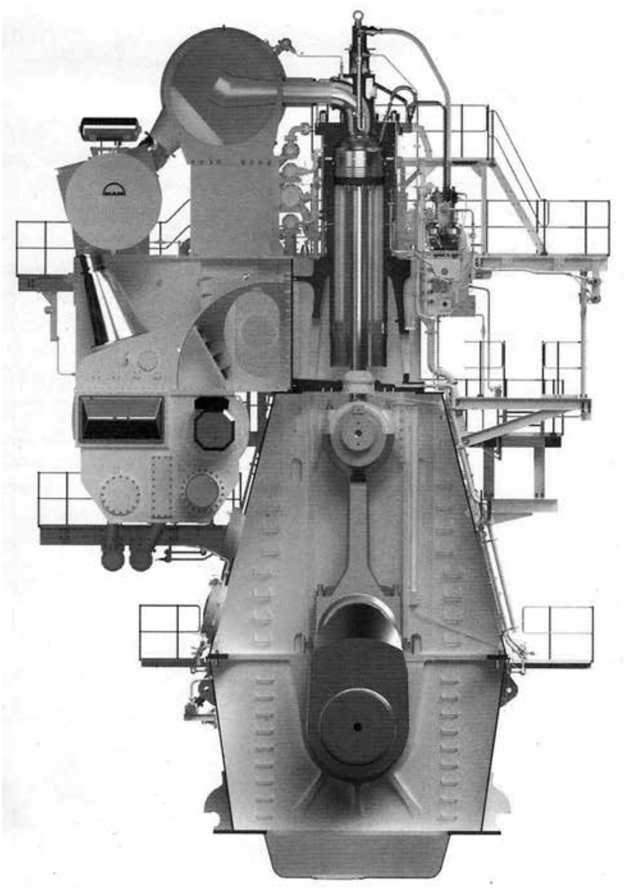
MAN Diesel & Turbo has developed the G-Series engine which has an ultra-long stroke. The longer stroke means that the crankshaft has a bigger throw, which means a wider engine, and this typically means a wider engine room and a wider aft end. The higher power and lower RPM allow the use of a larger-diameter propeller diameter, which is significantly more efficient in terms of engine propulsion, reduces fuel consumption and markedly reduces CO_2 emissions. As a result, the whole aft end of the vessel has to be re-designed to suit the G-Series engines.

As an example, Eric showed the comparison between propulsion options of a G-Series and an S-Series (long-stroke) engine for a 64 000 dwt bulk carrier:

	G-Series Ultra-long Stroke	S-Series Long Stroke
MCR Power (kW)	8500	8050
MCR RPM	77	89
Propeller diameter (m)	7.15	6.7
Propeller type	FP, 4 blades	FP, 4 blades
MCR speed (kn)	15.6	15.15
Service speed (kn)	14.4	14.4
Service power (kW)	6600	6842
Service RPM	70.8	84.3

The service speed is achieved with the G-Series engine with lower RPM and less power and the propeller diameter is larger. The engine itself is wider, higher, and has lower vibration characteristics due to a new method of bracing. As a result, the aft end of the vessel has to be designed to suit the whole propulsion train.

Eric then showed a number of diagrams, including a cross-section of a G-Series engine, the layout diagram (MCR power vs engine/propeller speed) and the specific fuel-oil consumption (SFOC) for the powering of a 13 000–14 000 TEU container vessel at 23 kn.

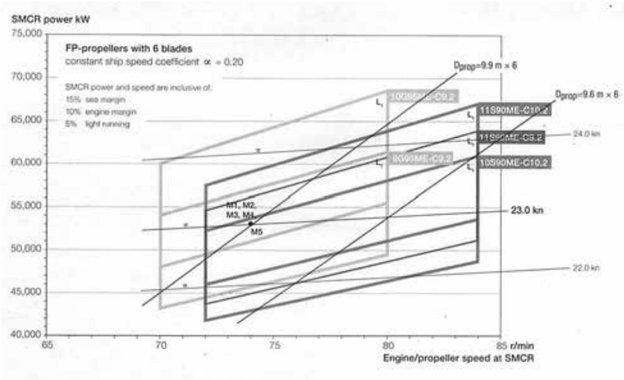


Rendering of the G95ME-C9.2 engine
(Image from MAN's *Diesel Facts* 2013-3)

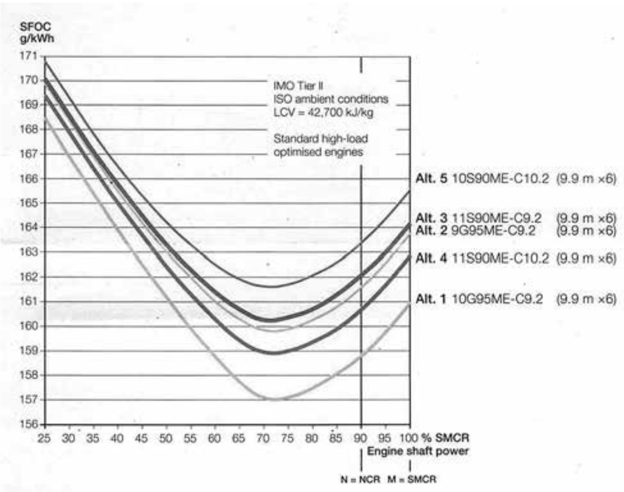
The layout diagram shows that, with the G-Series engines, the MCR power can be higher and achieved at lower RPM than for the S-Series engines.

The SFOC diagram shows that the specific fuel-oil consumption is lower for the G-Series engines, resulting in fuel savings for the owner.

Further benefits of the ultra-long stroke engines include



Layout diagram MCR Power vs engine/propeller speed for propulsion of 13000–14000 TEU container vessel at 23 kn
(Image from MAN's *Diesel Facts* 2013-3)



Expected specific fuel-oil consumption for propulsion of 13000–14000 TEU container vessel at 23 kn
(Image from MAN's *Diesel Facts* 2013-3)

lower lube oil consumption over the entire load range, and slightly lower exhaust gas temperatures.

Eric then showed a listing of Tier II G-Series engines built by ship type, and these have been installed mostly on bulk carriers, tankers and container ships. There are close to 200 G-Series engines on order.

The G-Series engines were developed from the Mk.9 S-Series engines, but have slim-design connecting rods, and high-pressure (300 bar/30 MPa)) hydraulic oil systems running in single-wall piping, low-force exhaust valves, the main bearing lube oil is supplied through the main bearing supports, and the engines have triangular frame boxes.

A possible problem looming for all engines (which is being highlighted worldwide) is the use of low-sulphur fuels, further operational and design developments are studying the current and new engine design and plant layouts in order to overcome possible issues in the future.

MAN Engines

MAN Diesel & Turbo does not build the large two-stroke engines in their own factories. They design the engines, and all are produced under licence and all are quality controlled by MAN personnel. A typical engine takes six – nine months to build and test, depending on production timelines. The first-of-type engines are always stripped completely after test and inspected minutely.

Recently in Korea, MAN's latest G-Series engine passed its Type-Approval test at HHI-EMD, the engine and machinery division of Hyundai Heavy industries. The ultra-long stroke G60ME-C9 engine went through its paces under the watchful eye of many interested observers, including representatives from the major classification societies.

Slide Fuel Valves

Slide fuel valves are an innovation which provide constant delivery of fuel rather than a squirt and can be better controlled. The slide fuel valve eliminates the so-called "sac volume', thereby reducing fuel consumption and eliminates dripping from the fuel-valve nozzles.

Compared to conventional valves, the slide fuel valve has NOx-reduction potential. The reduced sac volume leads, by nature, to an improved combustion process, resulting in fewer deposits throughout the gas ways and a reduction in overall emissions of hydrocarbons, NOx and particulate matter. Visible smoke conditions are also greatly reduced as a result of the improved combustion.

Conversely, engines fitted with slide fuel valves have, due to improved low-load performance with regard to soot formation, a significant advantage in an era when "slow steaming" (sailing at part load) has become the industry norm. This reduces or eliminates the need to run at high RPM in order to clean exhaust-gas channels.

Engine Control System

The engine-control system now comprises small cabinets with a computer, and this provides all controls for the engine. When MAN technical personnel arrive on board a vessel for tuning or trouble-shooting purposes, they can plug in a laptop computer if needed and check the system.

OECD Projections

If, as projected by the OECD, world trade increases by an average of 3.5% per annum during the next 20 years, then the commercial vessel fleet will need to increase in capacity by 100% over those 20 years.

Typically engine-building appears to have cycles of five-to-seven years. All large engine-builders had crashes in their order books few years ago. Now, delivery times on two-stroke diesels are about six – nine months, while for four-stroke diesels the delivery times are about one year, depending on the plant requirements. The problem is that, as the order books increase, the rate of engine production decreases due to capacity rates being full; everyone seems to want their engines at the same time!

High-efficiency propeller Designs

MAN Diesel & Turbo has developed the Kappel propeller, an innovative propulsor with higher efficiency than a conventional state-of-the-art propeller. Whereas traditional ship propellers have blades modelled on the basis of helical surfaces, the Kappel propeller has modified blade tips, smoothly curved to the suction side of the blade. This is a development parallel to that in aircraft design, where many modern aircraft, from high-performance jet liners to sophisticated gliders, have similar modifications of the wing tips in the form of winglets. These are separate lifting surfaces attached more or less perpendicular to the wings at the wing tips. Numerical methods, as well as experiments, show that the effect of winglets is to increase the lift/drag ratio of the wing.

Kappel-shaped blades are available on both fixed-pitch and controllable-pitch propellers, and are useful for very-low RPM applications (they do not work well at high RPM). Benefits include higher efficiency, lower propeller-induced vibrations, and reduced risk of cavitation.

MAN is therefore becoming involved in the design of propellers as well.

Engine Tuning

There are few standard engines any more; using the basic design initially, each engine is built specifically for the vessel and customer's requirements. Tuning used to be all mechanical, but now the majority is done electronically as part of the control system. Each engine can be set for different parameters (ship speed, RPM, etc.) Variations and tuning can be carried out by MAN.

Vibrations

The vibratory forces experienced by a G-Series engine are of the same type as experienced by other types of diesel engines. However, due to the longer stroke, higher width and mass of the engines, these forces are higher. MAN has therefore come up with an innovative form of double bracing for the engine, bracing on both the fuel and exhaust sides. Finite-element calculations show 20–50% reductions in vibration characteristics when compared with standard exhaust-side bracing.

Tier III NOx Technologies

IMO's MARPOL Annex VI *Regulations for the Prevention of Air Pollution from Ships* sets limits on NOx and SOx emissions from ship exhausts, and prohibits deliberate emissions of ozone-depleting substances. The IMO emission standards are commonly referred to as Tier I, II and III standards. Tier II came into force globally in 2011, with Tier III due to come into force in 2016 in prescribed emission-control areas (ECAs).

Tier III requirements mean that technological measures are required to limit a vessel's emissions of NOx. The proven technologies include selective catalytic reduction (SCR) and exhaust gas recirculation (EGR). The deciding factors on which technology to use include first cost, operating cost, maintenance cost, reliability, space requirements (greater for SCR), flexibility of installation, etc.

As a finale, Eric showed an animation of the working section of MAN's new G-series engine, and Len Michaels requested a copy as a screen-saver!

Conclusion

Slow-speed marine diesel engines have exciting advances being made in their design. There are various drivers, which include the IMO's Tier III emission limits, the requirement for overall efficiency, and the move from standard engines to engines customised for each vessel or series of vessels.

Innovations include liquid gas injection, ultra-long stroke engines, slide fuel valves, engine control systems, engine tuning capability, Kappel propellers, and double bracing for vibration control.

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

Eric's presentation was not recorded by Engineers Australia.

Phil Helmore

COMING EVENTS

Australian Division AGM

The Annual General Meeting of the Australian Division of RINA will be held on Wednesday 19 March at 7.00 pm at theVic Hotel, 226 Hay St, Subiaco, WA; see notice elsewhere in this issue.

NSW Section AGM and Technical Meetings

The Annual General Meeting of the NSW Section of RINA will be held on Wednesday 5 March immediately following the scheduled technical meeting of RINA (NSW Section) and IMarEST (Sydney Branch) at 6:00 for 6:30 pm at Engineers Australia, 8 Thomas St, Chatswood; see notice mailed to NSW members with this issue.

Technical meetings are generally combined with the Sydney Branch of the IMarEST and held on the first Wednesday of each month at Engineers Australia, 8 Thomas St, Chatswood, starting at 6:00 pm for 6:30 pm and finishing by 8:00 pm.

The program of meetings remaining for 2014 (with exceptions noted) is as follows:

5 Mar	Sean Langman, Team Australia *The Quest for Speed under Sail*
5 Mar	NSW Section Annual General Meeting
2 Apr	Chris Pritchard, Block Manager, ASC Shipbuilding *The RAN's new Hobart-class Air Warfare Destroyers*
7 May	Brett Crowther, Managing Director, Incat Crowther Designs, *Design and Construction of Cutting-edge Vessels*
4 Jun	Peter Little, Vice-President Operations, Carnival Australia *A Cruise Ship*
2 Jul	Neil Edwards, Principal, Edwards Marine Services *New RAstar 3400 Tugs Building at Sanmar Shipyard in Turkey for South America*
6 Aug	Selwyn Oliveira, Marine and Diesel Manager, Alfa Laval Australia *Ballast Water Treatment*
3 Sep	Tony Fielding, Project Director, TK Shipping *CSIRO's New Research Vessel, RV* Investigator
1 Oct	IMarEST TBA
4 Dec	SMIX Bash

Contract Management for Ship Construction, Repair and Design

Fisher Maritime's widely-respected three-day training program, *Contract Management for Ship Construction, Repair and Design*, will be available in Auckland, New Zealand, on 18–20 November 2014.

This program is a lessons-learned one, not a theoretical course on contract management. It bears a lot of "scar tissue" from marine contractual disasters. It is designed for:

- Project Managers (Yards and Owners)
- Contract Managers and Specialists
- Newbuilding Shipyards, Repair Yards
- Fleet Managers
- General Managers of Shipyards
- Financial Managers (Yards and Owners)
- Ship Conversion Specialists
- Naval Architects, Marine Surveyors
- Federal, State, and Provincial Agencies
- Ferry Operators (Public and Private)
- Naval Shipyards
- Owner's Representatives
- On-Site Representatives
- Major Equipment Vendors
- Marine Superintendents
- Consultants and Attorneys

The presenter, Dr Kenneth Fisher, is recognised worldwide as the leading authority on the development and management of complex contracts and specifications for ship construction, conversion, repair, and design. He is author of the 2004 RINA publication, *Shipbuilding Specifications: Best Practices Guidelines*, and of the 2003 SNAME publication, *Shipbuilding Contracts and Specifications*. As an arbitrator, expert witness, consultant, and instructor for more than 30 years, he brings clarity and organisation to an otherwise-complex set of management requirements unique to the maritime industry.

For details of topics covered, visit www.fishermaritime.com/publications/pdf/cm.pdf, and for registration, visit www.fishermaritime.com/projecttraining/registration.html and click on the button for *Register for our AUST/NZ Programs*.

HPYD Conferences

The premier conferences on developments in sailing technology are the High Performance Yacht Design Conference (New Zealand), the Innov'Sail Conference (France) and the Chesapeake Sailing Yacht Symposium (USA). The inevitable clash of dates has been avoided by the conference organisers agreeing on a rolling three-year cycle with one key conference each year. The dates are:

Innov'Sail	2013, 2014, 2017
CSYS	2014, 2016, 2019
HPYD	2015, 2018, 2021

This agreement should smooth the organisation and make the conferences more enjoyable and of a higher quality for delegates. As a result, each conference will cross-promote the others.

Because both CSYS and Innov'Sail were held in 2013, there will be no HPYD conference in 2014. The next one, HPYD 5, will be held in Auckland in February/March 2015 to coincide with the Volvo fleet being in port. A call for papers will be made in March 2014, with abstracts due 30 June 2014.

Pacific 2016 IMC

The Pacific 2016 International Maritime Conference, organised by the Royal Institution of Naval Architects, the Institute of Marine Engineering, Science and Technology, and Engineers Australia, will be held, as usual, on 2–4 February 2016. However, due to re-construction of the Sydney Conference and Exhibition Centre at Darling Harbor, the venue will be at the Sydney Conference and Exhibition Centre at Glebe Island.

Initial details are on the website www.pacific2016.com.au.

Phil Helmore

CLASSIFICATION SOCIETY NEWS

Lloyd's Register Unveils Refreshed Brand Identity

Lloyd's Register (LR) on 9 December 2013 unveiled a refreshed brand identity, with the introduction of a new logo which celebrates the culture of innovation built over the company's 253-year history.

LR has undergone significant change and growth over recent years, having grown to a £1 billion-turnover service provider with over 9000 employees worldwide and undertaken the acquisitions of ODS, Human Engineering, ModuSpec, Scandpower and West Engineering. The group has also restructured to create the Lloyd's Register Foundation as the organisation's parent entity, invested in technology leadership through its global technology centres, diversified its services further into energy and rail, and expanded its management-systems business, LRQA. In September 2013, it announced a significant investment in Senergy, an integrated energy-services company.

Richard Sadler, LR Group CEO, laid out the reasons for the change; "We wanted to refresh our brand identity to reflect these changes to the market, our clients and all our stakeholders — with a logo that works in the digital age. We took inspiration for our new logo from the LR stamp — the true 'brand' that our surveyors have stamped into steel as proof of approval since 1884. But this is not a name change — we will continue to be called Lloyd's Register, recognising the value that the Lloyd's name has around the world as a mark of quality. Our new identity reflects our heritage and our continued commitment to independence, technical excellence and public benefit. And the new logo is a device which links together all the members in our group, including LRQA, making our broad service portfolio easier to navigate."

Mark Stokes, Group Communications Director, said "In line with our ethos of sustainability, to minimise the environmental impact we are introducing our new logo on digital items first. You will still see our old logo in use for a while on printed material, and on our employees' safety equipment which will be replaced gradually through wear and tear."

Independence

LR's reputation as an independent body—with safety, integrity and high standards as guiding principles—has been built up over 250 years. Lloyd's Register Foundation, a UK-registered charity, is the parent entity in the organisation. The operating company, Lloyd's Register Group Ltd (Lloyd's Register) and its subsidiaries, is a professional-services organisation which generates profits that fund the public-benefit activities of the Foundation.

"Our independence from shareholder dividends and government control marks us out as truly different, meaning that we provide impartial and informed advice which clients can trust, free from compromise, free from prejudice," said Stokes. "Our clients face continued pressure for transparency, environmental stewardship, corporate responsibility, profitability, and safe, sustainable operations. Our obligation is to support our clients in meeting these demands—with intelligent, practical and expert advice to help them build truly a sustainable business."

Technical excellence

LR has confirmed a commitment to innovation through the investment of around £100 million in two global technology centres, in Southampton, UK, and Singapore. LR is developing and supporting the innovations which will play a vital role in the immediate and long-term future of shipping and energy.

"As an independent third-party, we need to keep at the forefront of technology and increasingly understand the fundamental science and academic analysis behind new technologies. The two GTCs will serve as the cornerstones of our global R&D network which, along with the activities of the Lloyd's Register Foundation, will help to provide society and industry with the advanced technologies, systems and solutions required for this increasingly complex world," said Sadler.

Public benefit

The Lloyd's Register organisation is a global body with a mission to protect life and property and advance transportation and engineering education and research. The parent entity in the organisation, Lloyd's Register Foundation, is a charity, with a mission to fund science, engineering and technology research for public benefit worldwide.

The operating company, LR, is a professional-services business which generates the profits that fund the public benefit activities. Its compliance, risk and technical-consultancy services directly support a significant part of the Lloyd's Register Foundation's charitable objectives, to enhance the safety of life, property and the environment by helping our clients to ensure the quality, construction and operation of critical infrastructure.

On the launch of LR's new identity, Sadler said "LR is a truly unique organisation; a global body with a mission to protect life and property and advance transportation and engineering education and research. Our heritage is an important part of our culture and forward-thinking approach to our business, and the new identity should serve us well in the years ahead."

LR Press Release, 9 December 2013

DNV GL

As of 12 September 2013, Det Norske Veritas and Germanischer Lloyd have merged to form DNV GL. DNV GL is now the world's largest ship and offshore classification society, the leading technical advisor to the global oil and gas industry, and a leading expert for the energy value chain including renewables and energy efficiency. DNV GL has also taken a position as one of the top three certification bodies in the world. More details are available at www.dnvgl.com

DNV GL issues Recommended Practice for LNG Bunkering

DNV GL has released the first combined Recommended Practice (RP) entitled *Development and Operation of LNG Bunkering Facilities* (DNVGL-RP-0006:2014-01). The RP is intended to bridge the gap between the ISO *Guidelines for Systems and Installations for Supply of LNG as Fuel to Ships* (which, by their very nature, are generic) and specific regulations like port regulations, terminal procedures and bunker operator's operating procedures for LNG bunkering. It covers the life of an LNG bunkering facility from initial strategic considerations through to operation, and is recommended reading for parties such as bunker operators, ship managers, relevant authorities and cargo terminal operators.

The RP can be found at www.dnvgl.com/rules-standards/default.aspx.

Alternative Fuel Mix for Global Shipping

DNV GL has released a position paper on the future alternative fuel mix for global shipping. While LNG is expected to be an early success, the picture becomes more diversified with time, as more than 20 percent of shipping could adopt hybrid propulsion solutions, featuring batteries or other energy-storage technologies. The position paper is available for download at www.dnvgl.com.

DNV GL to Class New Methanol-fuelled Tankers

The first three vessels to use DNV GL's rules for low-flashpoint fuels will be a series of 50 000 dwt tankers ordered by the owners Marinvest and Westfal-Larsen. The vessels are the very first to be fuelled by methanol — a fuel which significantly reduces local air emissions.

Methanol is a low-flashpoint liquid (LFL) fuel which is gaining interest in the market because it does not contain sulphur and is therefore suitable for meeting the upcoming 0.1 percent SOx Emission Control Area requirements.

Methanol has a flashpoint of about 12^{o} C and the new vessels will be assigned the additional notation LFL FUELLED to demonstrate their compliance with the safety requirements set out in the industry-first rules published by DNV GL in June 2013.

"Some important safety measures which will be incorporated into these vessels relate to the location of tanks and piping to prevent energy impact from sources such as grounding or cargo operations, a full secondary fuel-containment system, leakage detection, automatic shutdown functions and ignition prevention. The safety philosophy is similar to that for gas-fuelled ships," says Håkon Skaret, DNV GL Business Director Tankers.

DNV GL was the first classification society to publish LFL rules and sees methanol as part of the future energy mix for shipping. As well as having low SOx and NOx emissions, a methanol fuel system is easy to retrofit on a ship.

DNV GL has been involved in the newbuilding project from the early design stage, working together with the ship owner, engine maker and yard to ensure an equivalent level of safety to that of a conventional fuel-oil system. DNV GL has made use of its long experience with LFL cargo handling on chemical tankers and offshore supply vessels designed to transport low-flashpoint cargo and its experience with alternative fuels from 15 years of working with gas-fuelled ship installations.

Sydney-to-Hobart Racers with DNV GL Certification

At the pinnacle of the yacht racing world sit the offshore ocean racers, designed for maximum performance in the most testing conditions imaginable. "Offshore racers are often on the cutting edge of design technology and in their use of new materials, and our customers are looking to DNV GL to ensure that the investment they make is protected," says Hasso Hoffmeister, from DNV GL's Special Craft Unit.

Many of the purpose-built ocean-racing newbuilds which competed in the recent Sydney–Hobart yacht race are certified by DNV GL to the new *Guidelines for the Structural Design of Racing Yachts > 24 m*, including the 60 ft (18.29 m) *Ichi Ban*, launched in 2013, the New Zealand-built Farr designed 80 ft (24.38 m) *Beau Geste;* and the 100 ft (30.48 m) *Perpetual Loyal*.

The new DNV GL guidelines were developed as a result of work which DNV GL's Special Craft Unit undertook with the International Sailing Federation (ISAF), which was looking to update the standards governing offshore racing yachts in the wake of several incidents. The rules are specifically tailored to the needs of high-performance vessels, with amendments which address their specific load cases for keels, keel fatigue assessment, bottom-slamming pressures and their design speed.

"We worked closely with the ISAF in establishing the procedures for the structural plan review of racing yachts and, soon after, began the process of developing our own rule set," says Hasso Hoffmeister. "Our plan review involves subjecting the design to static and dynamic sea loads, which we can also further examine through the use of 3D models and finite-element analysis."

DNV GL will soon begin the certification of its 50th offshore racing yacht. Designed by Reichel/Pugh in the USA, the new 100 ft (30.48 m) long yacht is built to the *Wally Cento* box rule [*see, for example, www.sailingworld.com/sailboats/tech-review-wally-cento-superyacht*—Ed.], which incorporate the DNV GL *Rules for Racing Yachts* and which mixes top-line racing performance with cruising comfort.

Rod Humphrey

FROM THE CROWS NEST

World Water Speed Record

The World Water Speed Record was set by Ken Warby in the jet-powered *Spirit of Australia* on Blowering Dam, NSW, on 8 October 1978 and stands at 511.12 km/h.

Ken and his son, David, are now building a new boat, *Spirit of Australia II*, in their workshop in the Newcastle, NSW, suburb of Mereweather for David to raise the record to new heights. Ken, who is based in Cincinnati, USA, makes flying visits to see David, who lives at Charlestown, NSW, and work on the boat.

They have modified the design of *Spirit*, and bought two Rolls Royce Orpheus 803 jet engines, which deliver more thrust and are lighter than the than the Westinghouse J34s used previously. The hull woodwork has been completed, apart from the deck which will go on last when the engine, cockpit and systems have been fitted. The bottom has been painted, the hull has been turned upright, the cockpit has been built and fitted to the hull, and they have started fitting the boat out.

David is an experienced boat builder and racer in his own right and will make his record attempt on Blowering Dam, which is near full after many years at low levels, and where Ken set his record 36 years ago. They expect to have the boat completed by the end of this year and to make the record attempt in early 2015.

Spirit of Australia II in December 2013
(Photo from Warbymotorsport website)

For more details and pictures, visit http://warbymotorsport.com.

Costa Concordia—the Largest Wreck Removal ever Undertaken

From the start, the removal of the wreck of *Costa Concordia* was going to be different. The ship capsized in an area of extreme environmental and cultural sensitivity, lying a few hundred metres off the entrance to Giglio Harbour in the Tuscan Archipelago National Park and the Pelagos Whale Sanctuary. Giglio Island derives all of its income from tourists who come to enjoy the pristine environment and peaceful island. Concern for the impact on this place dictated that the wreck could not be cut up in place and removed in sections.

The sensitivity of the place is not its only characteristic; it is also extremely rugged. The ship came to rest on its starboard side bridged across two rock ridges, suspended above the seabed in the midbody and with bow and stern cantilevered out over deeper water. The ruggedly creviced granite sloped steeply into deep water just offshore.

Costa Concordia is the largest wreck removal ever undertaken. He lightship is 45 000 t, about twice that of a typical VLCC. Water that permeated fabrics and became trapped in insulation spaces, etc. meant that the salvors (Titan Salvage and Micoperi) had to develop the forces and buoyancy to contend with an estimated 65 000 t, equivalent to about three VLCCs.

There is an interesting article on the whole salvage operation in *Soundings*, the journal of the American Salvage Association, see www.americansalvage.org/soundings.php and click on Winter 2014.

There is also a time-lapse video of turning the ship upright on YouTube at www.youtube.com/watch?v=k4JdEEFEhAE.

Radar Development Contract

On 28 November the Minister for Defence, Senator David Johnston, announced the award of a Standing Offer contract to Canberra-based company CEA Technologies to develop high-powered phased-array radar technology.

Senator Johnston said that the contract for the development of systems based on the CEAFAR radar would support a number of future Defence acquisitions.

"The CEAFAR radar is currently being fitted to the Anzac-class frigates as part of a major upgrade," Senator Johnston said.

The radar has proven to be a significant enhancement to self- and local-area defence against modern anti-ship missiles and has performed successfully in recent trials.

"This radar is a world-leading capability for a system of its weight and size and, importantly, is considerably more cost-effective than comparable systems," Senator Johnston said.

"The development of high-power phased-array radar based on the CEAFAR system builds on the substantial investment in domestic radar-related research and development."

Senator Johnston said that the CEAFAR radar is a focus of the phased-array radar element of the High Frequency and Phased Array Radar Priority Industry Capability (PIC).

"The High Frequency and Phased Array Radar PIC defines world-leading radar capabilities which are locally developed in Australia, providing effective capabilities in their respective operational environments, while the intellectual property stays here."

CEA Technologies is an internationally-recognised radar and communication systems supplier established by two former officers from the Royal Australian Navy in 1983.

Anzac-class Frigate Communications Upgrade

On 2 December the Defence Minister, Senator David Johnston, announced that Defence has awarded two multi-million dollar contracts to Selex ES Ltd for the acquisition and support of modernised communication systems for the Royal Australian Navy's eight Anzac-class frigates.

Senator Johnston said that the modernisation of the communications capability on board the Anzac frigates will be a significant boost for the Navy, ensuring that the Anzac frigates will achieve and maintain information superiority in the maritime environment.

"The SEA1442 Phase 4 Acquisition Contract, valued at nearly $188 million, will deliver a significant improvement to the communications capability through an integrated system, including new radio and switching systems, secure voice and tactical communications systems, and a communications-management system," Senator Johnston said.

"This new system will allow high-speed networking of ships within a task group as well as more efficient and effective communications from ship to shore, and is a design which is used by the United States, Canadian and the Royal Navies."

Senator Johnston said that the contract will provide job opportunities in Melbourne for engineers, project managers, logisticians and other specialists in military communications and in-service support.

"A separate five-year in-service support contract, valued at nearly $18 million, will provide logistics, supply, training, engineering, and maintenance support services for the sustainment of the delivered capability."

Selex ES Ltd, a UK-based company, with significant experience in delivering maritime communications capability, will establish Selex ES (Aust) in Melbourne to deliver this project and provide ongoing support following delivery.

Further opportunities for Australian industry will occur through a number of sub-contracts to small-to-medium enterprises in the fields of systems integration and engineering, project management, integrated logistics, ship installation and in-service support.

Senator Johnston said that Selex was selected through an open tender process for this significant Anzac-frigate upgrade program with the first upgraded ship planned to enter service in 2018.

HMA Ships *Anzac* and *Arunta* undergoing major refits at the BAE Systems facility in WA.
The work includes the fitting of the CEAFAR phased-array radar
(Photo John Jeremy)

Keel Laid for *Brisbane*

An important milestone for the Air-warfare Destroyer (AWD) project was achieved on 3 February with the laying of the keel for the second Hobart-class destroyer, *Brisbane*, at Techport Australia in Adelaide.

AWD Alliance Chief Executive, Rod Equid, said that the event is a long-standing shipyard and naval tradition marking the start of the hull-consolidation phase for *Brisbane* — the second of three destroyers being built for the Royal Australian Navy.

"As we celebrate the start of the consolidation phase for *Brisbane*, we also mark progress on Ship 1, *Hobart*. All 31 blocks have now been erected on the hardstand in readiness for the load-out and set-to-work of the Combat System," Mr Equid said.

"We have made significant strides over the past year on this first-of-class build, and I am proud of everyone within the AWD Alliance for their hard work to get us where we are today. We are now working hard in preparation for the launch of *Hobart* with as much equipment as possible being loaded out over the coming months.

"Once *Hobart* is floated off, *Brisbane* will take prominence on the hardstand of the Common User Facility where we will see the ship take shape. One of the next key milestones for *Hobart* will be the activation of the combat system following the successful integration testing at our land-based facilities."

"The *Hobart* equipment is in-country and the load-out and installation work is underway. The core Aegis weapon system will be critical to the capability needs of Navy."

Mr Equid commended the highly-skilled project workforce which includes about 1900 people in the AWD Alliance and a total of about 2850 people working across the country on the project.

"It is a complex and challenging project which has a talented and professional national workforce from the core Alliance Participants, ASC, Raytheon Australia and the Government's DMO. This is combined with the support and contribution of subcontractors and suppliers who have helped to build and strengthen our national shipbuilding capability in readiness for future projects," Mr Equid said.

"The Alliance model has enabled our teams to remain focused on successful outcomes whilst working together to overcome challenges along the way."

Collins Class Upgrade Contract

On 27 November Defence Minister Senator David Johnston announced that the Defence Materiel Organisation had signed a multi-million dollar contract with ASC Pty Ltd to update the control management and monitoring system for the Royal Australian Navy's Collins-class submarines.

Senator Johnston said that the Integrated Ship Control Management and Monitoring System is a highly-automated computerised system, which enables the crew to control, monitor and manage the large number of diverse and complex systems on board the submarines.

"Work under the $57 million contract will focus on updating electronic components and porting the software to operate on the new system," Senator Johnston said.

"The current Ship Control Management and Monitoring

The keel-laying cereemony for the future HMAS *Brisbane*
(Department of Defence photograph)

System has performed effectively and reliably since the Collins class entered service in the 1990s."

"However, it is essential to upgrade the current system to ensure that the system can be maintained for the remaining service life of the Collins-class fleet."

ASC is the Collins-class Submarine Platform System Integrator and they will be supported in the project by Saab Systems in South Australia.

The contract also covers design, development and manufacture of the hardware for two boats, the updating of the shore-based test facility and platform simulation trainer, and the installation of the updated system in the first boat.

Senator Johnston said that the majority of the work will be performed in Outer Harbour and Mawson Lakes in South Australia.

A Centenary of Submarine Service Recognised

The hundredth anniversary of submarines operating in the defence of Australia was marked by an event held at the Australian National Maritime Museum in Sydney on 7 February.

The Director General Submarine Capability, Commodore Peter Scott CSC RAN, joined the Minister for Defence, David Johnston, at the Centenary of Submarines launch, hosted by the Submarine Institute Australia (SIA) and Submarine Association Australia (SAA).

Commodore Scott acknowledged the SIA and SAA roles in celebrating the milestone, and reflected on the last 100 years of submarine service.

"The Royal Australian Navy was an early adopter of submarine technology. The arrival of *AE1* and *AE2* at the outbreak of the First World War marked the beginnings of a proud submarine heritage."

"These first-generation submarines served with distinction and made a significant contribution to the RAN's WWI service record. Sadly, both submarines were lost during the war, with *AE1* disappearing off Rabaul, taking with her thirty-five lives. Her resting place remains one of Navy's greatest mysteries," said Commodore Scott.

The Minister for Defence, the Hon David Johnston MP addressing the crowd at the Centenary of Submarines launch at the Australian National Maritime Museum, Darling Harbour, Sydney (RAN photograph)

"During the decades that followed, numerous attempts were made to establish a submarine force, including the five J-class submarines given to Australia by Britain after the war and the O-class of the late 1920s."

"While Australia did not operate any indigenous submarines during World War II, apart from *K9*, which was used for training, hundreds of Allied submarines operated from Brisbane and Fremantle. After the war, a flotilla of three British submarines was based at HMAS *Penguin* between 1949 and 1969, continuing to defend Australia and the Commonwealth's interests," Commodore Scott said.

"It wasn't until the 1960s that the modern era of submarines in the RAN commenced with the acquisition of Oberon-class submarines. The diesel-electric 'O-boats' served from 1967 to 2000 and provided invaluable service."

"When it came time to replace the O-boats, no off-the-shelf design met Australia's requirements for range, endurance and overall capability, so a new design solution was required. The resultant Collins-class guided-missile submarines continue to provide Australia with critical offensive and defensive capability," said Commodore Scott.

"Over the decades, submarine design has continued to evolve. What has not changed is the potency of submarines as instruments of maritime power and their importance to Australia's defence strategy and our ability to trade," said Commodore Scott.

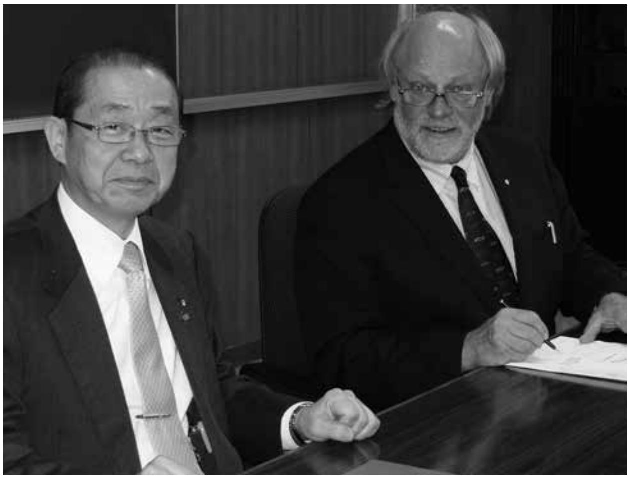
"While the submarines receive a lot of attention, it is also important to acknowledge the men and women who have served in them. The bravery and pioneering spirit of our earliest submariners continues to be reflected in the pride modern day submariners have in 'The Silent Service'.

The RAN, SIA and SAA will host a number of commemorative events during 2014. A program can be viewed at http://www.aussubs100.com.

Natalie Staples

Incat to Build for Japanese Customer

In December Incat Tasmania Pty Ltd announced that it has signed a contract with Japanese ferry operator Sado Kisen for the construction of an 85 m wave-piercing catamaran for operation on the 39 n mile route from Naoetsu Port in the Niigata prefecture to Ogi, the southernmost port of Sado Island.



Mr Takeshi Ogawa, President of Sado Steam Ship Co. Ltd, with Robert Clifford, Chairman of Incat Tasmania (Photo courtesy Incat Tasmania)

The 85 m wave-piercing catamaran will comfortably transport 700 passengers to Sado Island and will have capacity for 7 large trucks and 98 cars or, in car-only configuration including mezzanine decks, it will be able to carry 173 cars.

Sado Kisen is a long-standing and respected operator in Japan, with origins from the Sado Steam Ship Company. The company has a fleet of conventional car ferries and jet-foils, however, with an operating speed of 30 to 34 kn, the new Incat Hull 068 will be Sado Kisen's first high-speed vehicle and passenger ferry.

Incat Hull 068 under construction (Photo courtesy Incat Tasmania)

The 85 m vessel was selected following a competitive international tender process which prioritised a proven hullform and sea-keeping, reliability, efficiency, heavy-freight capacity, barrier-free access, minimal crewing, timely delivery and the ability to integrate with existing port infrastructure.

Sado is the sixth-largest island of Japan in area, following the four main islands and Okinawa Island. Its rich history and relaxed rural atmosphere make Sado one of the major tourist destinations in the Niigata Prefecture.

The Incat ferry will operate a year-round service replacing the 1995-built conventional 120 m car ferry *Kogane Maru*.

The future HMAS *Adelaide* passing through the channel between Point Lonsdale and Point Nepean at the entrance to Port Phillip Bay on board the heavy-lift ship *Blue Marlin* on the way to Williamstown and completion by BAE Systems. *Adelaide* left Navantia's shipyard in Ferrol on 2 December 2013 and is expected to be commissioned in late 2015 (RAN photograph)

Although the Naoetsu to Ogi service will be the vessel's main route, she will also support the Niigata to Ryotsu route on a seasonal basis.

Incat Chairman Robert Clifford and Managing Director Craig Clifford were both present at the signing ceremony on Thursday 28 November at Niigata. Robert Clifford commented: "This is yet another positive foray into the growing Asian market, with continued interest in fast and economical ferries. We are excited to be working with a new client in Japan, and look forward to building their ship through 2014 for delivery in 2015".

Incat will be expanding the production team in 2014, including taking on new apprentices, as the shipyard is also currently building a 70 m fast crewboat for delivery to the oil and gas industry in Azerbaijan in late 2014.

Austal Hands Over Catamaran to SNC Aremiti Ferry

On 20 December Austal Limited announced the handover of a 79.8 m ro-pax catamaran, the most recent iteration of its enduring Auto Express ferry range, to French Polynesian operator and repeat customer SNC Aremiti Ferry. The vessel was due to arrive in Papeete just before Christmas to enter service between Tahiti and Moorea.

This delivery is a major achievement for Austal's new facility in Balamban, Philippines, which started operations barely two years ago.

Designed by the Austal team in their global headquarters in Henderson, Western Australia, and built in this new Philippines shipyard, the bespoke platform's distinctive hull and propulsion package offers operators in the medium-to-high-speed ferry market an exciting new solution to reduce their running and maintenance costs, stylishly packaged in a low-risk and low-cost platform.

Aremiti Ferry II is a 79.8 m high-speed aluminium catamaran, classed Germanischer Lloyd ✠ 100 A5, HSC-Passenger B, Ro-Ro Type, DG rules, operable in conditions with a significant wave height up to 4 m. Approved for 967 passengers with 146 available car bays, or 228 truck lane metres, the deadweight capacity is 480 t.

The catamaran is powered by four MTU 16V 4000 M53R 'IronMen Series' engines, in combination with ZF 7640 gearboxes and a quadruple Teignbridge FPP shaft-line configuration, with four spade rudders. Two 160 kW DTG tunnel thrusters are provided, one per hull, along with Austal's ride control system compromising active T-foils under each hull forward, with active interceptors across each transom.

Four Volvo D9MG 225 kWe generators are located in pairs in each engine room, sharing the compartment with the two main engines and their gearboxes. The quadruple-screw propulsion equipment is controlled by a dual-lever ZF ClearCommand system, positioned on the bridge and on each bridge-wing, in combination with a Navitron NT1000 steering-control system activating the paired rudders. The quad-screw quad-rudder configuration in combination with the bow thrusters provides exceptional manoeuvrability and steering performance, equivalent to Austal's water-jet-powered vessels, with a similar ability to walk the vessel sideways during mooring operations.

Aremiti Ferry II
(Photo courtesy Austal)

With only 6080 kW of total power available (at 100% MCR), *Aremiti Ferry II* achieved a full-load speed of over 21 kn. While operating at 18 knots, the fuel consumption of *Aremiti Ferry II* is 850 L/h which equates to less than one-litre of diesel per seat over a one-hour journey. The tankage enables a range of over 2000 n miles.

Austal developed a hard-chine symmetrical hull shape specifically for this project, designed for low cost of manufacture but with the lowest possible resistance. The main engines have a published time between overhauls (TBO) of 30 000 hours. The sea trials revealed better-than-expected performance providing some growth margin for Aremiti and potentially an even longer TBO.

Austal designers provided a practical engine-room layout which maximises access around the engines. Engine room flooring, structural fire protection, the exhaust layout and the design of the services have all been designed with a genuine emphasis on maintainability. Should it be required, engine removal is addressed by way of three soft patches per engine room located above each main engine and the pair of generators, along with a purpose-built engine-lifting and removal frame which is stored off-vessel. The framework permits main engines to be lifted up onto the vehicle deck and out of the vessel with minimal fuss.

The open vehicle deck provides 950 m^2 of available space for trucks and cars on the main deck, with a further 725 m^2 of hoistable ramps and decks arranged as two independent assemblies port and starboard which enable 63 cars or smaller packaged goods to be transported at mezzanine level. Ample tie-down points, rub-rails and large storage bins for tie-downs are located throughout the deck.

Minimal shore infrastructure is required for vehicles to gain access via the substantial bow and stern vehicle ramps, boasting 5.5 m wide vehicle lanes for two-abreast loading and a maintenance-friendly cable-winching arrangement with simple-to-operate manual hydraulic control. The bow ramp features a novel inner-bow-door design, which independently lowers the bow door as a separate entity flush into a recess in the bow ramp for loading/unloading, effectively forming a single integrated ramp, whilst maintaining two independent sealing and dogging arrangements to secure the bow before transit. As the vehicle space features structural pillars located on the vessel centreline only, along with the independent reconfigurable mezzanine decks, the Ro-Ro deck configuration is designed to minimise turn-around times and maximise versatility. Furthermore, the vessel is also certified to carry dangerous goods of category 2.1 and 3 (flammable liquids and gases), with suitable reductions in passenger numbers.

Austal developed a distinctive non-slip solution to external decks, in both passenger and crew areas. Multiple aluminium studs were individually spot-welded to the bare aluminium, providing exceptional grip with zero maintenance compared to non-slip paint. The aluminium handrails were left unpainted. Once painted, always painted — the theory being that it's easier, cleaner and more cost-effective for the crew to use a pressure cleaner rather than a paintbrush over the life of the vessel.

Passengers on boarding are greeted by two spacious internal accommodation decks, and the opportunity to promenade on a large exterior sun deck, containing 150 additional non-revenue seats. Styled by Austal's in-house design team in conjunction with Aremiti, the passenger space features three distinctive colour-schemes. The upper deck aft features a large central kiosk, with hot and cold displays, ample drinks fridges, hot-dog roller grille and even soft-serve ice cream. Seating provides a combination of four and six seats with tables, or curved leather-clad lounges and tub-seats, with all seating supplied by Beurteaux Australia. The upper deck forward and the bridge deck provide two- and three-abreast aircraft-style leather seating, installed at an 850 mm pitch. Whilst passengers forward enjoy the view from the large forward windows, all passengers are able to enjoy one or more of the 48 televisions on board, including two 52 inch (132 cm) screens forward in the bridge deck, with satellite TV, DVD and three 500 GB hard-drive media players providing ample entertainment options. Austal incorporated specific design features such as Móz Designs decorative metal panels to provide modern, clean and operator-friendly feature artworks that complement the décor.

The low internal noise levels also enhance the passenger experience. The HSC Code mandates a maximum of 75 dB(A) noise levels within passenger spaces. *Aremiti Ferry II* peaks at well below 70 dB(A), with the majority of the bridge deck space registering under 60 dB(A).

The vessel also provides full access for disabled passengers, with a Kone MonoSpace lift servicing main, upper and bridge decks, suitable for use underway at sea, along with dedicated easy-access seating, permanent doorway ramps and wide aisles to enable wheelchair movements.

Austal's in-house team designed a water-cooled direct-expansion HVAC system, with six air-handling units suppling crisp conditioned air to the passenger spaces. It's a comfortable practical passenger space which would meet with the requirements of a variety of operators.

The bridge features a large forward console for Captain and First Mate, with a separated console for the Engineer, ample standing space for crew and storage for their documents. The engineer's console centre-piece is Austal's widely-acclaimed Marine Link monitoring and control system, displayed via two fully-redundant LCD screens. Marine Link has received further enhancements on this vessel, incorporating a SCADA and process bus, consisting of a fully-redundant ethernet network ring, with two routes to each device. Marine Link also integrates the monitoring of all principal systems including main engines, generators and gearboxes, providing a single point of reference at the engineer's console as well as full access, via touch-screens, from the main switchboards in the engine rooms.

The bridge and crew areas contain a common crew's mess and officer's mess, along with two double berths, each with en suite, and all meeting the regulatory requirements of French Flag.

Austal has provided a ground-breaking cost-effective environmentally-sound and refreshingly new variant to their Auto Express range.

This 79.8 m catamaran is a highly-efficient platform, with the ability for fast turn-around in port, sufficient range enabling optimised scheduling for re-fuelling, a focus on reduced maintenance and extended TBO, and a quiet and pleasant experience for passengers. *Aremiti Ferry II* heralds the first of a new generation of medium-speed ro-pax ferries for ferry needs today and into the foreseeable future.

General Particulars	
Length OA	79.8 m
Tonnage length	75.6 m
Beam moulded	17.0 m
Hull depth mld	5.9 m
Hull craft	2.85 m
Capacity	
Passengers	967
Vehicles	146 cars or 228 truck lane metres
Design deadweight	480 t
Fuel capacity	117 t
Propulsion	
Engines	4 × MTU 16V 4000 M53R each 1520 kW at 1600 rpm
Gearboxs	4 × ZF 7640
Propulsion	4 × fixed-pitch propellers
Manoeuvring	2 × 160 kW tunnel-type bow thrusters
Steering	4 × spade rudders
Generators	4 × Volvo 225 kWe
Survey	
Classification	Germanischer Lloyd ✠ 100 A5 RSA (200) HSC-Passenger B Ro-Ro Type DG "High Speed Passenger / Ro-Ro Type" Machinery ✠ MC Certified to carry Dangerous Goods of Cat 2.1 (except hydrogen) and Cat 3

Austal Launches USNS *Fall River*

On 16 January 2014, Austal USA successfully launched USNS *Fall River* (JHSV 4). Recently christened, this 103-m high-speed catamaran is part of a 10-ship program, the funds for all of which have been appropriated, worth over $US1.6 billion.

The launch of USNS *Fall River* was conducted in a multi-step process which involved having Berard Transportation transfer the ship from Assembly Bay 3 onto a deck barge, which was then towed to BAE Systems Southeast Shipyard. The next day, *Fall River* was transferred onto BAE's dry dock *Alabama*. She was floated and then returned to Austal's facility where she will undergo final outfitting and activation before sea trials and delivery to the Navy later this year.

Craig Perciavalle, Austal USA President, commented "It's really amazing how easy the team makes this complicated process look. I appreciate the efforts of all involved."

JHSV 4 is now one of four Austal-built Navy ships moored in the Mobile River, joining USNS *Millinocket* (JHSV 3), *Coronado* (LCS 4), and *Jackson* (LCS 6).

Craig Perciavalle added "With JHSV 3 recently completing acceptance trials and preparing for delivery, and now the launch of *Fall River*, the JHSV program continues to progress well as we meet our commitments to the Navy. The incredible shipbuilders here at Austal should be very proud of this accomplishment".

USNS Spearhead (JHSV 1) was delivered in December 2012 and is soon to be deployed. *USNS Choctaw County* (JHSV 2) was delivered to the Navy in June 2013. *USNS Millinocket* (JHSV 3) has completed acceptance trials and is scheduled to be delivered during February. Construction is well underway on *Trenton* (JHSV 5) which was to begin final assembly in Assembly Bay 3 by the end of January, and construction will begin on *Brunswick* (JHSV 6) by the end of January.

The JHSV is a relatively new asset which will be an important Navy connector. In peacetime, JHSVs will be operating forward, supporting Navy Expeditionary Combat Command and riverine forces, theatre cooperating missions, Seabees, Marine Corps, and Army transportation. Each JHSV also supports helicopter operations and has a slewing vehicle ramp on the starboard quarter which enables use of austere piers and quay walls, common in developing countries. A shallow draft (under 4 m) will further enhance theatre port access.

Austal Launches Second Cape-class Patrol Boat

Austal launched the second of the Cape-class patrol boats during a ceremony at the company's Australian Defence Facility at Henderson, Western Australia, on 7 January 2014, exactly one year to the day after launching *Cape St George*. *Cape Byron* was launched some four weeks ahead of schedule.

Cape Byron is the second of eight 56 m patrol boats which are being delivered to the Australian Customs and Border Protection Service by Austal as prime contractor for the design, build and in-service sustainment contract which is valued at approximately $330 million. Austal is also using its in-house expertise to develop and integrate sophisticated electronic systems for command, control and communication.

The ceremony marked the first time that the boat has been lowered into the water. Following maritime tradition, specially-minted coins were placed under the keel block of the vessel as a symbol of good fortune on 25 January 2013. These were removed prior to the launch and will be presented to the boat, ACPBS and Austal at a later date. The boat was then lowered into the water using Austal's slipway facility.

Cape Byron entering the water
(Photo courtesy Austal)

With the vessel in the water, Austal is on target to achieve completion and sea trials prior to an official naming ceremony and final delivery to the Australian Customs and Border Protection Service in the second quarter of 2014.

Austal President and General Manager, Graham Backhouse, said "This special milestone represents a significant achievement by many people, from both Commonwealth and industry who have come together to work as a high-performing collaborative team to make this possible. *Cape Byron* is a state-of-the-art maritime-defence capability which will play a significant role in Operation Sovereign Borders, protecting Australia's borders from multiple maritime threats, and has been designed to have greater range, endurance and flexibility, as well as enhanced capability to operate in more-severe sea conditions and across longer range than the current Australian Customs and Border Protection Service and Royal Australian Navy patrol boat fleets.

"*Cape Byron's* launching represents the start of another busy year for our Australian Defence Facility in Henderson, with *Cape Byron* being the first of five Cape-class launches and three deliveries scheduled for this year. The overall program continues to be on schedule with workforce levels increasing by over 100 in recent months to be on target for full production in the second quarter of 2014 — a workforce that we believe positions Austal well to provide additional capability to the Commonwealth of Australia either through more Cape-class vessels or an early replacement of the current Armidale-class patrol boats".

Austal Lays the Keel for *Cape Jervis*

On 17 January 2014, Austal hosted a keel-laying ceremony for *Cape Jervis*, the fifth of eight 56 m patrol boats which Austal is designing, building and supporting for the Australian Customs and Border Protection Service (ACBPS).

Austal was awarded the contract for the design, construction and through-life support of the Cape-class patrol boats for the Australian Customs and Border Protection Service in August 2011. The eight 56 m aluminium monohulls are due to be delivered between March 2013 and August 2015.

Although Austal's design and manufacturing approach is thoroughly modern, the ceremony retained long-held shipbuilding traditions. This included placing three specially-minted coins under a keel module as a symbol of good fortune and to bless the ship. These coins will be removed just before the patrol boat's launch.

The three coins were placed by Roman Quaedvlieg, Deputy Chief Executive Officer — ACPBS, Paul Grant, Commanding Officer of *Cape St. George*, and Ben Wardle, Program Manager — Austal. The keel module was formally positioned by two of Austal's high-achieving apprentices, Jake Combs and Jason Anson-Clarke.

Master of Ceremonies for the event, Nigel Perry, National Director Border Force Capability — ACBPS, remarked that "*Cape Jervis* represents South Australia in the Cape-class patrol boat program where each of the boats is named after a cape from each state and territory". Mr Perry praised the efforts of both the ACPBS and Austal teams in delivering what continues to be a successful program.

Ben Wardle noted "The Cape-class Patrol Boat Program is a successful collaboration which, in a short space of time, has taken the program from only one vessel in production to six vessels in production. Austal is proud to be laying the fifth keel of the Cape-class patrol boats on schedule. *Cape Byron*, the second vessel in the fleet, was successfully launched last week, some four weeks ahead of schedule. All this is supported by a workforce which, including additional apprentices, has increased by over 100 in recent months with the program now more than half way through the construction phase."

The keel unit of *Cape Jervis* was formally positioned by two of Austal's high-achieving apprentices, Jake Combs and Jason Anson-Clarke
(Photo courtesy Austal)

Investigator for Australia

At the end of 2013, the team of Sembawang Shipyard of Singapore and Teekay Shipping Australia were scheduled to hand over the new Research Vessel *Investigator* to her owners, the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Investigator will be among the most-capable and quietest non-naval research vessels in the world. She will serve Australia in diverse scientific operations ranging over an area from the equator to the ice shelf of Antarctica, and spanning almost one-third of the circumference of the globe. An area this large is hugely diverse and the types of research to be undertaken are numerous and demanding, resulting in the need for a very flexible, capable and seaworthy research vessel.

The design and build contract for construction of this ship

Investigator approaching completion
(Photo courtesy Robert Allan Ltd)

was awarded to a team led by Teekay Shipping Australia and Sembawang Shipyard of Singapore. The design was developed by RALion, a joint venture between naval architects, Robert Allan Ltd of Vancouver BC, Alion Science and Technology of Alexandria, Virginia, and Alion Canada of Ottawa. The contract was awarded to this international team in January 2011. An extensive program of model testing and design work was completed by November of that year. The vessel was launched on 21 July 2013 and then officially named *Investigator* at a ceremony in Singapore on 5 September

Investigator has been designed to handle the heat and humidity of the tropics and the cold and ice of Antarctica, while working safely and effectively in the broad expanse of the Great Southern Ocean separating these extremes. This ice-capable vessel has also been designed to meet the underwater radiated-noise requirements of the DNV "SILENT-R" notation up to 11 kn — a capability which enables her to undertake the most-sensitive types of environmental research.

Investigator is fitted out with a full range of scientific laboratories, science and fishing winches, coring equipment, air- and water-sampling devices, and acoustic systems. She is capable of general-purpose oceanographic-survey operations in coastal and deep-ocean areas, including physical, chemical and biological oceanography, multi-discipline environmental investigations, ocean engineering and marine acoustics, coastal hydrographic survey, marine geology and geophysics, bathymetric surveys and fisheries research.

In support of these missions, the ship is extensively equipped to perform all the following tasks:

- Acoustic habitat mapping.
- Acoustic surveys in support of bathymetric, geomorphological and biological research using a combination of hull-mounted, drop-keel mounted, and towed transducers.
- Acoustic surveys of marine species.
- Acquiring geological samples of the ocean bottom in depths of up to 5000 m.
- Acquisition of benthic samples of the ocean bottom at depths up to 6500 m.
- Acquisition of up to 20-30 m core samples of the ocean bottom at depths up to 7000 m.
- Bottom trawling to depths up to 4000 m.
- Calibration of ship-mounted transducers.
- Conduct horizontal or oblique plankton tows over the stern or over the side of the vessel.
- Conduct oceanographic sampling with rosettes of up to 36 bottles and CTD instrument packages to >6500 m depth while continuously sounding.
- Freeze and cold store samples for further analysis at shore-based facilities.
- Launch/tow/retrieve a broad variety of active and passive sensors and sensor platforms, including magnetometers, hydrocarbon sniffers, sonar tow fish, AUVs and UUVs.
- Launch/tow/retrieve a variety of egg, larval, juvenile and adult fish-sampling systems.
- Marine mammal and seabird enumeration, identification, tracking, and bio-assessment.
- Mid-water and surface trawling.

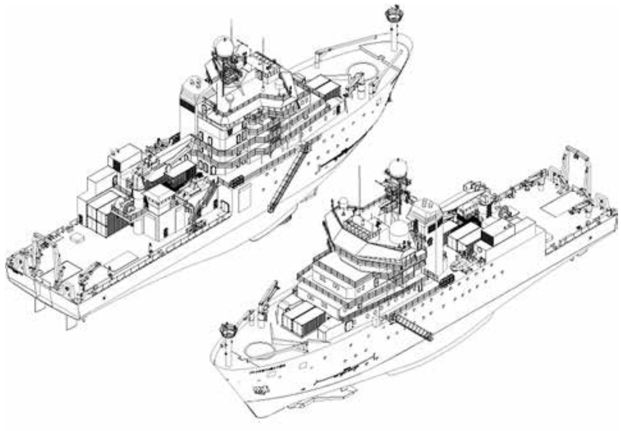
To accomplish these scientific missions, *Investigator* is fitted with a gondola and two retractable drop keels to house the extensive scientific sonar and transducer suites, supplied by Kongsberg. The vessel is fitted with a stern ramp to support fisheries research activities.

Investigator is classed by Lloyds Register of Shipping with the notation ✠100A1, ✠LMC, UMS Ice 1C IWS, EP, Research Vessel, DP (AM) and DNV SILENT-R.

The principal particulars of this ship are:

Length OA	93.9 m
Beam	18.5 m
Depth to main deck	9.45 m
Draft	5.70 m
Draft (navigational)	6.9 m (to bottom of gondola)
Complement	60 (including scientists)
Speed	15 kn, fully loaded in Sea State 2
Range	10 800 n miles
Endurance	60 days

The vessel is twin screw, powered by an integrated diesel-electric propulsion and ship-service plant provided by L3 Marine Systems. Three maK 9M25C diesel generators provide a total electrical output of 9 MW at 690 V. To meet the noise requirements of DNV SILENT-R notation, all three diesel generators are double resiliently mounted on a raft system engineered by RALion and supplied by maK. The L3/Indar 690V AC 2600 kW propulsion motors feature a resiliently-mounted rotor and other design features to meet the noise requirements. These propulsion motors are believed to represent the first use of AC motors of this size range in a research vessel to meet DNV SILENT-R requirements. Wärtsilä provided the 3.5 m diameter 5-bladed propellers, which are specially designed to be cavitation-free at 11 kn, and the complete shaft-line from motors to propeller. The ship is also equipped with an azimuthing,



General views of *Investigator* as designed
(Drawing courtesy Robert Allan Ltd)

retractable bow thruster, Thrustmaster model TH1500MLR, rated at 1200 kW and with Becker flap-type high-lift rudders, all creating a vessel with much enhanced manoeuvrability at low speeds.

The layout of the ship is as follows:

First Platform Deck: scientist's accommodation forward, stores and transceiver room amidships, and control room, switchboard room, winch room and container hold aft.

Main Deck: contains all the science labs, CTD lab offices and workshops, and is the primary working deck.

Forecastle Deck: crew accommodation, galley, mess, lounge spaces and galley stores, with the upper-level CTD lab and CTD winch spaces aft, and enclosed anchor and mooring space forward.

02 Deck Level: senior crew, offices, hospital, chemistry lab, and boat deck.

03 and 04 Decks: senior officers and senior scientist accommodations and offices.

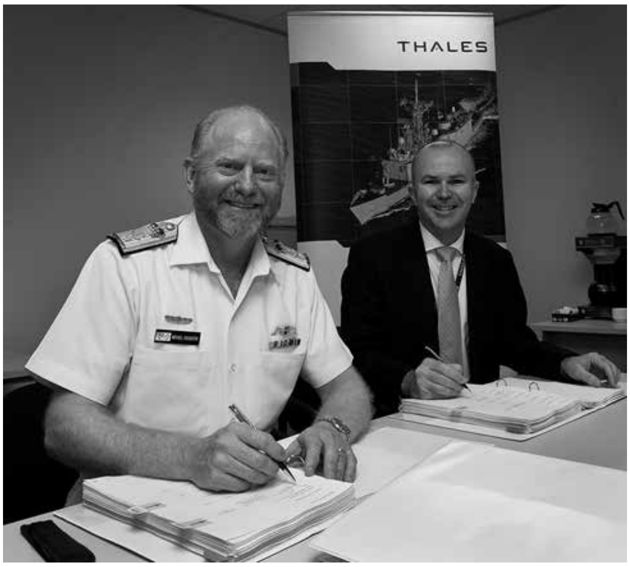
Wheelhouse: the large and extensively-equipped bridge is located above a full-height plenum containing bridge equipment and HVAC system.

The complete suite of fisheries, scientific, and ship's deck equipment was supplied by Rapp-Hydema, including an array of coring, trawling, towing, general-purpose, CTD-deployment, drum, and anchor/capstan electric winches. Triplex AS, a Rapp-Hydema subsidiary, supplied the coring boom, pipe handler, over-stern A-frame, and CTD overhead crane. The aft deck is serviced by a Bergen DKF300 main crane, with a capacity of 25 t at 12 m, or 5 t at 20 m. In addition there is also a Bergen DKF40 utility crane and a Bergen DKF70 stores crane fitted. Roll stabilisation on the ship is provided by a U-tube tank system designed by Hoppe.

Frigate Support Contract Awarded

On 23 November the Chief Executive Officer of the Defence Materiel Organisation (DMO), Warren King, announced that a multi-million dollar contract had been signed with Thales Australia for in-service support for four Royal Australian Navy ships.

Mr King said that the $46 million contract provides support for the Adelaide-class guided missile frigates (FFG) combat systems and offers increased job security to the 48 staff within Thales who have been engaged under the interim contract.



Director General Major Surface Ships — Maritime Systems Division, Commodore Michael Houghton, and Director, Above Water Systems — Thales, Mr Damien Elford, sign the FFG Combat System Support Contract
(RAN photograph)

"This contract will ensure that the FFG-class combat system, which is among the most capable in the world, is effectively sustained until the RAN transitions to the new air-warfare destroyers," Mr King said.

"The Commonwealth looks forward to working with Thales in maintaining the war-fighting capabilities of the FFG fleet."

Mr King said that the contract also covers on-board systems and associated support facilities, and will be delivered from the company's facilities in Sydney and Perth.

The versatile FFG combat system was developed by Thales as part of the FFG upgrade project which concluded in 2011 and was the most technologically-advanced warship upgrade program ever performed in Australia.

At the core of the upgrade, the Australian Distributed Architecture Combat System (ADACS) integrated various shipboard sensors, effectors, tactical data links and support systems to provide the frigates' command teams with a common battle-space management environment.

Incat Crowther opens Office in Brazil

Incat Crowther has announced the opening of an office in Rio de Janeiro, Brazil. The office has been created to meet the growing demand for Incat Crowther's products and services in South America, and puts Incat Crowther at the centre of the South American offshore oilfield industry.

The Incat Crowther Group has experienced significant international growth. This is a result of a track record of diverse vessel designs and unique consulting services. The office in Brazil is a reflection of this growth and will initially target specialised high-speed aluminium ships for the local offshore-support market. These include fast supply vessels, high-speed crew vessels, offshore support vessels, dive support vessels, oil recovery vessels and patrol vessels.

The Brazilian office is the point of contact for Incat Crowther's local clients and will provide support during the development stage as well as the construction stages of the vessels.

As Incat Crowther has grown, it has developed robust business systems resulting in ISO9001 certification in 2012. The Brazilian office capitalises on the capability and expertise of the Incat Crowther Group, by using well-established cloud-based systems and procedures to deliver services locally with the quality and customer service which is core to the Incat Crowther culture. Incat Crowther understands the increasing demands of targeted vessels in the region and the short time frames in which accurate engineering solutions need to be presented.

Raoni França, General Manager, Incat Crowther Brazil, says "Incat Crowther's presence in Brazil is crucial to our commitment to providing high-quality responsive services to our Brazilian clients".

The Brazilian office is already involved in several large projects. These include three 42.5 m monohull DSVs under construction at Seasafe for Sistac Marine, twelve 48 m UT4000 FSVs under construction at ETP Engenharia, and three 45 m P3 crewboats at Arpoador Engenharia with the first, *BS Maresias (*see below) recently successfully delivered.

Incat Crowther will make further announcements about new projects in South America in the near future.

For more information contact Raoni França at raoni@incatcrowther.com.

Rendering of the first of three 42.5 m monohull DSVs under construction at Seasafe for Sistac Marine (Image courtesy Incat Crowther)

Two of twelve 48 m monohull UT4000 FSVs under construction at ETP Engenharia (Photo courtesy Incat Crowther)

BS Maresias from Incat Crowther

Incat Crowther has announced the launch and delivery of *BS Maresias*. Built by Arpoador Engenharia, *BS Maresias* is the first of three 45 m monohull crewboats meeting the specifications of the Petrobras P3-type crewboat for service in the Brazilian offshore oil fields.

The vessel's design features a large aft main cargo deck optimized for cargo and crew transfers. The 78 m^2 cargo space has a cargo capacity of 150 t.

The main cabin features seating for 60 passengers, two toilets, a beverage counter and large luggage racks.

Below-deck accommodation includes the galley, mess area, laundry space, four 2-person staterooms with two shared heads, plus a single-person stateroom with private head.

Below-deck tankage includes fuel oil and fresh water for both the ship's use and cargo. Ship's fuel exceeds 30 000 L, whilst cargo fuel capacity exceeds 100 000 L. There are also large grey- and black-water tanks, as well as large lube oil and waste oil tanks.

BS Maresias is powered by four Caterpillar C32 ACERT main engines. These turn a brace of Twin Disc MGX 6620 SC gearboxes, with main propulsion from Doen DJ 290 waterjets. Station will be maintained by a Rodriquez 149 kW tunnel bow-thruster. Electric power will be provided by a pair of Cummins 60 *e*kW generators.

BS Maresias performed well in sea trials, exceeding 32 kn, whilst achieving high levels of comfort and noise suppression in the main passenger cabin.

Principal particulars of the three vessels are

Length OA	45.4 m
Length WL	42.0 m
Beam OA	8.25 m
Depth	3.75 m
Draft (hull)	1.70 m
Passengers	60
Crew	9
Cargo deck area	78 m^2
Cargo deck capacity	150 t
Cargo deck strength	2.5 t/m^2
Maximum deadweight	250 t
Ship's fuel oil	34 400 L
Ship's fresh water	6000 L
Cargo fuel oil	104 200 L
Cargo fresh water	34 400 L
Grey water	4000 L
Sullage	2000 L
Main Engines	4×Caterpillar C32 ACERT
Gearboxes	4×Twin Disc MGX 6620 SC
Propulsion	4×Doen DJ 290 waterjets
Speed (service)	24 kn
(maximum)	32 kn
Bow Thuruster	Rodrequez TMS-150
Generators	2×Cummins 60 ekW
Construction	Marine-grade aluminium
Flag	Brazil
Class/Survey	RINa

BS Maresias on trials (Photo courtesy Incat Crowther)

Birds-eye view of *BS Maresias*
(Photo courtesy Incat Crowther)

Super Dream from Incat Crowther

Incat Crowther has is announced the launch of *Super Dream*, a 32 m catamaran passenger ferry for Ishigaki Dream Tours. Recently launched by Richardson Devine Marine Constructions in Hobart, *Super Dream* is the second Incat Crowther–RDMC vessel for the operator, following on from *Premium Dream,* launched in 2008.

Super Dream demonstrates Incat Crowther's commitment to constant evolution by being a modern interpretation of the previous vessel. Major improvements over *Premium Dream* include the addition of Incat Crowther's latest hullform and a sleek, single passenger-deck superstructure, resulting in a more-efficient vessel.

The main passenger cabin seats 197 passengers, designed to comply with Japanese "barrier-free" accessibility regulations. Features include dedicated wheelchair storage, boarding ramp and specific seats. A kiosk sits at the aft end of the main deck. Passenger comfort is enhanced by a built-in window-washing system which ensures that windows can be quickly and easily cleaned prior to each tour.

Super Dream has flexible boarding arrangements. In addition to the aft doors, a pair of large doors are fitted amidships. All three locations feature large double doors and wheelchair access. The aft deck gates are supplemented by a wheelchair ramp on the starboard side. Additionally, a gate is fitted to the upper deck on the starboard side, allowing for docking at higher wharves.

Super Dream is powered by a pair of Caterpillar C32 ACERT main engines. Propulsion is by 5-bladed fixed-pitch propellers. The vessel has a service speed of 30 kn, with a maximum speed of 34 kn.

Super Dream built by Richardson Devine Marine Constructions in Hobart
(Photo courtesy Incat Crowther)

As with *Premium Dream*, the new vessel is designed and built to Japanese Government rules, with structure designed to Class NK. Part of Incat Crowther's expertise is working closely with government agencies and classification societies to negate any potential non-compliance issues.

Incat Crowther has a strong tradition of repeat custom, and Ishigaki Dream Tours is another example of this. Just like *Premium Dream*, *Super Dream* will be another successful and profitable addition to the operator's fleet.

Principal particulars of *Super Dream* are

Length OA		31.65 m
Length WL		30.00 m
Beam OA		8.50 m
Depth		3.05 m
Draft	(hull)	1.20 m
	(skeg)	1.75 m
Passengers		197
Crew		4
Fuel oil		7000 L
Fresh water		2000 L
Sullage		1000 L
Main engines		2×Caterpillar C32 ACERT each 1081 kW @ 2100 rpm
Propulsion		2×propellers
Speed	(service)	30 kn
	(maximum)	34 kn
Generators		2×Caterpillar C4.4 76 kW
Construction		Marine-grade aluminium
Flag		Japan
Class/Survey		Japanese Government

Elizabeth Cook from Incat Crowther

Incat Crowther has announced the launch of *Elizabeth Cook*, a 24 m catamaran passenger ferry built by Richardson Devine Marine Constructions in Hobart for Captain Cook Cruises, a subsidiary of Sealink Marine. *Elizabeth Cook* has been designed to operate throughout Sydney Harbour, with class-leading efficiency and robustness. Incat Crowther worked closely with Sealink to develop a vessel which offers exceptional value to the operator, with tangible measures taken to reduce both capital investment and running costs. In addition to low fuel usage, machinery selection and systems design focussed on reducing ongoing maintenance costs. The result is a vessel with exception per-passenger capital and running costs.

Elizabeth Cook features a main passenger cabin with seats for 116 passengers. A further 27 seats are located on the aft deck. Toilets are located adjacent to the stairs to the upper deck. Large hinged engine hatches provide ample access to the engine rooms for day-to-day maintenance tasks.

Boarding gates are located on the foredeck, with particular attention paid to the visibility of these from the wheelhouse. Behind the wheelhouse, an open upper deck has seats for 55 passengers, with ample space for passengers to stand and view the sights.

Elizabeth Cook is certified to carry 127 passengers for coastal operations and 198 passengers for harbour operations.

Powered by a pair of Scania DI13 070M main engines, the vessel performed strongly in recent trials. In a fully-loaded service condition, *Elizabeth Cook* cruised effortlessly and efficiently at 25 kn. Her top speed was in excess of 28 kn.

Through a collaborative design process with Sealink, Incat Crowther has delivered a new-generation of vessel, offering cutting-edge design, low fuel consumption and increased capability. The success of the project has led Sealink Marine to commission two further vessels, the keels of which were recently laid at Richardson Devine Marine constructions.

Port bow of *Elizabeth Cook*
(Photo courtesy Incat Crowther)

Starboard quarter of *Elizabeth Cook*
(Photo courtesy Incat Crowther)

Elizabeth Cook on Sydney Harbour
(Photo courtesy Incat Crowther)

Red Hook I and *Cruz Bay I* from Incat Crowther

Incat Crowther has announced the launch of *Red Hook I* and *Cruz Bay I*, a pair of 25 m catamaran passenger ferries to operate in St Thomas in the US Virgin Islands.

Delivered by Midship Marine in Louisiana, these vessels follow on from the successful trio of UltraJet boats, also built by the yard to Incat Crowther's design. The new vessels have a similar configuration, with a half-height wheelhouse allowing a completely-open upper passenger deck.

The upper deck is fitted with seats for 72, whilst the main deck passenger cabin is fitted with seats for 131, plus a pair of wheelchair spaces.

The aft deck houses an ADA-compliant toilet and luggage racks. As with the UltraJet boats, boarding is via fold-down ramps situated on all four corners of the vessel.

Designed and built to the requirements of USCG Subchapter K, these boats meet the recent updates to fire and safety regulations. Compliance with these most-recent regulations requires the protection of the embarkation and muster stations from the effects of fire and flooding. To meet these regulations, these vessels are fitted with A-class structural fire protection and fire doors to the main passenger cabin.

The vessels are powered by a pair of Caterpillar C32 ACERT main engines, each producing 969 kW brake power. The vessels' required speed of 30 kn was achieved at 75% MCR.

Principal particulars of the new vessels are

Length OA		26.4 m
Length WL		23.3 m
Beam OA		7.75 m
Depth		2.95 m
Draft	(hull)	1.30 m
	(propeller)	2.05 m
Passengers		200
Crew		4
Fuel oil		3800 L
Fresh water		750 L
Sullage		750 L
Main engines		2×Caterpillar C32 ACERT each 969 kW @ 2100 rpm
Propulsion		2×propellers
Generators		2×NL M6502.25 65 kW
Speed	(service)	27 kn
	(maximum)	30 kn
Construction		Marine-grade aluminium
Flag		US Virgin Islands
Class/Survey		USCG Subchapter K

Stewart Marler

Red Hook I alongside
(Photo courtesy Incat Crowther)

Civil Marine Works from BCTQA

Burness Corlett Three Quays Australia has developed expertise in barge stability and structural assessments for civil marine works. These projects review the stability of a floating platform during the loading and operation of the civil equipment. The structural integrity of the pontoons and connecting structure is assessed, including dunnage specification for protection of the deck. The proposed mooring methods, spud design, limit flow velocities and environmental limitations are also reviewed.

Transfer of earthmoving equipment onto a pontoon
(Photo courtesy BCTQA)

Module Load-outs for Oil and Gas Industry from BCTQA

Burness Corlett Three Quays Australia provided detailed ballasting and stability analysis for the loading and unloading of modules onto a transport barge as an intermediate step for loading onto a ship. These modules had masses of up to 255 t with lengths up to 50 m. All work was performed to classification society requirements, including preparation of stowage plans, loadout drawings, pump arrangement plans, ballasting procedures and stability reports.

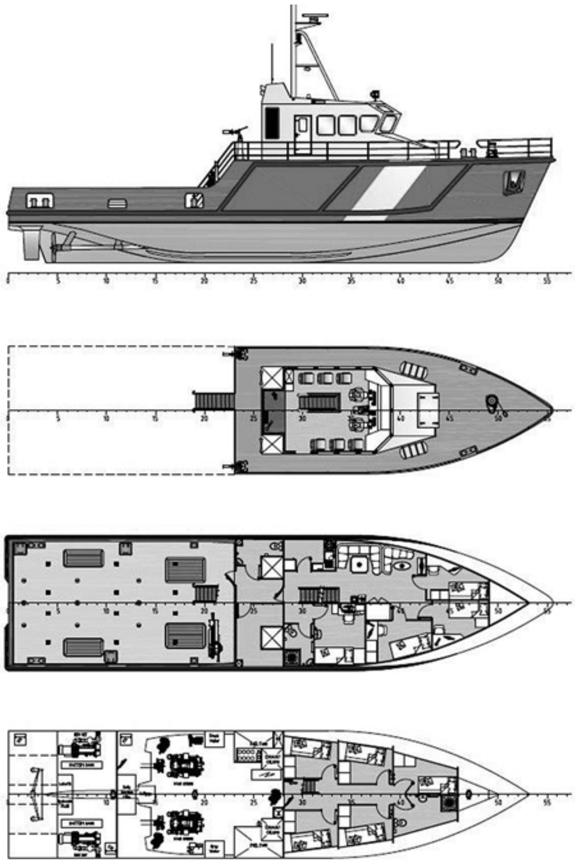
Module being loaded onto transport barge
(Photo courtesy BCTQA)

Module on barge under tow
(Photo courtesy BCTQA)

Module ready for transfer from barge to ship
(Photo courtesy BCTQA)

Fisheries patrol Vessel from BCTQA

Burness Corlett Three Quays Australia was the successful tenderer for the design of a 28 m fisheries patrol vessel (FPV) for operations in the middle east. Using BCTQA's successful *Kikori Tide* as a basis vessel, this FPV is of monohull steel design, capable of long stays on station and off-ship firefighting, with a large engine room and a large open aft working deck which can be fitted with further processing or accommodation blocks. This vessel is ideal for an owner or operator looking for a vessel which is reliable, powerful and capable of staying on station for long periods of time for survey and/or patrol.

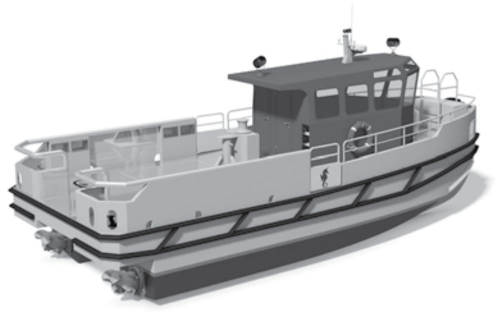


General arrangement of 28 m fisheries patrol vessel
(Drawing courtesy BCTQA)

Ocean Utility Vessels from BCTQA

With Australia's oil and gas industry growing, Burness Corlett Three Quays Australia is developing and researching new ways to deliver the best in offshore support vessels. BCTQA has developed a range of line-handling workboats specifically to target the Asia–Pacific's needs, developing the "workhorse" or "ute" of the Asia-Pacific region. The aluminium asymmetric catamaran hull shape allows for a large open working deck which is fitted with towing bollards and capstans. The smaller 9 m variant is capable of being lifted by a ship's crane, and all boast transit speeds of 25+ kn to allow for quick transits.

BCTQ *News Update*, November 2013



Rendering of 12 m ocean utility vessel
(Image courtesy BCTQA)

Rendering of 9 m ocean utility vessel
(Image courtesy BCTQA)

Jack-up Barge Spud Leg Extension from BCTQA

The current arrangement on a jack-up barge consisted of several road-transportable pontoons with 28.5 m spud legs. In order to remove operational restrictions, it was requested that these legs be extended by 8 m, giving a total leg length of 36.5 m.

Burness Corlett Three Quays Australia investigated the stability of the 8 m spud extension of the legs on the jack-up barge via Maxsurf modelling. The structural implications of the spud extension were investigated via a finite-element analysis.

It was found that the spud extension was feasible and production drawings for the spud leg extension followed.

Model and finite-element analysis of jack-up barge
and extended spud legs
(Images courtesy BCTQA)

Torpedo Recovery System from BCTQA

A torpedo recovery system (TRS) was required to be installed onto the aft deck of *Seahorse Horizon*. Burness Corlett Three Quays Australia was tasked with completing a ship check to ensure that the TRS mounting plates did not interfere with existing equipment on the vessel. The TRS was positioned on the deck such that the mounting plates coincided with existing structural elements. BCTQA then produced the installation drawing.

[*Built in 1984,* Seahorse Horizon *was initially operated by the National Safety Council of Australia as MV* Blue Nabilla*. She was purchased by the RAN in 1990 for use as a surveillance, training, and diving-support vessel and renamed HMAS* Protector*. During her military career,* Protector *supported the trials of the Collins-class submarines, and was involved in a search for the wreck of the World War II cruiser, HMAS* Sydney*. The ship was decommissioned and sold to Defence Maritime Services in 1998. Renamed* Seahorse Horizon*, she now operates out of HMAS* Creswell *as a training vessel.* —Ed.]

BCTQ *News Update,* December 2013

Seahorse Horizon
(Photo courtesy BCTQA)

Torpedo recovery system installed on *Seahorse Horizon*
(Photo courtesy BCTQA)

Log Exports from Eden

The Multi-purpose Wharf on the south side of Twofold Bay at Eden, NSW, is used principally for logs, containers, general cargo and naval operations. It is a modern, concrete-decked wharf with a face length of 200 m, a width of 30 m, and can berth vessels up to a length overall of 185 m and draft up to 10.5 m. The wharf is licensed to handle Class 1 Dangerous Goods (explosives) up to a quantity of 30 t NEQ (net explosive quantity). A hard-stand storage yard of 8 hectares is located nearby.

The wharf continues to be used for the export of pine logs from the Monaro (principally around Bombala) to the rest of the world. *Global Aquarius*, with a length of 170 m, beam 27 m and draft 10.3 m and registered in Panama, departed Twofold Bay on 2 February with a load of pine logs bound for Mawan, China.

Global Aquarius with a load of pine logs departing Twofold Bay
and bound for Mawan, China
(Photo courtesy Robert Whiter)

Cruising

The summer cruise season has moved into high gear, with visits to Sydney in late November by *Carnival Spirit, Pacific Pearl, Rhapsody of the Seas, Celebrity Millennium, Sun Princess, Volendam, Voyager of the Seas, Oosterdam, Pacific jewel, Radiance of the Seas, Pacific Pearl* and *Celebrity Solstice.*

In addition to returns by many of these vessels, December added visits by *Dawn Princess, Costa neo Romantica, Silver Shadow* and *Seabourn Odyssey,* January added a visit by *Seven Seas Voyager*, and early February added visits by *Columbus 2, Silver Whisper, Seabourn Sojourn, Amsterdam, Astor* and *Aurora.*

Phil Helmore

Voyager of the Seas dwarfing a Manly ferry during her departure on 24 January 2014
(Photo John Jeremy)

Submariners Practice Rescue Skills

An intensive three-week submarine escape-and-rescue exercise was carried out off the east coast of Australia during November last year.

During Exercise Black Carillon 2013, members of the RAN's Submarine Force simulated being evacuated from HMAS *Farncomb*, which was bottomed in 112 m of water, in the James Fisher Rescue Service LR5 submersible.

The 21.5 t submersible was then lifted onto the deck of a rescue vessel, where its passengers were transferred into decompression chambers without being exposed to the outside air pressure.

The James Fisher Rescue Service LR5 Submersible was mobilised from its base at Henderson, WA, flown by RAAF 86 Wing C17 Globemaster to the east coast and then embarked on Australian Defence Vessel (ADV) *Ocean Shield*.

Commander Submarine Force, CAPT Mark Potter RAN, said that while it's unlikely the equipment will be needed, maintaining the capability is essential.

"Submariners are an important part of naval capability. Should the unthinkable happen, it is essential that we have established and well-practised procedures in place to rescue personnel," said CAPT Potter.

"During Black Carillon, the Navy worked closely with defence partners and the contractor, James Fisher Defence, to mobilise and test the equipment on the east coast. It was also the first time that ADV *Ocean Shield* was used as the mother ship. Her size and ability to dynamically position proved to be an invaluable capability during the rescue operation.

"The Navy's underwater medical specialists also played a vital part in the exercise. Type B decompression chambers were tested and life-saving medical techniques aimed at preventing and responding to decompression sickness were simulated," said CAPT Potter.

This was the twelfth time the Royal Australian Navy has conducted a submarine escape-and-rescue exercise.

Australia is also a member of the International Submarine Escape and Rescue Liaison Organisation which would provide international support should an Australian submarine be disabled.

The LR5 submersible being recovered on board *Ocean Shield*
(RAN photograph)

HMAS *Farncomb* and ADV *Ocean Shield* sailing from Sydney for Exercise Black Carillon 2013
(RAN photograph)

Back Against the Wall

R J Dunworth
Department of Defence, Navy Engineering Division

Summary

An inclining experiment is the established method used to determine the vertical centre of gravity of a ship. At the same time, the other lightship properties can be found — displacement and the longitudinal and transverse centres of gravity.

Only in exceptional circumstances will the traditional, or classic, method of calculating *KG* give a completely-accurate result due to the dependence on wall-sided formulae. The problem is discussed and the magnitude of potential error is investigated.

An alternative calculation method is proposed, with validity demonstrated by calculation and example. The method overcomes the drawbacks of the classic calculations and allows the evaluation of *KG* and TCG of any hull form, inclined to any angle of heel.

This paper expands on a previous paper, *Up Against the Wall,* presented by the author at the Pacific 2013 IMC.

Nomenclature

Δ	Displacement of the system (ship plus inclining masses) (t)
BM_0	Height of the transverse metacentre above the centre of buoyancy (m)
d	Distance of inclining mass shift (m)
φ	Angle of heel (degrees)
GG'	Shift of centre of gravity (m)
GM_0	Transverse metacentric height when upright (m)
GZ	Righting arm (m)
HZ	Heeling arm (m)
HZ_0	Heeling arm when upright (m)
KG	Height of vertical centre of gravity above baseline (m)
KG_1	Height of vertical centre of gravity above baseline with inclining masses in their initial position (m)
KM_0	Height of transverse metacentre above baseline (m)
KN	Righting arm about the origin (m)
KN_0	Righting arm about the origin when upright (m)
LCG	Longitudinal centre of gravity
ρ	Density (t/m^3)
TCB_0	Transverse centre of buoyancy when upright (m)
TCG	Transverse centre of gravity (m)
TCG_0	Transverse centre of gravity when in upright equilibrium (m)
TCG_1	Transverse centre of gravity of the system with inclining masses in their initial position (m)
w	Inclining mass (t)

1. Introduction

The concept of an inclining experiment was first proposed in 1697 by Hoste [1], a professor of mathematics at the Royal Naval College in Toulon, France, but it was nearly fifty years before a practical method of conducting an inclining experiment was described in 1746 by Bouguer [2].

The first inclining was conducted two years later in 1748 at the Brest naval shipyard on the 74-gun ship *Intrépide* by Clairin-Deslauriers [3]. At that time, the French navy was fighting in the War of the Austrian Succession and had recently suffered defeats by the British in the first and second battles of Cape Finisterre. Gaining an advantage through the ability to carry more sail was of great importance to the navy. Metacentric height GM_0 was used to determine a ship's stiffness and, hence, the sail-carrying capacity.

The traditional calculation associated with an inclining experiment led directly to a value of GM_0 and, as this was the primary measure of stability, it was not necessary to know the position of *KG* itself until the development of the concept of *GZ* by Atwood and Vial de Clairbois [4] in 1798. By that time, Bouguer's calculation method was well established and continues to be used to this day.

The Australian Department of Defence requires regular inclining experiments on Royal Australian Navy (RAN) vessels to monitor the growth in displacement and *KG* which is a common phenomenon on naval ships. Communication, navigation and armament equipment increase with time and tend to be placed high up. Conversely, when heavy machinery low down in the ship is upgraded, it is often replaced with more efficient, lighter equipment.

Without compensation, these effects almost guarantee that *KG* will rise over time. Growth must be captured and updated regularly in the stability information provided to ships.

For the RAN, stability is managed by comparison of a load condition's *KG* with a curve of limiting *KG*. If *KG* has been over-estimated, then unnecessary operational restrictions may result but, if *KG* has been under-estimated, then the vessel may be at risk if it encounters the environment and/or damage which underlie the curve of limiting *KG*.

The lightship characteristics of RAN ships are regularly checked by inclining experiments with the interval determined by the expected time before any standard load condition will exceed the limiting *KG* due to growth. Over the whole fleet, there is about one ship checked every three or four months.

2. The Classic Inclining Equations

When a mass is moved across a ship so as to produce a shift of centre of gravity from *G* to *G'* and a resulting heel angle φ, then $\tan\varphi$ is given by:

$$\tan\varphi = \frac{GG'}{GM_0} \tag{1}$$

This can be re-arranged to derive GM_0:

$$GM_0 = \frac{GG'}{\tan\varphi} \tag{2}$$

If the mass *w* is moved a distance *d* across a vessel of displacement Δ, then the shift of centre of gravity GG' is given by:

$$GG' = \frac{w\ d}{\Delta} \quad (3)$$

This leads to the classic formula for evaluating GM_0 from an inclining experiment:

$$GM_0 = \frac{w\ d}{\Delta\ \tan\varphi} \quad (4)$$

Each value of $w\ d\ /\ \Delta$ is plotted against the corresponding value of $\tan\varphi$.

The slope of the linear line of best fit (trendline) through the points gives $w\ d\ /\Delta\ \tan\ \varphi$ which, from Equation 4, is equal to GM_0.

Alternatively, values of $w\ d$ may be plotted against the corresponding values of $\tan\varphi$. The slope of the trendline through the points, when divided by Δ, then gives GM_0.

The height of the transverse metacentre KM_0 can readily be found from the vessel's hydrostatics corresponding to the draft and trim at the inclining. This, together with GM_0, will provide the height of the vertical centre of gravity:

$$KG = KM_0 - GM_0 \quad (5)$$

3. Up Against the Wall

The derivation of the formula for BM_0 and its relationship to GM_0 are not presented here as they are well documented in naval architectural texts, e.g. Reed [5], but examination of these shows that the accuracy of the classic KG calculation depends on several assumptions:

- The ship is wall sided: that is, the sides of the ship are vertical in way of the waterline when the vessel is upright.
- Throughout the length of the waterplane, the immersed and emerged wedges are identical.
- The distance between the centroids of the immersed and emerged wedges is equal to 2/3 of the local waterline beam.
- For small angles of heel, the metacentre is assumed to be fixed, though it is questionable as to how small is "small" and how fixed is "fixed".

An elegant case which illustrates the behaviour of the metacentre is one of the most-basic wall-sided shapes: a square-section prism floating at its half depth. When upright, the metacentre is on the centreline at M_0 (Figure 1a), a little ($B/12$) below the waterplane. As the shape rotates, the metacentre moves significantly and by 45° it has moved to a position M_{45} (Figure 1b), significantly ($B/3\sqrt{2}$) above the waterplane. With further rotation, M does a sharp U-turn and heads back again.

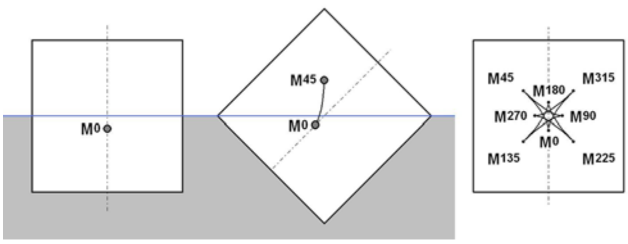


Figure 1a: Upright Metacentre | Figure 1b: 45° Heel | Figure 1c: Metacentrique

The full locus of the metacentre, the "metacentrique", as the ship rotates through 360° is shown in Figure 1c. The metacentre moves significantly, even for a wall-sided form. It was Bouguer [2] who first described and named the metacentrique, and he must surely have recognised the inaccuracy which this introduced into the inclining experiment method which he devised.

While the initial movement is relatively slow, it is quite rapid by 45° heel. This may not be a significant problem if a ship is truly wall-sided throughout, but it certainly is for the patrol boat shown in Figure 2. The deadrise of the bottom of this vessel is less than 45° at the waterplane along most of its length, not unlike the box in Figure 1b, where movement of the metacentre is both significant and rapid.

Not only are flare and deadrise problematic, but chines and other knuckles can cause the metacentre to move erratically. There are cases of asymmetric vessels and, for these, the metacentric height differs depending on the direction of heel.

Figure 2: Armidale-class Patrol Boat (ACPB)

Clearly, any calculation of KG which relies on the assumption of a fixed metacentre will be up against the wall-sided limitations when it comes to delivering consistent, accurate results.

4. Accuracy

4.1 Derivation of the Lightship

A detailed ship check is undertaken to capture the masses on board which are not part of the lightship and any items not on board which should be included. Tanks are dipped at the beginning of the inclining experiment and any tanks which must remain in use during the experiment are dipped again at the end. These measures ensure that the derivation of the lightship from the as-inclined condition is as accurate as possible.

With such effort going into these aspects of the inclining experiment, it is important that the most accurate method of deriving the as-inclined KG and TCG should be employed.

4.2 Setting a Standard

A useful benchmark to use when judging improvements in the accuracy of the inclining experiment workup is the magnitude of the experimental errors to be expected. Unless any improvement is significantly greater than the inherent errors, it is of doubtful value.

For a detailed treatment of the experimental errors, every naval architect should read Shakshober and Montgomery [6]. At an inclining, all measurements are taken as accurately as possible. Readings of drafts, calibration of inclining masses, measurements of mass shifts and pendulum deflections each carry a potential error of a few millimetres in the calculated *KG*.

4.3 Experimental Errors

One means of judging the effect of experimental errors is to calculate the change which each would cause to GM_0 in the classic inclining Equation 4. The potential errors in *KG* for naval warships, ignoring any detrimental effects of adverse weather or avoidable causes of error, have been investigated. An example for a frigate of about 3500 t displacement is shown in Table 1.

Table 1: Cumulative Weighted Potential Error in *KG*

Cause	Reading Error	Affects	Error	Effect on *KG* (m)
Mass Calibration	1 kg/t	*w*	0.016 t	0.0010
Distance *d*	10 mm	*d*	0.01 m	0.0008
Pendulum Length	3 mm	*tan*ϕ	0.00002	0.0003
Pendulum Deflection	0.5 mm	*tan*ϕ	0.00010	0.0016
Draught Reading	5 mm	Δ	6 t	0.0009
Hydrometer Calibration	0.5 kg/m³	Δ	1.6585 t	0.0005
Cumulative weighted potential error in *KG*				0.0051

The results are weighted with the inclining mass and hydrometer calibrations, which cannot vary, each being weighted by the factor 1.0. The other causes of error are subject to multiple readings and have accordingly been given an arbitrary weighting factor of 0.5. The resulting cumulative weighted potential error in *KG* of 0.005 m for the frigate is a little below the average potential error of 0.008 m over the fleet of RAN warships.

5. Proposed New Method

The inclining experiment can be regarded as a practical means of determining a portion of a vessel's righting arm (*GZ*) curve over a small range.

5.1 Equating Heeling and Righting Arms

After each mass shift, the vessel comes to rest so, for the vessel to be in equilibrium, there must be a righting moment of magnitude equal to the heeling moment created by the mass movement.

Since displacement remains constant during the experiment, heeling and righting arms must similarly be of equal magnitude:

$$\text{Heeling Arm } (HZ) = \text{Righting Arm } (GZ) \qquad (6)$$

Unless the vessel is exactly upright, the horizontal distance which an inclining mass moves is less than the slope distance across the deck. The heeling moment at equilibrium after a mass movement is therefore given by:

$$\text{Heeling Moment } = w\, d \cos\varphi \qquad (7)$$

Dividing the moment by displacement will give the heeling arm (*HZ*):

$$HZ = \frac{w\, d\cos\varphi}{\Delta} \qquad (8)$$

Displacement, trim and initial heel are determined from the draft readings. For each mass movement, the pendulum deflection is used to calculate the *change* of heel and adding this to the initial heel gives the actual heel. The average heel angle from all pendulums should be used. For each mass movement, the hull model can then be interrogated at the actual displacement, trim and heel to derive the value of *KN*. Each righting arm can be calculated from *KN* using the standard equation:

$$GZ = KN - KG_{\mathrm{I}} \sin\varphi - \mathrm{TCG_I} \cos\varphi \qquad (9)$$

where KG_I and TCG_I are the respective *KG* and TCG with the inclining masses in their initial positions.

The sign of the last term in Equation 9, $TCG_I \cos\varphi$ is dependent on the sign convention being used. If, for example, distances to starboard and heel to starboard are both positive or both negative, then the sign of the term will be negative as shown. If distances and heel angle are of opposite signs, then the term will be positive.

Substituting *HZ* for *GZ* from Equation 6 into Equation 9:

$$HZ = KN - KG_{\mathrm{I}} \sin\varphi - \mathrm{TCG_I} \cos\varphi \qquad (10)$$

This heeling arm equation is the basis for the proposed new method.

5.2 The Solution for TCG_I

When $\varphi = 0$, $\sin\varphi = 0$ and $\cos\varphi = 1$, so Equation 10 reduces to:

$$HZ_0 = KN_0 - \mathrm{TCG_I} \qquad (11)$$

Equation 11 can be re-arranged to give a solution for TCG_I:

$$\mathrm{TCG_I} = KN_0 - HZ_0 \qquad (12)$$

KN_0 is identical to TCB_0 and could be found from hydrostatics. However, it is more convenient to calculate KN_0 with the other *KN* values which will be required. KN_0 can be expected to be close to zero, but will only be exactly so if both hull and appendages are truly symmetric about the centreline. The actual value should generally be calculated.

HZ_0 can be found from the trendline through the *HZ* points when plotted against heel angle and is the value of *HZ* when heel = 0, i.e. the intercept of the trendline.

A third-order polynomial trendline should be used because it can closely match non-linear data sets which include a point of inflection — such as generally occur near equilibrium in *GZ* plots.

5.3 The Solution for KG_I

Equation 10 can be re-arranged as:

$$KG_{\mathrm{I}} \sin\varphi = KN - HZ - \mathrm{TCG_I} \cos\varphi \qquad (13)$$

and the solution for KG_I is therefore:

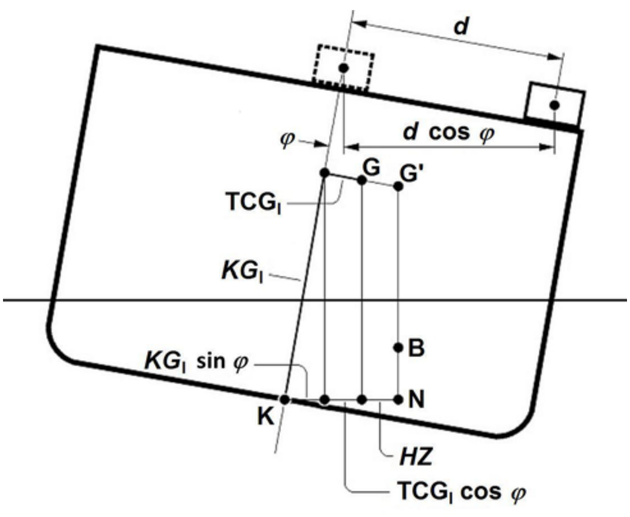


Figure 3: Illustration of Equation 13

$$KG_{\text{I}} = \frac{KN - HZ - \text{TCG}_{\text{I}} \cos\varphi}{\sin\varphi} \quad (14)$$

For each mass move, $KG_{\text{I}} \sin\varphi$ (from Equation 13) is plotted against $\sin\varphi$. The value of KG_{I} is equal to the slope of the trendline and, as all points should lie on a straight line, a linear trendline is used to find an average result.

5.4 Interpretation of TCG_{I}

In Equation 9, KG_{I} and TCG_{I} are assumed to be constants. Over the duration of the inclining experiment, the *KG* should remain constant, with care being taken not to shift the inclining masses vertically. The masses (or mass groups) should always be placed on the deck and not stacked on top of each other.

The TCG of the system will change as the inclining masses are shifted from side to side and it is important to distinguish between the constant TCG_{I} and the instantaneous TCG after each mass shift. It will be shown that TCG_{I} is the TCG of the complete system — ship plus inclining masses — with the inclining masses in their initial position. The initial angle of heel, which is unlikely to be exactly upright, is found from the draft readings.

When upright, the ship may have a non-zero TCB_0 due to asymmetry of the hull and appendages. There could also be an inherent off-centre location of the transverse centre of gravity, TCG_{I}, due to the ship loading. Either, or both, would require a mass shift of moment $w\,d_0$ to bring the ship to upright equilibrium.

At upright equilibrium TCB_0, TCG_0 and KN_0 are identical. The summation of transverse moments gives:

$$\text{TCG}_0 = \frac{\Delta\ \text{TCG}_{\text{I}} + w\ d_0}{\Delta} = KN_0 \quad (15)$$

This can be expanded and rearranged to:

$$\text{TCG}_{\text{I}} = KN_0 - \frac{w\ d_0}{\Delta} \quad (16)$$

At upright, when $\cos\varphi = 1$, Equation 8 reduces to:

$$HZ_0 = \frac{w\ d_0}{\Delta} \quad (17)$$

Substituting into Equation 16 gives:

$$\text{TCG}_{\text{I}} = KN_0 - HZ_0 \quad (18)$$

which is identical to Equation 12, the solution for TCG_{I}. This confirms that the constant term TCG_{I} is the initial TCG of the system (ship plus inclining masses) with no heeling moment, i.e. with the inclining masses on board and in their initial positions, prior to the first mass movement.

5.5 Consideration of Liquid Movement

In interpreting TCG_{I} it was assumed that the TCG of the ship alone is a constant; it is common practice to assume that the centre of gravity of the ship, together with any liquids aboard, remains fixed throughout the inclining experiment. An adjustment is then made to the as-inclined fluid *KG* to obtain the solid *KG*.

Experience has shown that, even with small angles of heel, the transverse moment of inertia of the liquid surfaces may change significantly and it is not necessarily valid to assume that the total free-surface moment (FSM) is constant throughout the experiment.

As it is now a simple matter to determine values of free-trimming *KN* at any angle — and this method depends upon that capability — so also moments of transference of liquids in tanks at any combination of heel and trim can be calculated. The difference between initial and heeled *KN*s is the arm of transference.

If specific software with this capability is not available, then each tank can be treated as a ship hull. KN values run in fresh water (ρ = 1.0), with displacement set to the volume of liquid, will deliver arms of transference in global coordinates. The products of these and the mass of liquid will be the moments of transference.

For each mass shift, the corresponding moment of transference should be included to give the total heeling moment. Note that, if moments of transference are in ship coordinates, then they should be added to the term $w\,d$ but, if in global coordinates, then they should be added to the term $w\,d\cos\varphi$.

Care must still be exercised to ensure that liquids do not flow out of any tank due to excessive heel.

5.6 Benefits of the New Method

The proposed new method makes no reference to the metacentre and is free of the associated errors. It can be used on any hull form and, within the constraints of liquids on board, to any angle of inclination.

Curves of limiting *KG* are, to a large extent, derived from *GZ* values for the intact and damaged ship. *GZ*s, in turn, are based on *KN* data. Therefore, the use of *KN* data to evaluate the inclining experiment ensures a good correlation between actual *KG* and limiting *KG*.

6. Validation by Calculation

The accuracy of the proposed new method has been tested by mathematical analysis of regular prisms. A range of TCGs was used to induce initial heel. The actual shapes used were:

- a box with 8 m beam and 4 m draught
- a wedge with 45° deadrise and 4 m draught; and
- a wedge with 30° deadrise and 1.52 m draught.

Three initial angles of heel were assumed: 0°, 0.8° and 2.0°.

By using regular shapes, the characteristics could be calculated exactly to ensure accuracy. Both classic and new methods were used to analyse KG and, in every case, the classic method underestimated KG by the amounts shown in Table 2. Less than 1×10^{-8} m error, the limit of accuracy of the calculation, was found when using the new method.

Table 2: Calculated differences in *KG* (m)

	Δ	*KG*	Initial Heel		
	t	m	0.0°	0.8°	2.0°
Box	3200	3.00	0.001	0.002	0.004
45° Wedge	1600	4.00	0.006	0.007	0.016
30° Wedge	200	3.50	0.013	0.017	0.036

The difference in *KG* between the classic method and the new method has also been investigated by re-analysing the inclining experiments for a number of ship types.

Both methods generally give similar values for most vessels, but three ship types stand out as having significant differences. For a Survey Motor Boat, a small hard-chine aluminium craft, the classic method underestimated *KG* by 21 mm. The RAN Landing Ship Heavy, though generally wall-sided, has a significant chine aft with pronounced bottom flare below, and *KG* was underestimated by 56 mm. The ACPB, as noted earlier, has a deadrise of less than 45° at the waterplane throughout most of its length, and *KG* was underestimated by 63 mm — an order of magnitude greater than the expected experimental error.

7. Validation by Example

To validate the method for an extreme case with asymmetry and a large heel angle, a simulated inclining experiment on a proa (Figure 4) is presented. The data has been arranged so that, at one mass move, the outrigger comes out of the water and the craft is close to the point of capsize.

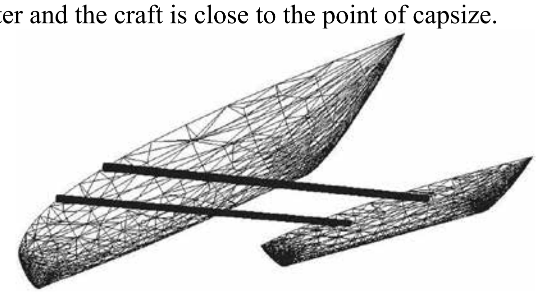


Figure 4: Mesh Model of a Proa

The craft is very stiff when heeling towards the outrigger, but quite tender when heeling away. This gives rise to significantly different values of GM_0, depending on the direction of heel.

Table 3: Proa Inclining Experiment Data

Ship Readings		Inclining Readings		
Draught	0.400 m	Pendulum length		1000 mm
Trim	0.000 m	Move	*w d* (t m)	Defl'n (mm)
Heel	-0.735 deg			
Water density	1.0000 t/m³	0	0.000	0.0
		1	-0.212	-12.5
KG	**0.375 m**	2	-0.413	-23.5
TCG	**-0.150 m**	3	0.000	0.0
From Hydrostatics		4	0.212	14.5
Displacement	2.58 t	5	0.413	109.0
KM_0	6.427 m	6	0.000	0.0

A 3-D mesh model was built with *Rhinoceros* software and used to generate the inclining experiment data shown in Table 3. Calculated pendulum deflections have been rounded to the nearest 0.5 mm. At Move 5, when the outrigger comes clear of the water, a heel of over 5° is developed. This is clearly illustrated in Table 3 by the large pendulum deflection.

7.1 Evaluation by the Classic Method

Hydrostatics were run for the as-inclined condition and KM_0 found to be 6.427 m.

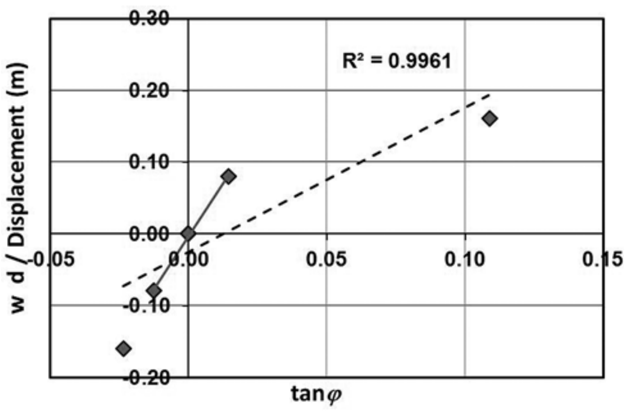


Figure 5: Proa Pendulum Plot

The classic pendulum plot, from the data in Tables 3 and 4, is shown in Figure 5. A linear trendline through all points, shown dotted, clearly does not fairly represent the full set of results.

In practice, the outlying point at Move 5 would be discarded and, to achieve a reasonable fit, so too would the point from Move 2. The linear trendline through the remaining points is shown as a solid line.

This gives a GM_0 of 5.904 m. With a KM_0 of 6.427 m, the KG is calculated from Equation 5 to be:

$$KG = 6.427 - 5.904 = 0.523 \text{ m}$$

An R^2 value of 0.9961 suggests that a reasonable result could be expected, but it is clear that the calculated *KG* does not compare well with the actual *K*G of 0.375 m.

With differing values of *GM*s to port and starboard, a single trendline almost inevitably leads to this erroneous result.

7.2 Evaluation by the New Method

Table 4: Proa Workup by the New Method

Move	*w d* (t m)	Defln (mm)	$\tan\varphi$	$\delta\varphi$ (deg)	φ (deg)	*HZ* (m)	*KN* (m)	*KG* $\sin\varphi$ (m)
0	0.000	0.00	0.0000	0.000	-0.735	0.0000	-0.1547	-0.0049
1	-0.212	-12.50	-0.0125	-0.716	-1.451	-0.0821	-0.2393	-0.0074
2	-0.413	-23.50	-0.0235	-1.346	-2.081	-0.1600	-0.3236	-0.0140
3	0.000	0.00	0.0000	0.000	-0.735	0.0000	-0.1547	-0.0049
4	0.212	14.50	0.0145	0.831	0.096	0.0822	-0.0695	-0.0019
5	0.413	109.00	0.1090	6.221	5.486	0.1593	0.0465	0.0362
6	0.000	0.00	0.0000	0.000	-0.735	0.0000	-0.1547	-0.0049

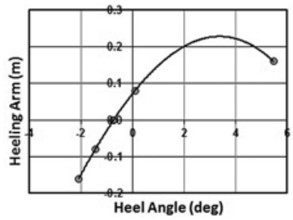


Figure 6a: Proa Heeling Arm vs Heel Angle

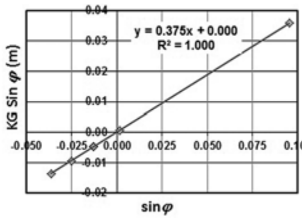


Figure 6b: Proa *KG* $\sin\varphi$ vs $\sin\varphi$

The proposed new method copes easily with this data. An analysis performed in Excel is shown in Table 4 with the results plotted in Figure 6. At each move, *HZ* is calculated as shown in Equation 8 and *KG* $\sin\varphi$ as shown in Equation 13. KN_0 is calculated to be –0.079 m and, using a third-order polynomial trendline, the *HZ* intercept in Figure 5a (HZ_0) is found to be 0.071 m. Equation 12 then gives:

$$TCG = -0.079 - 0.071 = -0.150 \text{ m}$$

The coefficient of determination R^2 of the linear trendline of *KG* $\sin\varphi$ vs $\sin\varphi$ in Figure 5b is 1.000 and the slope gives:

$$KG = 0.375 \text{ m}$$

Even in this extreme case, the results are correct to the nearest millimetre.

8. Worked Example

This example shows the workup of an actual inclining experiment on a patrol boat. The data from the experiment is shown in Table 5.

The classic method gives GM_0 = 1.296 m. KM_0 is found from the craft's hydrostatics at the initial state shown in Table 5. *KG* is calculated from Equation 5 to be:

$$KG = 5.331 - 1.296 = 4.035 \text{ m}$$

An analysis performed in Excel using the proposed new method is shown in Table 6 with the results plotted in Figure 7.

Table 5: Patrol Boat Inclining Experiment Data

Ship Readings		Inclining Readings		
Draught	1.586 m	Pendulum length		3691 mm
Trim	0.589 m	Move	*w d* t m	Defl'n mm
Heel	0.610 deg			
Water density	1.0220 t/m^3	0	0.000	0.00
		1	4.511	48.50
		2	8.883	92.25
		3	0.000	0.75
From Hydrostatics		4	-4.422	-48.75
Displacement	265.12 t	5	-8.806	-97.00
KM_0	5.331 m	6	-0.200	-0.50

Table 6: Patrol Boat Workup by the New Method

Move	*w d* t m	Defln mm	$\tan\varphi$	$\delta\varphi$ deg	φ deg	*HZ* m	*KN* m	*KG* $\sin\varphi$ m
0	0.000	0.00	0.0000	0.000	0.610	0.0000	0.0574	0.0438
1	4.511	48.50	0.0131	0.753	1.363	0.0170	0.1282	0.0976
2	8.883	92.25	0.0250	1.432	2.042	0.0335	0.1923	0.1452
3	0.000	0.75	0.0002	0.012	0.622	0.0000	0.0585	0.0449
4	-4.422	-48.75	-0.0132	-0.757	-0.147	-0.0167	-0.0138	-0.0107
5	-8.806	-97.00	-0.0263	-1.505	-0.895	-0.0332	-0.0842	-0.0646
6	-0.200	-0.50	-0.0001	-0.008	0.602	-0.0008	0.0566	0.0438

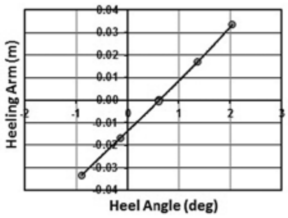


Figure 7a: Patrol Boat Heeling Arm vs Heel Angle

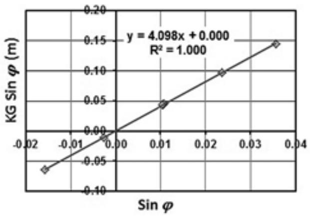


Figure 7b: Patrol Boat *KG* $\sin\varphi$ vs $\sin\varphi$

With a symmetric hull, KN_o is 0.000 m. The intercept in Figure 6a gives HZ_o as –0.014 m, so Equation 12 gives:

$$TCG = 0.000 - (-0.014) = 0.014 \text{ m}$$

The coefficient of determination R^2 in Figure 6b is 1.000 indicating good accuracy and the slope gives:

$$KG = 4.098 \text{ m}$$

This result shows KG to be 0.063 m higher than that calculated by the classic method.

9. Conclusions

There are inherent errors in the classic method of evaluating inclining experiments using the wall-sided formulae. In most cases, though not in the example of the proa, calculations of the as-inclined ship condition which rely on *GM* will underestimate KG.

Further, a high coefficient of determination R^2 of the linear trendline through the classic pendulum plot is no guarantee of an accurate result.

The new method described above is simple, robust and accurate. It can be used with confidence for any hullform and can cope with angles of heel outside the range normally prescribed for inclining experiments.

The method will ensure good correlation between actual *KG* and limiting *KG*, and avoids the errors associated with the assumptions of a symmetrical, wall-sided ship and fixed metacentre.

10. References

1. Hoste, P. (1697), *Théorie de la Construction des Vaisseaux (Theory of the Construction of Vessels),* Arisson & Posule, Lyon.
2. Bouguer, P. (1746), *Traité du Navire, de sa Construction et de ses Mouvemens (Treatise of the Ship, its Construction and its Movements*), Jombert, Paris.
3. Nowacki, H. and Ferreiro, L.D. (2003), *Historical Roots of the Theory of Hydrostatic Stability of Ships*, 8th International Conference on the Stability of Ships and Ocean Vehicles, Madrid.
4. Atwood, G. and Vial de Clairbois, H-S. (1798), *A Disquisition on the Stability of Ships,* Philosophical Transactions of the Royal Society of London, vol. 88, pp. vi-310.
5. Reed, E. (1885*), A Treatise on the Stability of Ships,* Charles Griffin & Co., London.
6. Shakshober, M.C. and Montgomery, J.B. (1967), *Analysis of the Inclining Experiment,* SNAME, Hampton Roads Section, 2 February.

EDUCATION NEWS

University of New South Wales

Undergraduate News

New Program Structure

Following a review of the degree programs offered in the School by Em/Prof. John Simmons of the University of Queensland in 2012, a revised program structure commenced rolling out for students in Years 1 and 2 in 2013, rolling into Year 3 this year and Year 4 next year.

The main changes to the naval architecture degree program are as follows:

- MATS1101 Materials Science and Chemistry moves from "recommended" to the Year 1 Engineering Elective list.
- MMAN1130 Design and Manufacture becomes MMAN2130 and moves from Year 1 into Year 2.
- MATH2089 Numerical Methods and Statistics moves from Year 2 into Year 3.
- MMAN3200 Linear Systems and Control moves from Year 3 into Year 4.
- A general-education elective moves from Year 3 into Year 4.
- MMAN4000 Professional Engineering becomes MMAN3000 Professional Engineering and Communication and moves from Year 4 into Year 3.

The new structure of the naval architecture degree program can be seen at www.engineering.unsw.edu.au/mechanical-engineering/sites/mech/files/uploads/BE_Plan_3710_NAVL_Basic_2012.pdf.

Feedback from students in Years 1 and 2 so far has generally been positive.

Thesis Projects

Among the interesting undergraduate thesis projects currently under way are the following:

Investigation of Catamaran Resistance Prediction

The field of resistance prediction for catamarans has been less well researched than that for monohulls, although the situation is improving.

Ming Fang is investigating the resistance of catamarans. He has compared the resistance of a model with the resistance predicted both by the slender-body method in Maxsurf and by Hydros and found good correlation. He has then used the model as a parent to generate a systematic series of catamarans, will run the resistance predictions, and then do a regression analysis of the results to provide an equation to predict the effects of length-beam ratio, slenderness ratio, demihull spacing, etc. on the resistance.

Investigation of Trimaran Resistance Prediction

The field of resistance prediction for trimaranshas been less well researched than that for monohulls and catamarans, although the situation is improving.

Raymond Fagerli is investigating the resistance of trimarans. He has compared the resistance of a model with the resistance predicted both by the slender-body method in Maxsurf and by Hydros and found good correlation. He has then used the model as a parent to generate a systematic series of trimarans, will run the resistance predictions, and then do a regression analysis of the results to provide an equation to predict the effects of length-beam ratio, slenderness ratio, stagger, sidehull spacing, etc. on the resistance.

Post-graduate and Other News

New Faculty of Engineering Websites

The Faculty of Engineering and all schools in the Faculty have launched new websites. Check out the Faculty at

www.engineering.unsw.edu.au/

and the School of Mechanical and Manufacturing Engineering at

www.engineering.unsw.edu.au/mechanical-engineering/.

The Faculty has worked hard to evolve from multiple stand-alone faculty and school websites, to a comprehensive website which is more interactive, easier to scan, read and navigate, enabling visitors to find what they need quickly. Just as importantly, the messages and value propositions are evident and clear.

With improvements throughout, the new websites now include a social connectivity platform (Facebook, Google+, etc.) and online forms, allowing more-efficiently response to enquiries.

The websites will be updated on a regular basis, with news, events, and new content. The Faculty encourages visitors to contact them through the website, sign up for the newsletter (the first issue of which will be released in early 2014) and provide feedback using the feedback form at the bottom of every page.

Construction Progress

The refurbishment of the Mechanical Engineering buildings is progressing and there have been huge changes to the Mechanical Engineering link wing. Demolition works are progressing well, and the main demolition scaffolding and tower crane have been erected. The relocation of services from J17 Mechanical Engineering is now complete. The most-significant item to be relocated was the cooling towers which required a 95 t crane to lift and relocate them from the roof of J17 South to the roof of J17 North during December 2013.

There is a significant amount of demolition to be undertaken and, by nature, this is noisy and dusty work. Richard Crookes Constructions have the necessary controls in place to mitigate disturbances.

Willis Annex (the laboratory building J18) South has been completely stripped back to 'bare bones' allowing the structural, facade and building services works to commence. The building will receive a brand-new roof with an increased acoustic rating, upgraded insulation and new windows to increase the building's overall thermal performance. These passive-design elements will aid in improving internal comfort for the new state-of-the-art laboratories while reducing future energy consumption.

You can watch the action streaming *live* by going to www.facilities.unsw.edu.au/campusdevelopment/mechanical-andmanufacturingengineering-precinct-development-project-mmepd

and clicking on the links to the two web cams.

All staff and students have now been decanted from the Mechanical Engineering Building (J17) to Electrical Engineering (G17), Old Nura Gili (F21), Tyree (H6) and the Blockhouse (G6). The main office of the School of Mechanical and Manufacturing Engineering and the Faculty of Engineering Student Centre is located on Level 4 of the Electrical Engineering Building (G17).

Demolition of the link wing under way
(Photo courtesy Tracie Barber)

Roof of Willis Annex South, showing the encapsulation of the existing wind tunnels in the Aerodynamics Lab for protection during works
(Photo courtesy Tracie Barber)

Kensington Colleges Reconstruction

The new Basser, Goldstein and Philip Baxter Colleges (the Kensington Colleges), together with the new Seniors' Hall and Islamic College are completing final fit-out and landscaping, and students will be in residence for Semester 1 in 2014.

It is expected that alumni of the three colleges will be invited to a reunion and tour of the new colleges in the middle of the year.

For further details, and a fly-through of the new colleges, visit the TKC website at www.kensingtoncolleges.unsw.edu.au/mediaEvents/NewTKC.html

Graham Morrison AM

Emeritus Professor Graham Morrison was awarded an AM in the 2014 Australia Day Honours list for significant service to science in the field of applied physics, particularly renewable energy and solar thermal technologies. Many graduates will remember having been taught fluid mechanics or thermodynamics by Em/Prof. Morrison.

Phil Helmore

Australian Maritime College

Training Centre set to Transform Australia's Naval Industry

The Australian Maritime College at the University of Tasmania has secured $3.8 million in funding to establish a new training centre to transform the nation's naval manufacturing industry.

The total sum is made up of nearly $2.4 million in federal funds and more than $1.4 million in industry contributions administered under the Australian Research Council's Industrial Transformation Training Centres scheme.

Project chief investigator, Dr Jonathan Binns, said that the centre would transform the Australian naval manufacturing industry by creating a new cohort of industry-focused high-level and broadly-skilled engineers and researchers.

"Australia's navy building program is set to become the largest commitment this nation has ever made to Defence," Dr Binns said.

"This industrial transformation will bring significant benefits to Australia as it commences an ambitious shipbuilding program comprising the design and manufacture of new fleets of submarines, future frigates and patrol boats.

"The success of these major projects is reliant on training this cohort of highly-qualified engineers to solve the key research questions. The training centre will create a new network of engineering researchers which will enable the Australian naval manufacturing industry to more rapidly innovate."

The project provides an opportunity for 10 higher degree by research students and three postdoctoral fellows to undertake a combination of research and professional training in an industrial environment.

Each student and postdoctoral fellow will work on a specific industry-driven research project in collaboration with researchers from the three universities and two government organisations involved in the partnership.

AMC Principal, Prof. Neil Bose, welcomed the funding announcement, saying that the project would have far-reaching benefits.

"Significant economic benefits from developing advanced techniques to efficiently design, construct and sustain naval platforms will impact the defence, social and economic welfare of Australia. Projects include the future submarines, whose construction will be Australia's largest engineering project," Prof. Bose said.

The project is a collaboration between the University of Tasmania, University of Wollongong, Flinders University, ASC Pty Ltd, Incat Tasmania, Babcock International Group, Defence Materials Technology Centre, Defence Science and Technology Organisation, Thales Australia Ltd and PMB Defence Engineering.

The ARC's Industrial Transformation Training Centres scheme aims to foster close partnerships between university researchers and other research end-users to provide innovative higher-degree and postdoctoral training in industries vital to Australia's future.

Navy Signs On with AMC

A training working group has been formed between the Royal Australian Navy's Training Force Headquarters and the Australian Maritime College.

The terms of reference for the working group were signed by Commodore Training, RADM Michael Noonan, and AMC Principal, Prof. Neil Bose, on 13 December at fleet headquarters.

AMC Principal, Prof. Neil Bose and Commodore Training, RADM Michael Noon AM RAN, sign the Terms of Reference for the establishment of a working group between Training Force Headquarters and the Australian Maritime College at Fleet Headquarters in Sydney
(Photo courtesy AMC)

The creation of the working group has formalised the relationship of more than 30 years between the two parties, allowing for the establishment of formal strategic discussions on mutual maritime-training issues and a better understanding of each other's needs and capabilities.

RADM Noonan said that the terms reaffirm and strengthen the relationship between Navy and the AMC, also representing the Maritime Training Memorandum of Understanding partners at Hunter and Challenger TAFE Colleges.

"Acceptance of the terms of reference highlights Navy's commitment to increasing cooperative arrangements in recruitment, training and training standards," RADM Noonan said.

"Establishing a collaborative approach to sustaining a strong maritime sector across Australia is in Navy's interest, in particular in identifying ways in which Navy could assist the commercial maritime sector achieve its training requirements."

Navy has agreed to increase cooperative arrangements in recruitment, training and training standards as part of the Australian Maritime Workforce Strategy paper developed in May 2013 for the Federal Government.

Navy personnel continue to conduct training at AMC in the areas of navigation and naval architecture.

Prof. Bose said that the agreement underlines AMC's and the MOU partners' commitment to working more closely with Navy in the national interest and to mutual benefit.

"This signing marks the consolidation of the significant formal engagement between Navy and AMC at a strategic and operational level, commencing with Deputy Chief of Navy in February this year which has been strongly supported by RADM Noonan and his staff," Prof. Bose said.

"AMC welcomes this collaborative approach to seeking solutions to both the national maritime training issues and exploring ways of collaborating on our mutual needs in maritime and seafarer training."

NCMEH Advisory Committee Meets in Melbourne

The Industry Advisory Committee for AMC's National Centre for Maritime Engineering and Hydrodynamics (NCMEH) met recently at the offices of the Defence Science and Technology Organisation in Melbourne hosted by the chair of the committee, Adjunct Prof. Stuart Cannon.

Representatives from INTECSEA, Austal Ships, DNV GL, AMOG, the Department of Defence, DSTO and IMarEST joined Prof. Giles Thomas, Dr Jonathan Binns and Dr Shuhong Chai from the National Centre.

The membership of the committee encompasses a range of sectors of the maritime engineering industry including shipbuilding, classification societies, oil and gas industry, renewable energy and the defence industries.

"The committee provides an industry perspective to NCMEH activities and provides us with advice on our strategic direction" Prof. Thomas said.

"It's a vital forum to help ensure the continued industry relevance of our courses and help identify future trends and opportunities."

The NCMEH Advisory Committee during its meeting in Melbourne
Seated (L to R): Prof. Giles Thomas, Mr Wayne Murray, Adjunct Prof. Stuart Cannon, Adjunct Associate Prof. Hayden Marcollo, Dr Hannah Flint.
Standing (L to R): Adjunct Associate Prof. Alex Robbins, Mr Tim Holt, Adjunct Prof. Yuriy Drobyshevski, Dr Shuhong Chai, Dr Jonathan Binns, Mr John Colquhoun, Ms Leslie Lundie
(Photo courtesy DSTO)

Accreditation of Surveyors for the National System

The Australian Maritime Safety Authority circulated a draft of the *Marine Safety (Domestic Commercial Vessel) Amendment (Surveyor Accreditation) Regulation 2014* in mid-January, which is the legislation proposed to cover the accreditation of surveyors for the new National System, i.e. the single national jurisdiction for domestic commercial vessels.

Accreditation is the mechanism by which the Australian Maritime Safety Authority (AMSA) will ensure that persons are competent and fully supported to conduct and provide survey services for domestic commercial vessels under the Marine Safety (Domestic Commercial Vessel) National Law Act 2012 (National Law). It has been developed in close cooperation with Australian and international marine surveyor and naval architect professional associations, classification societies and industry representatives, as well as with the States and Territories.

The scheme has been designed to achieve:

- a cost-neutral approach, allowing existing government and non-government surveyors a simple renewal process to enable them to continue to work;
- a straightforward route for new government surveyors into the accreditation scheme based on existing delegates' recruitment and employment practices;
- a straightforward route for new non-government surveyors to achieve accredited status; and
- robust and transparent governance mechanisms including audit, centrally coordinated to ensure the quality of the work accredited surveyors produce in order to ensure the integrity of the national system.

Following the close of this formal consultation on 16 March 2014 the expert reference group will be re-convened to consider the comments and revise the regulation as necessary.

Adam Brancher

AMSA

The draft document is available at

https://www.amsa.gov.au/search/index.asp?q=Marine+Safety+%28Domestic+Commercial+Vessel%29+Amendment+%28Surveyor+Accreditation%29+Regulation+2014

and click on the top item for a PDF copy.

RINA Australian Division and Sections have been requested to provide comments on the draft legislation by 28 February. However, individual naval architects and consultancies are encouraged to submit their own comments direct to AMSA by 16 March 2014.So get your copy today, and comment away!

Phil Helmore

Adjustment to Ballast Water Management Convention Implementation Schedule

The International Maritime Organization's governing body, the Assembly, recently adopted Resolution A.1088(22) which adjusts the implementation schedule for the Ballast Water Management (BWM) Convention. The major changes are that:

- all ships which are in service or under construction at the time that the Convention enters into force are considered to be existing ships;
- the BWM Convention renewal survey has been harmonised with the MARPOL IOPP (International Oil Pollution Prevention) Certificate renewal survey; and
- references to compliance by the next "intermediate or renewal survey" have been changed to compliance by the next "renewal survey".

The table below shows the adjusted implementation schedule, detailing the dates by which ships will be required to discharge ballast water in compliance with the D-2 discharge standard (i.e. using a ballast water treatment system). **Note:** as the Convention cannot be amended before it enters into force, the Resolution only recommends that administrations apply these changes. However once the Convention enters into force it is likely that these changes will quickly be mandated by an amendment to the Convention.

Once the Convention enters into force, all ships will also be required to have on board an approved ballast water management plan and ballast water record book.

Lloyd's Register's *Class News No. 02/2014*

Ballast capacity (m^3)	**Existing ships Constructed before 2009**	**Existing ships Constructed in or after 2009 but before 2012**	**Existing ships Constructed in or after 2012**
<1500	Entry into force (EIF) before 2016: compliance by 1st IOPP renewal survey after the anniversary date of the delivery of the ship in 2016 EIF after 2016: compliance by 1st IOPP renewal survey		
1500–5000	Compliance by 1st IOPP renewal survey after EIF		
>5000	EIF before 2016: compliance by 1st IOPP renewal survey after the anniversary date of the delivery of the ship in 2016 EIF after 2016: compliance by 1st IOPP renewal survey		Compliance by 1st IOPP renewal survey after EIF

RAN Ships to Change Colour

The RAN fleet is to progressively start wearing a new coat as the hull colour of RAN ships is changed to better meet regional environmental conditions.

The last change was in the early 1950s, when HMAS *Queenborough* became the first ship in the RAN to be painted the present greenish-grey colour which was believed to provide camouflage under overcast conditions but has proved to be less effective in the blue sunlit conditions prevalent in northern Australian waters. In the years after World War II, RAN ships were painted a plain light grey, AP 507C. The new colour selected sixty years ago was BS 381C:1948 colour number 631, Light Grey. It is now commonly known by its Australian Standard equivalent N42, Storm Grey, and it is also widely used in industry.

In recent years, DSTO has carried out research into alternative colour schemes with several trials being conducted on patrol boats. In the late 1990s HMAS *Fremantle*, for example, was painted an interesting shade of blue. DSTO has also been carrying out research into new resin systems which would provide better durability and gloss retention. The gloss level for the new RAN paint is still being studied.

It has been determined that the best colour for Australian waters is the US Navy's 'Haze Gray', which incorporates a little blue in the colour pigment rather than the present green. The new RAN Haze Grey paint will be similar and will also use a new resin known as polysiloxane which has increased durability over the polyurethane coatings used today. Polysiloxane paint also has greater fire resistance due to the non-inflammable silicone component of the resin. Importantly, from a workplace health-and-safety perspective, polysiloxane paint is isocyanate free making it much more user-friendly for dockyard workers and ship's staff. The US Navy has also noted these advantages and is moving to polysiloxane-based paints.

Like the present RAN Storm Grey polyurethane coatings, the new paint will incorporate Near Infrared Reflecting Pigments (NIRR) which have been shown to reduce external shipboard temperatures by up to 20° C. These low solar-absorbing (LSA) paints have a substantial impact on comfort levels inside a ship and on air-conditioning loads. The LSA paints also reduce a ship's infrared signature which has important combat considerations.

Introduction of the new RAN Haze Grey coatings will take place over a period of years as ships undergo major maintenance periods.

Team Australia Sets Records

Team Australia is the Sydney-based ORMA 60 trimaran owned and skippered by renowned yachtsman Sean Langman, and the name given to the racing team behind this extreme multihull. *Team Australia* has a length and beam of 60 ft (18.29 m) and a displacement of 5.7 tons (5.8 t), and can reach speeds of around 40 kn.

Team Australia has already set the following records:

- Sydney to Hobart: 630 n miles in an elapsed time of 29 h 52 min 23 s at an average speed of 21.1 kn on 25 February 2013.
- Sydney to Auckland: 1260 n miles across the Tasman Sea in an elapsed time of 2 days 19 h 2 min 45 s at an average speed of 18.8 kn on 20 October 2013.
- Pittwater to Coffs Harbour: 225 n miles in an elapsed time of 17 h 3 min 5 s at an average speed of 13.2 kn on 3 January 2014.

Further details can be found on the *Team Australia* website, http://teamaus.net.au/. Sean Langman will be giving a presentation, *The Quest for Speed under Sail*, to a joint meeting of RINA and IMarEST in Sydney on 5 March (see *Coming Events* on page 9).

Phil Helmore

Team Australia on Sydney Harbour on Australia Day 2014
(Photo Steve Oom)

City of Adelaide arrives at Port Adelaide

The final voyage of the 1864-built sailing passenger ship *City of Adelaide* has, at last, been completed with the ship arriving in Port Adelaide at 8:50 am on 3 February 2014. *City of Adelaide* left Rotterdam on 26 November on board the heavy-lift ship MV *Palanpur*. The voyage took her to Norfolk, Virginia, and Cape Town before a stop at Port Hedland to unload six locomotives which had been loaded in Norfolk.

Over a quarter of a century *City of Adelaide* carried English, Scottish, Cornish, German, Danish, Irish and other migrants to South Australia. It is intended that she will now be displayed at a Seaport Village in Port Adelaide — for more information visit www.cityofadelaide.org.

City of Adelaide being lifted for offloading from MV *Palanpur* in Port Adelaide
(Photo Peter Roberts)

City of Adelaide being placed on a substantial barge after her arrival at Port Adelaide
(Photo Peter Roberts)

HydroComp Resolves Static Thrust Problems on Wind-farm Service Vessels

HydroComp's NavCad® is software for resistance and propulsion which can be found in the toolbox of hundreds of naval architects and marine professionals from around the world. The latest challenge for NavCad is to help resolve a unique problem for propeller-driven wind-farm service vessels (WFSVs). Much like the problems of dynamic positioning in offshore and platform support vessels, WFSVs are finding issues of insufficient thrust during static (i.e. bollard) operations. This is a solvable problem but one which must be evaluated on a case-by-case basis.

The Nature of the Problem

The problem exhibited in WFSVs is one of mutually-exclusive operational objectives for the propeller — efficient high-speed operation versus maximum static thrust for the crew-transfer maneuvre. Of course, a propeller optimised for one case (high speed) will be less effective at the other (bollard pull).

Potential solutions

A controllable-pitch propeller (CPP) would be the ideal solution but, since this is not generally a feasible option, we will set it aside to focus on fixed-pitch propeller (FPP) systems. For FPP propellers, maximum static thrust is determined by an equilibrium relationship between the engine's ability to generate power and a propeller's power requirement at a given RPM. There is one point on the engine's power curve where the propeller cannot be spun any faster as it would require more power than the engine is capable of producing. The thrust is generated by the propeller at this RPM and, in general, more thrust means more RPM.

The solution, therefore, is to

- increase low-end power for the engine so that it can spin the propeller faster;
- reduce the propeller's power requirement (in a way that does not affect high-speed operation); or
- some combination of both.

A solution could come from different engine models with different power curves, or from different propeller characteristics which change the shape of the torque curve.

Propulsion Analysis with HydroComp NavCad

Both of these options can be evaluated by NavCad, which includes a "towing" propulsion analysis that is built upon this equilibrium-power relationship described above. In this analysis, NavCad can find the maximum equilibrium thrust given the engine, transmission and propeller characteristics. It allows the entry (and archiving) of specific engine-model power curves, so that the effect of different power curves can be evaluated. It also allows for consideration of different propeller types and parameters, including their effect on cavitation breakdown. This offers the ability to look for "WFSV-friendly" propeller geometries. As mentioned above, such an analysis needs to be run on a case-by-case basis, since geometric properties like shaft angle and stern-run angle need to be considered in the analysis.

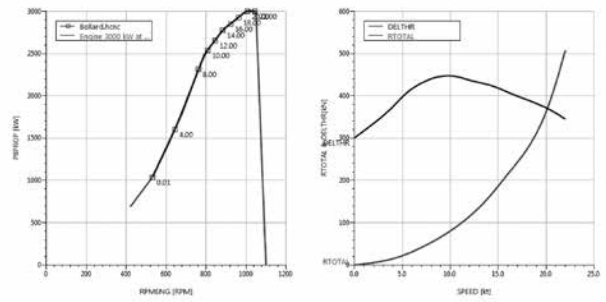
Example

The following plots illustrate how NavCad can evaluate the effect on static thrust due to differences in engine-power curves and propeller characteristics. The static "bollard" condition is represented by a 0.01 kn speed, and the propeller design operating speed is 20 kn.

The plots to the left show engine loading for the given power curves of engines rated at 3000 kW at 1000 RPM. The plots to the right are delivered thrust overlaid onto the resistance curve. The top speed is where the two lines intersect, and the static delivered thrust is found at the nominal zero-speed position.

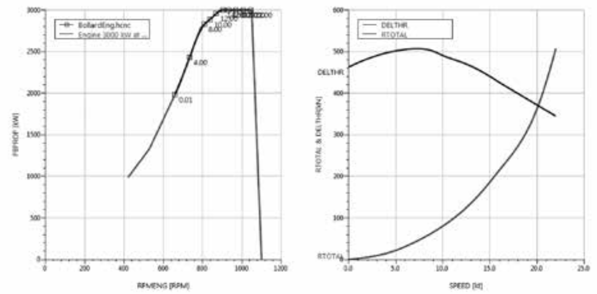
Basis — 300 kN Thrust

This is the original engine and propeller. Bollard equilibrium occurs at 520 RPM.



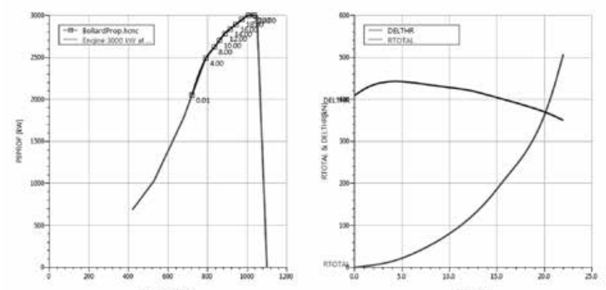
New engine model — 460 kN Thrust

This is for a new engine model of the same rating but with modestly different engine power curve, using the original propeller. While the engine is not substantially different from the original, the modest increase in low RPM power results in approximately a 50% increase in static thrust with increase in RPM to 660. The top speed is shown to be maintained (intersection at 20 kn).



New propeller — 410 kN Thrust

This is for the original engine with a new propeller which is designed with characteristics to reduce the torque at bollard conditions. The engine is not changed, but the new propeller delivers some 35% more static thrust at 720 engine RPM. Top speed is maintained (intersection at 20 kn).



These plots illustrate how NavCad can be used to investigate the differences in engine power curves on static thrust — where an increase in the power delivery curve at low RPM will allow the propeller to spin up to a higher RPM and generate more thrust. It also shows how NavCad can assess the effect of propeller characteristics on static thrust where, for the same power requirement, a different propeller might deliver more thrust. Since maintaining top speed is an important mission constraint, NavCad's robust resistance-prediction capabilities are also critical to success.

As has been described, finding an acceptable overall solution to the problem of insufficient static thrust requires a tool that has the ability to

- correctly model the influence of engine curve shape and propeller performance on the equilibrium power "towing" condition at the bollard; and
- properly predict vessel resistance to ensure that top speed is not compromised by any changes which might be proposed.

HydroComp Celebrates 30 Years

HydroComp, Inc. of Durham, NH, USA began as a business venture in 1984 to meet the specific needs of naval architects and shipbuilders in the area of resistance and power predictions. Thirty years later, HydroComp has grown into a multi-faceted corporation with clients from design to construction to academia in over sixty countries.

Founded in 1984 in New Hampshire, USA by Jill Aaron (Managing Director) and Donald MacPherson (Technical Director), HydroComp was a pioneer in the very specific area of applied hydrodynamics. This focus shaped a line of unique naval architectural software packages beginning with their flagship product NavCad®, and which now include SwiftCraft®, PropExpert®, PropCad®, SwiftTrial® and, most recently, PropElements®.

In addition to providing the foremost in speed and power prediction, propeller sizing and propeller-design tools, HydroComp maintains a culture of active in-house research and development to help ensure that the company continually evolves with the changing needs of the maritime community. This dedication to academic and in-the-field research is what sustains their cutting-edge knowledge and expertise.

In its thirty years, HydroComp has been frequently recognised for a comprehensive array of consulting projects, as well as custom software programs. These projects range from AUV/ROV (submersibles), fuel-efficiency projections, waterjet analysis, high-speed combatant craft, model tests, deep-sea propulsors and even pool toys.

"We are humbled to have to reached this significant milestone" according to Jill Aaron. "Without the support and loyalty of our customers, dealers and representatives, and especially our employees, this significant landmark would not have been achieved. It has been a great privilege to create quality products and provide valued services."

New Steel Processing Equipment Helps Build AWDs

Inventive steel processing companies provide the backbone for infrastructure, transport, shipping and consumer goods sectors. One such company, Ferrocut Australia, was called on by ASC in Adelaide to provide steel plate-cutting services and support for the construction of the RAN's air-warfare destroyers.

Ferrocut, a South Australian plate-profiling business, specialises in offering oxy, plasma and laser cutting, and bending services, for a variety of industrial sectors including defence, mining construction and specialist fabrication.

Employing over 50 people, the business operates out of a purpose-built, 11 250 m^2 warehouse and office complex on a 2.24 ha site within the Techport Australia supplier precinct which was developed by the Government of South Australia.

To deliver the cut steel plate for the AWD contract, Ferrocut turned to Australian computer numerically controlled (CNC) gas and plasma cutter manufacturer, Profile Cutting Systems (PCS), based in Victoria, to deliver a 400 A Plasma Bevel Head

"It played an integral part in cutting plate for the AWD, with its ability to bevel cut and etch plates in the one process. The large bed allows for multiple plates to be loaded at one time, increasing machine efficiency," said Ferrocut Australia General Manager, Shawn Rowle.

The patent-protected Plasma Bevel Head — PCS's first zero-offset plasma machine — is fully-programmable to cut parts with bevel and straight cuts, cutting steel and performing the weld preparation at the same time, in order to eliminate double-handling of material and parts.

The system is able to be retrofitted to existing cutting machines, and performs 95° side-to-side and forward-back motions, and 360° full rotations, without twisting any cables or hoses.

Arc voltage automatic height control provides accurate bevel tolerance, while the lightweight but robust design and stainless-steel construction make it suitable for heavy industrial environments, with consistent and reliable bevel quality for holes and edges.

The system incorporates a fixed tool centre point to eliminate kinematic adjustments, and the plasma torch movement is provided by SERCOS digital drive amplifiers and servo motors for all axes (tilt, rotation and vertical height).

According to Rowle, it is important for Ferrocut to remain at the cutting-edge of technology adoption. "We consider ourselves the market leader in plate profiling and it is important to maintain that position," he said.

"Ferrocut has a long-standing relationship with PSC which goes back approximately 16 years. Our relationship goes above and beyond the normal supplier/customer relationship

The company now operates a number of PCS machines alongside the 400 A Bevel Head Plasma, including three oxy-cutting machines, one bevel-head oxy machine with machine beds ranging from 13–25 m long, two conventional plasma cutting machines, and the team's latest purchase: a BHB Series integrated plate-processing system, the PCS6000HPB.

This latest unit allows combination profile cutting and drilling, tapping and general steel processing of plate product. It incorporates a drill machine with bevel-head plasma, allowing drilling and bevelling in the one operation, and two oxy torches, allowing a full range of plate thicknesses to be processed without the need for separate machinery.

Mr Rowle said that Ferrocut purchased the machine in October/November 2012 due to its ability to drill precision and counter-sunk holes, which would consequently allow the company to access new markets

"Drilled holes are becoming an important part of the profiling-cutting requirements due to accuracy," Mr. Rowle explained

"Drilled holes reduce the requirement for parts to be cleaned after cutting, reducing processing time. They also give us access to structural markets demanding precision holes in plate

"The machine has enabled us to produce a new product for the mining market. Also, we have engineers now specifying drilled holes for structural applications. Drilling small holes into thick plate is also a niche market of which very few are capable."

PCS is an Australian manufacturer of combined drilling and profile-cutting machines, and offers sales and support across Australia, Europe, Asia, South East Asia and America, from its base in Campbellfield, Vic. Since its inception in 1989, the company has installed over 500 systems across the globe

The BHB Series is PCS's largest and most powerful unit to date, designed for large steel-processing companies and service centres. The team at PCS spent 18 months planning and developing the new series of machines before Ferrocut placed its order, such is the calibre of the technology built into the unit. The supplier can now custom-build BHB Series models to suit varying customer specifications.

"The machine has a massive 44.7 kW spindle motor capable of drilling 50 mm diameter holes through 100 mm plate in 30 seconds, allowing you to drill perfectly-round parallel holes faster than you could cut them," said PCS director and founder, Leon Cottee.

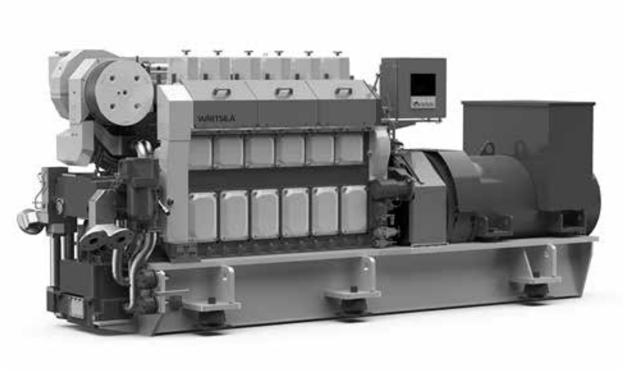
Wärtsilä Expands its Portfolio with Two New Auxiliary Engines

Wärtsilä is expanding its engine portfolio with the introduction of two additional auxiliary engines, the Wärtsilä Auxpac 16 and the Wärtsilä Auxpac 32.

Both the Auxpac 16 and the Auxpac 32 are pre-engineered gensets with a turbocharged four-stroke engine having direct fuel injection and charge-air cooling to provide the electrical power onboard all types and sizes of ships.

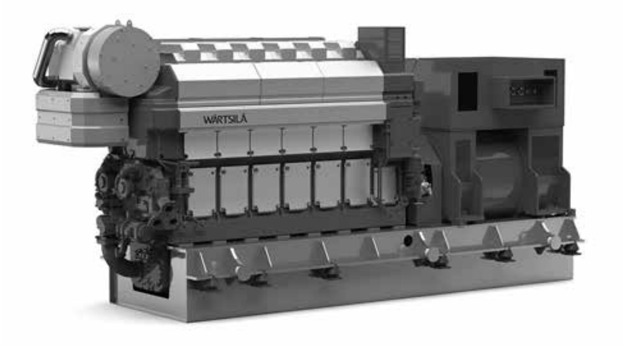
They are based upon Wärtsilä's four-stroke engine technology, which has been proven with more than 1000 Auxpac 20 and 26 engines in operation and having in excess of 6 million accumulated running hours experience. As a result, these new additions to the portfolio offer a high level of reliability and compliance with the IMO's Tier II environmental regulations. Tier III compliance can be achieved with the addition of an exhaust treatment system.

The Wärtsilä Auxpac 16 is a brand-new product. It is designed for merchant vessels, such as bulk carriers, tankers and smaller container vessels, with installed auxiliary power in the 500 kWe to 750 kWe per generating set range. The Wärtsilä Auxpac 16 is the smallest Auxpac generating set in the portfolio. It has been developed in co-operation with the Shanghai Marine Diesel Engine Research Institute (SMDERI) in China. The Auxpac 16 development project began in spring 2011 and has utilised the engineering experience and design of the successful Wärtsilä Auxpac 20. The engine will be produced at the Wärtsilä Qiyao Diesel Company (WQDC) joint-venture company in China.



The Wärtsilä Auxpac 16
(Image courtesy Wärtsilä)

The Wärtsilä Auxpac 32 is the auxiliary engine version of the Wärtsilä 32 family. It is aimed at the upper end of the merchant market, notably large container vessels with an auxiliary power need from approximately 2500 kWe to 4500 kWe per generating set. It will be produced in China at the Wärtsilä Yuchai Engine Company (WYEC) joint-venture facilities.



The Wärtsilä Auxpac 32
(Image courtesy Wärtsilä)

The introduction of these new engines is an important step in Wärtsilä's strategy for increasing its share of the auxiliary engine market. The involvement of the Asian joint-venture companies has played an important role in making these developments possible.

"These latest additions to our engine portfolio will help us to serve an even broader market, and it is important that they are being manufactured in China — close to our Asian customer base. The new engines are competitive and have outstanding performance for the markets they serve. Furthermore, our customers have the unique Wärtsilä worldwide service network to rely on. We expect our auxiliary engine sales to develop quickly," said Lars Anderson, Vice President Four-stroke, Wärtsilä Ship Power.

Wärtsilä Qiyao Diesel Company (WQDC)

Wärtsilä and SMDERI signed the 50/50 joint-venture agreement in 2005 to establish WQDC in Lingang, China. The factory produces Wärtsilä Auxpac diesel generating sets for the buoyant Chinese shipbuilding market, and for export through Wärtsilä's global sales network.

Wärtsilä Yuchai Engine Company (WYEC)

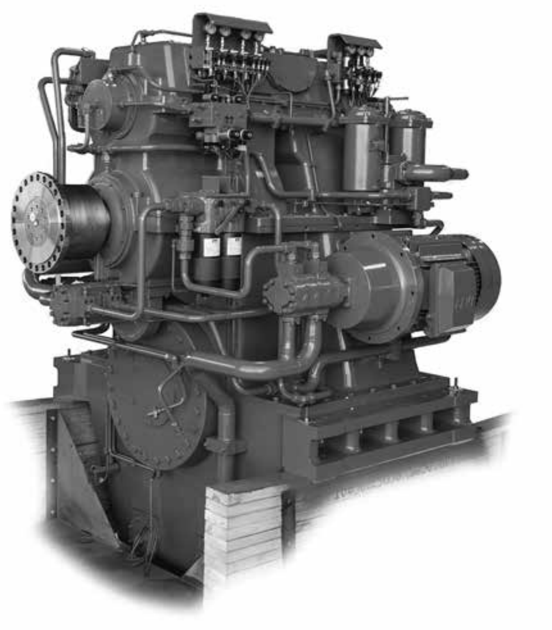
Wärtsilä and Yuchai Marine Power Co. Ltd (YCMP), a subsidiary of Guangxi Yuchai Group, signed an agreement in 2012 to establish a 50/50 joint venture for manufacturing medium-speed marine engines in Zhuhai City, Guangdong Province. The joint venture will serve the increasingly-dominant Chinese shipbuilding industry, with the focus being on the assembly and testing of Wärtsilä 20, Wärtsilä 26 and Wärtsilä 32 engines. Operations are planned to start in 2014.

Wärtsilä Launches New Two-speed Marine Gearbox

Wärtsilä has launched a new two-speed marine gearbox offering notable economic and environmental benefits. The product will serve vessels having multiple operational modes or reduced transit speed including, among others, ro-pax ferries, offshore support vessels, tugs, and fishing vessels.

Compared to a single mechanical propulsion system, a fuel consumption reduction of eight percent was verified with Wärtsilä's two-speed gearbox during sea trials. It is anticipated that further reductions of up to 15 percent can be achieved, with a similar lowering of nitrogen oxide (NOx) and sulphur oxide (SOx) exhaust emissions.

These cost savings and environmental benefits are achieved by operating the ship's propeller at low speed when maximum vessel speed or propeller thrust is not required. At the same time, the engine speed is kept constant, thereby allowing the electric power generation from the power take-off on the gearbox to remain uninterrupted. Furthermore, the Wärtsilä two-speed gearbox will reduce noise emissions by as much as 20 dB, both inside the ship and externally. This allows greater comfort for passengers and crew, while the reduced underwater radiated noise is important for fishing and seismic vessels, and is beneficial to marine life in general.



Wärtsilä's new two-speed marine gearbox
(Image courtesy Wärtsilä)

The first ship to utilise the new Wärtsilä two-speed marine gearbox is a rescue vessel owned by the Rescue and Salvage Bureau of the People's Republic of China's Ministry of Transport. The sea trials have been successfully carried out at the Huangpu shipyard in China. The contract was signed in December 2011. The vessel operates mostly in low-speed mode and reaches full speed only for limited periods of time. The Wärtsilä two-speed gearbox allows the operator to make the necessary adjustments as needed, thereby saving costs even when operating at low speed.

"The Wärtsilä two-speed gearbox is the best solution for our rescue vessel in terms of both economy and overall efficiency. This gearbox enables a proper balance between full-speed operation and the ship's daily operating mode, which is important because its operating profile varies," said Sun Lu Ming, Deputy Chief Engineer of MOT Rescue and Salvage Bureau.

"This new propulsion solution is based on Wärtsilä's proven gearbox technology and systems engineering. It offers considerable fuel-cost savings, increased environmental sustainability, efficient utilisation of the main engine, a high degree of redundancy, retention of 100 percent engine power at reduced propeller speeds, advanced functionality with low technical complexity, and much more. It also strengthens Wärtsilä's leading position as a provider of complete solutions and integrated systems to the maritime sector," said Arto Lehtinen, Vice President Propulsion, Wärtsilä Ship Power.

The Wärtsilä two-speed gearbox will be available with a high degree of modularisation in the power range from 2 MW to 10 MW. This gearbox family has been designed in response to the increasing need for ship owners and operators to lower operating cost and to increase environmental performance. These requirements are likely to become even more crucial in the future. Wärtsilä will continue to introduce its range of two-speed marine gearboxes throughout 2014 and 2015.

Wärtsilä to Design Environmentally-advanced Container Ship for US Owner

Wärtsilä has been awarded the contract to supply the extended engineering scope for the initial, basic, and production designs for a series of two container ro-ro vessels to be built for US-based owner, Crowley Maritime Corporation. The vessels will be powered by liquefied natural gas (LNG), and are to be built at VT Halter Marine's shipyard in Pascagoula, Mississippi. The contract was signed in the third quarter of 2013.

Wärtsilä Ship Design's WSD CRV 2400 WB provides the capability to carry conventional 20 ft, and 40 ft containers, as well as the special 45 ft and 53 ft wide-body high-cube containers developed for the American market. The ro-ro capacity is in excess of 350 private cars. When built, these will be among the very first LNG-powered, American-flagged, container ro-ro ships. They will operate between Jacksonville, Florida, and San Juan, Puerto Rico, on a weekly rotational basis. The ships will be 219.5 m long overall with a beam of 18 m and a service speed of 21 kn.

Because of the recently-established Emission Control Area (ECA) along the eastern seaboard of the United States, the vessel design had to meet stringent environmental

An impression of the Crowley Maritime Corporation ships
(Image courtesy Wärtsilä)

guidelines while serving the high-performance operational requirements of the owners. Low emissions, reliability, and appropriate transit speed were, therefore, primary considerations.

"This vessel design raises the bar for merchant shipping, not only for US-flagged ships, but globally. We are proud to be taking this bold step in bringing environmentally-viable designs to the market, with Wärtsilä as a key partner," said Rick Zubic, Vice President Business Development, VT Halter Marine.

"Wärtsilä Ship Design has extensive experience in designing innovative and efficient vessels. This experience, combined with Wärtsilä's vast know-how and leading global position in LNG propulsion solutions for the marine industry, has given us a strong competitive edge. This is reflected by this latest order. We have enjoyed a long co-operation with both Crowley Maritime Corporation and VT Halter Marine," said Riku-Pekka Hägg, Vice President, Wärtsilä Ship Design.

LHD02, the future HMAS *Adelaide*, leaving Ferrol in Spain for Vigo and loading on *Blue Marlin* for transport to Australia
(RAN photograph)

SUMMER SAILING IN SYDNEY

Derry-Londonderry-Doire, winner of the Clipper 70 Division, manoeuvring before the start of the 2013 Rolex Sydney to Hobart yacht race
(Photo John Jeremy)

A committee boat perspective less than two minutes befoe the start of the 2013 Rolex Sydney to Hobart yacht race
(Photo John Jeremy)

The beautifully restored 12 m America's Cup challenger *Gretel II* starting with the Classic Division 1 during the 178th Australia Day Regatta on Sydney Harbour
(Photo John Jeremy)

The Mistake, winner of the Historic 18-foot Skiff Division in the 178th Australia Day Regatta
(Photo John Jeremy)

VALE KEITH ADAMS

Keith Martin Adams AM passed away after a long battle with cancer on 15 November 2013.

Born in Mosman on 16 December 1927, Keith began a career in science in the research laboratories of the Royal North Shore Hospital. He began work with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in 1952, studying antibody responses to various injected antigens.

In 1960 Keith took up a research post for two years with the Veteran's Administration Hospital and University of Miami Medical School in the United States where he established two tissue-culture laboratories and introduced research studies into the cultivation and study of leukemic blood cells. He also won a place in the Harvard Medical School in Boston to attend the accelerated course in pathology.

Keith returned to the CSIRO in 1963 and worked with the myxoma virus which was eventually released to the wild rabbit populations which plagued many parts of Australia with devastating results. Between 1970 and 1972, along with an officer from the Tasmanian Parks and Wildlife service, Keith was responsible for the release of the myxoma virus to control rabbits on Macquarie Island.

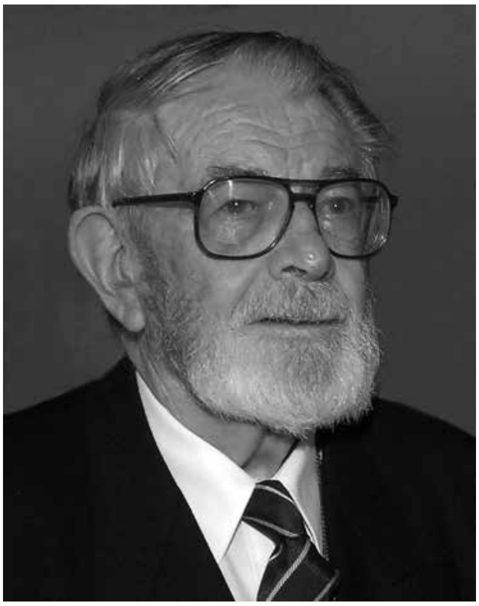
In 1976 Keith was seconded to the Department of Prime Minister and Cabinet in Canberra where he became the Executive Secretary of the Marine Sciences and Technologies Committee which was part of the Australian Science Technology Council. His duties included the preparation of reports and studies and advice to the Government on future directions of marine activities. As Science Advisor he was involved in the preparation and presentation of a submission in support of the provision of a national oceanographic research vessel and was a member and secretary of the steering committee for the construction of the research vessel. RV *Franklin* was built by NQEA in Cairns in 1985 and was based at the Marine Science Laboratories in Hobart.

On returning to the CSIRO, Keith was appointed to oversee the construction of the new Marine Science Laboratories in Hobart. He was also tasked with moving the CSIRO Marine Laboratories from Cronulla in NSW to Hobart.

Keith retired from the CSIRO and government service in 1987. During his scientific career he published as author or co-author some 30 papers and reports and a number of reviews of scientific programs.

After 1989 Keith undertook a range of tasks, such as consultant to the Director of Marketing of the Australian Broadcasting Corporation, Executive Manager reporting to the Managing Director of ABC Datacast and company secretary of the Australian subsidiary of an American IT company.

Throughout his life Keith Adams loved the sea, a passion which crept into his working life before and after retirement. For over 40 years Keith was an active member of the Royal Australian Naval Reserve, commencing as a Naval Cadet in his youth and in due course becoming an officer in the Naval Reserve. His duties in the RANR included reporting on training activities at the RAN's Gunnery School at HMAS *Cerberus*, Commanding Officer of the Naval Reserve Cadets and the implementation of new training methods at HMAS *Nirimba*. He also reviewed the RAN Hydrographic Services offices and facilities and subsequently made recommendations for the relocation and upgrading of those facilities.



Keith Adams AM

On 26 January 1980 Commander Keith Adams RFD RANR was appointed a Member of the Order of Australia (AM) for service to the Naval Reserve Cadets.

In retirement Keith continued his interest in the Naval Reserve Cadets, and the Navy more generally, through his involvement with the Navy League of Australia. For many years he served as Vice President of the NSW Division of the Navy League.

In 1995 Keith Adams joined the Australian Division of the Royal Institution of Naval Architects as Executive Officer for the Australian Division Council. It was a time of reorganisation of the Council and the Australian Division to make it more relevant to the changing times and the widespread membership throughout Australia. Keith gave fearless and determined support and encouragement to the President of the Australian Division and the Council members during his 14 years in the position. The Australian Division owes a great deal to Keith who was very much a driving force within the Institution as it reshaped itself in Australia for the 21st century.

Keith was also a member of the organising committee for the Pacific series of International Maritime Conferences, an involvement which he continued after he retired from his position in 2009, until advancing ill health finally forced him to take a lower profile.

A Companion of the Institution, Keith Adams will be much missed by all RINA members who knew him and worked with him. He was a great friend and colleague.

Keith is survived by Shirley, his wife for more than 60 years, his daughters Elizabeth and Jane and son Stephen, and seven grandchildren. To them we extend the sympathy of all Australian Division members.

John Jeremy, with help from Keith's family

MEMBERSHIP

Australian Division Council

The Council of the Australian Division of RINA met on Thursday 5 December 2013 by teleconference based in Sydney. Our President, Jim Black, made the trip from WA to take the chair. Some of the matters raised or discussed during the meeting, which had an exceptionally long agenda, are outlined as follows:

BPEQ Definition of Engineering Work

A paper by the Vice President, outlining the issues from RINA's perspective regarding the present exclusion of "Code" implementation, was considered. Council agreed to a process for further development of the paper prior to its submission for consideration by the Joint Board on naval architecture towards the end of January.

Future Demand for Naval Architects of all types in the Naval Sector

Council agreed to send a letter on this subject to the Minister of Defence following the Christmas period.

Council also received the written report on work by Manufacturing Skills Australia regarding future vocational naval architecture courses. Further information on some current developments is required before responding formally to MSA.

The Walter Atkinson Award

Council noted that the Award for 2013 would be presented at the SMIX Bash following the meeting.

It was agreed that there would be no change to the arrangements for the 2014 Award, covering written papers presented to Division meetings and conferences, such as Pacific 2013 IMC and Section meetings, in the year ending 30 June 2014. Details of the Award are on the Division's page of the RINA website and nominations will close in July 2014.

Implementation of the National System for Maritime Safety

Council noted that some members had observed problems with implementation of the system. Members are requested to bring any problems to the Secretary's attention for possible consolidation into a future letter to AMSA on the subject.

Keith Adams AM

Council noted with regret Keith's passing as notified in the November issue of *The Australian Naval Architect*.

PACIFIC 2013 International Maritime Conference

Council noted the success of the Conference on 7-9 October in Sydney and that planning would soon be commenced for the next Conference in 2016.

London Council Issues

The Division Council was briefed on the main issues covered by the Institution's October Council meeting, one of which was that I have been appointed to the Institution's Board of Trustees.

Next Meeting

The next meeting of the Australian Division Council will be held on Wednesday 19 March 2014 based in Perth/Fremantle on the day of the Division's AGM (see notice in this issue).

Rob Gehling
Secretary

Free Papers for Members

Members should be aware that they are entitled to four free copies of RINA papers each year. This includes papers from previous transactions, conferences, etc., and is especially useful if you are interested in just one or two papers from a particular conference as you don't then need to buy a copy of the entire proceedings.

Papers published by RINA are searchable on the RINA website www.rina.org.uk; click on

Publications>Search Publications and Order.

The procedure for obtaining a free copy is to email your request to publications@rina.org.uk, with the subject line "Member's Free Paper", and specify the author(s) and year, the title of the paper, where the paper appeared (transaction year/volume, conference name and year, etc.) and, finally, your name and RINA membership number.

Free Places for Student Members at RINA Conferences

RINA also makes available two free places for Student Members of RINA at conferences organised by the Institution, including the Pacific International Maritime Conferences in Sydney.

The procedure for obtaining a free student place is to email your request to the Chief Executive, Trevor Blakeley, at tblakeley@rina.org.uk, and specify the conference, your name and membership number.

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 Division		rina.austdiv@opwtusnet.com.au
Section	ACT	rinaact@gmail.com
	NSW	rinansw@gmail.com
	Qld	peter@directmarinesolutions.com.au
	SA/NT	danielle.hodge@defence.gov.au
	Tas	mfsymes@amc.edu.au
	Vic	srkelly@globalskm.com
	WA	rina.westaus@gmail.com

Phil Helmore

THE ROYAL INSTITUTION OF NAVAL ARCHITECTS

AUSTRALIAN DIVISION

NOTICE OF ANNUAL GENERAL MEETING

WEDNESDAY 19 MARCH 2014

Notice is hereby given that the Annual General Meeting of the Australian Division of the Royal Institution of Naval Architects will be held at the Vic Hotel, 226 Hay Street, Subiaco, WA, on Wednesday 19 March 2014 at approximately 7.00 pm Western Standard Time. The meeting will be preceded by a Technical Meeting and the Annual General Meeting of the Western Australian Section, at 5.30 pm for 6.00 pm.

AGENDA

1. Opening
2. Apologies
3. Confirmation of the Minutes of the AGM held in Fremantle on Wednesday, 19 March 2013
4. President's Report
5. Receive, consider, and adopt the Financial Statements for the year ending 31 December 2013
6. Appointments to Council of the Australian Division
7. Other Business

R C Gehling
Secretary
10 February 2014

NAVAL ARCHITECTS ON THE MOVE

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

Hibibul Ahmed moved on from the Department of Defence many moons ago and, after some time at BAE Systems and Samson Express Offshore, has now taken up the position of Chief Engineer with Offshore Marine Services in Perth.

Trevor Allan has moved on and is now based in Sao Paulo, Brazil, with his wife and is dividing his time between doing a master's degree in naval architecture at the University of Sao Paulo (researching optimisation techniques in submarine concept design), and working in the family eel-fishing business in Vitória during the peak season. They use 5 m aluminium tri-hull vessels, built by Alufarm Marine in Goolwa, South Australia, and fyke nets to catch the eels.

Tony Armstrong (the younger) moved on from Eurobodalla Shire Council two years ago and, after some time consulting as Mangerton Consulting, has now taken up the position of Director Newbuilding and Projects with Teekay Corporation in Vancouver, Canada.

Grant Brunsdon moved on from Clough three years ago and, after some time at Woodside Energy, has taken up the position of Offshore Workpack Manager with Chevron in Perth.

Tobias Clarke moved on from Austal Ships many moons ago and, after some time with Polyline Industries and then African Evangelical Enterprises in Rwanda, returned to Australia and set up his own consultancy, TC Design in Fremantle. In addition to custom marine designs in anything from aluminium to HDPE, he also contracts to the Department of Transport WA as a surveyor on new-construction projects.

Derek Gill has completed his MBA degree at the University of Western Australia and has taken up the position of General Manager AWD Operations at ASC in Adelaide

Jon Gould moved on from Crondall Energy three years ago and has taken up the position of Senior Deepwater Engineer with Woodside Energy in Perth.

Mark Hughes has moved on from consulting and, two years ago, took up the position of Senior Marine Consultant with Saudi Aramco in Ras Tanura, Saudi Arabia.

Martin Jaggs has moved on from the Victorian Department of Transport and has taken up the position of Manager Maritime Incident Management with Transport Safety Victoria in Melbourne.

Jude Kennedy has moved on from the AWD Alliance and has taken up the position of Engineering Project Manager with the Defence Materiel Organisation in Adelaide.

Regina Lee has moved on from Nura Gili at the University of New South Wales and has commenced a combined Bachelor of Medicine/Bachelor of Surgery (MBBS) degree, a four-year graduate-entry program, at the University of Notre Dame in Sydney.

Richard Liley has moved on within Austal Ships and has taken up the position of Production Manager in Fremantle.

Vesna Moretti moved on from Austal Ships many moons ago and, after a year consulting, has taken up the position of Senior Engineer at Woodgroup in Perth.

Graeme Mugavin has moved on within the NSW Maritime Authority and has taken up the position of Team Leader Initial Survey in Sydney.

Jon Pattie has moved on with SeaLife Designs which he renamed Naval Architects Australia and has taken up the position of Principal Naval Architect/Director in Brisbane. The company grew significantly now provides a full spectrum of naval architecture services.

Adrian Phua has moved on from the Scana Industries shipyard on Berhala Island, Sabah, Malaysia, and has taken up a position as a visiting researcher in the School of Mechanical and Manufacturing Engineering at the University of New South Wales.

Simon Robards has moved on within the NSW Maritime Authority and has taken up the position of Acting Principal Manager of the Commercial Vessels Branch in Sydney.

Jaime Sotelo has moved on from Global Marine and Engineering and has taken up a position as a naval architect with Qinetiq Australia, contracting to the Department of Defence's Amphibious and Afloat Support Group at Garden Island in Sydney.

Jason Steward has moved on from Austal Ships and has taken up the position of Business Development Manager with BMT Design and Technology in Melbourne.

Mike Tiller moved to Thailand as Managing Director of DIAB Thailand, but then moved on to consulting as Tiller Marine, and has now taken up the position of Director Sales and R&D for Technical Panels Co. in Bangkok, Thailand.

Lachlan Torrance has moved on from ASO Marine Consultants and has taken up the position of Safety Adviser with QGC (previously Queensland Gas Company) in Brisbane. QGC is part of the international BG Group, and is one of the largest of several Australian coalbed methane companies developing methane reserves within the Bowen and Surat Basins of Queensland.

Alistair Verth has moved on from Chandler McLeod and, after some time contracting to Aluminium Boats Australia and Forgacs Engineering, has taken up a position as an engineer with Anode Engineering in Brisbane.

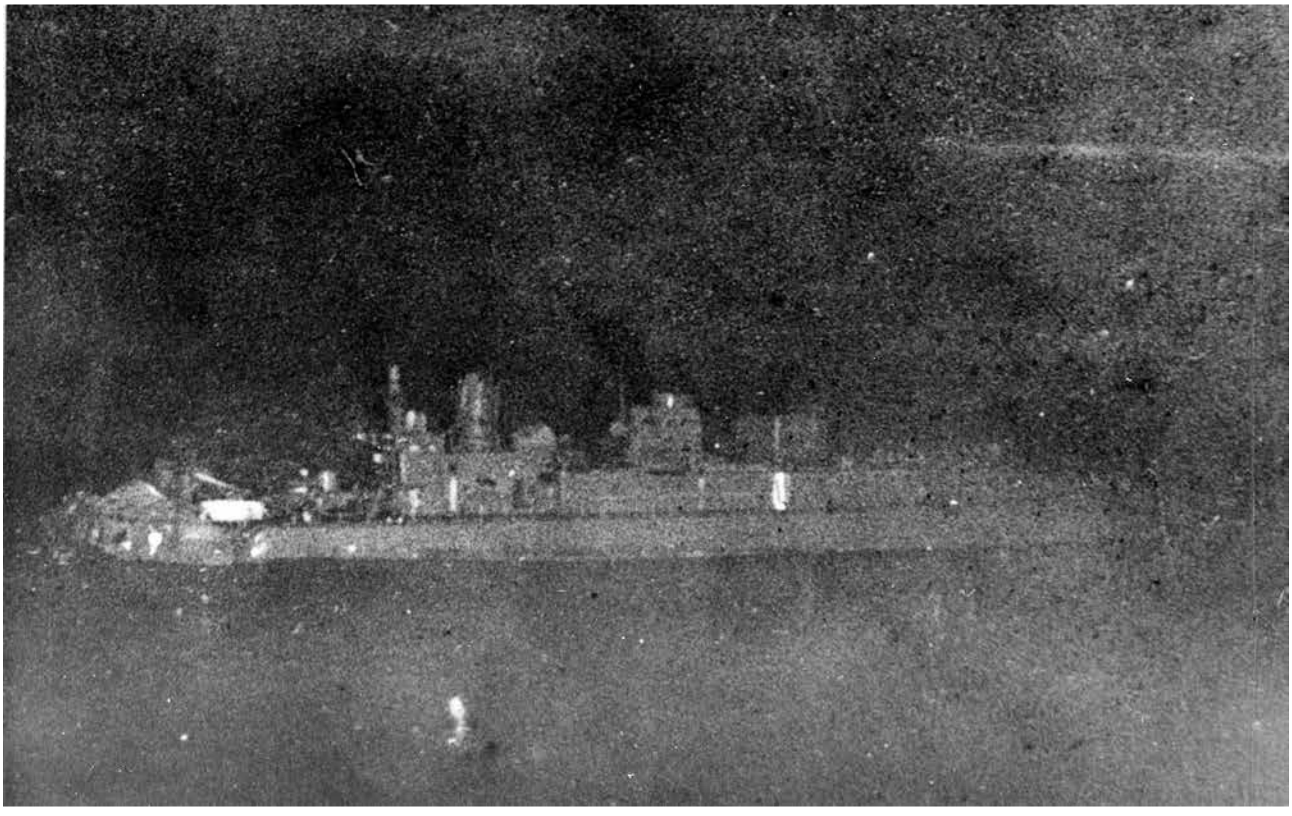
Horden Wiltshire spent time as the Commanding Officer of the Collins-class submarine HMAS *Sheehan*, then Mnet Group and, a year ago, took up the position of CEO at Soprano Design in Sydney.

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 to reduce the number of copies of *The Australian Naval Architect* emulating boomerangs.

Phil Helmore

FROM THE ARCHIVES

Fifty years ago, on 10 February 1964, the Australian destroyer HMAS *Voyager* was sunk in collision with the aircraft carrier HMAS *Melbourne* during night flying exercises off Jervis Bay on the NSW coast with the loss of 82 lives. *Voyager*, a Daring-class destroyer was the first all-welded warship constructed in Australia and was completed at Cockatoo Island in Sydney in 1957
(Photo RAN Historical Collection)



HMAS *Voyager* was cut in two by HMAS *Melbourne*. The bow section sank immediately but the stern section, seen here, remained afloat for several hours
(Photo RAN Historical Collection)