THE NAVAL ARCHITECT

40th Anniversary Issue

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Editor Nick Savvides
Assistant Editor Samantha Fisk
Design/Production Manager Sandy Defraine
Group Sales Director John Payten
Assistant Advertisement Manager Daniel Payne
Advertisement Production Manager Stephen Bell
Subscriptions & Publications Manager Josie Pearlson
Publisher Mark J Staunton-Lambert

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The Royal Institution of Naval Architects
Editorial & Advertisement Office:
10 Upper Belgrave Street
London SW1X 8BQ, UK
Telephone: +44 (0) 20 7235 4622
Telefax: +44 (0) 20 7245 6959
E-mail editorial editorial@rina.org.uk
E-mail advertising advertising@rina.org.uk
E-mail production production@rina.org.uk
E-mail subscriptions subscriptions@rina.org.uk

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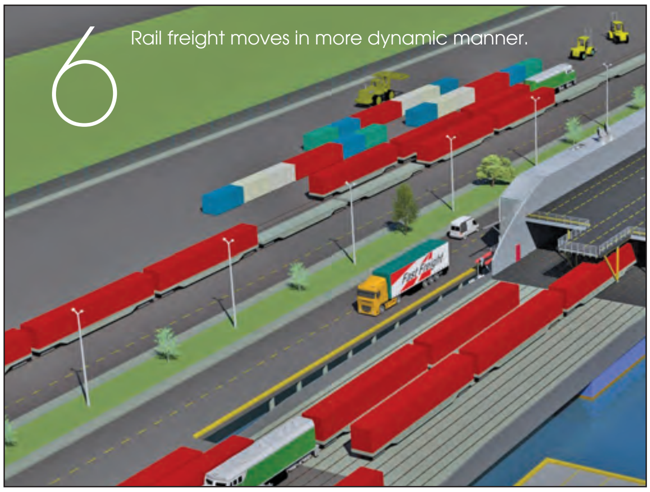
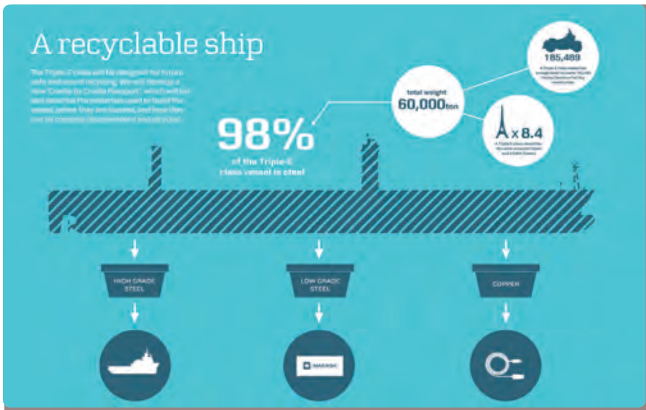


6 Rail freight moves in more dynamic manner.

On-line Edition

The Royal Institution of Naval Architects is proud to announce that as of January 2008, *The Naval Architect* journal has gone digital. We are very pleased to inform the maritime industry that each issue will be published online, on the RINA website. Visit www.rina.org.uk/tna and click on the issue cover you wish to view. This means that the entire publication, including all editorials and advertisements in the printed edition, can be seen in digital format and viewed by members, subscribers, and (for a limited time) any other interested individuals worldwide.



Fathoming the future

The Triple-E class will be designed for future safe recycling. Maersk will develop a cradle-to-cradle passport, listing all the materials used to build the vessel, where they are located and how they can be correctly disposed of. But will the Triple-E be the last of the behemoths?

In April 1971 the first issue of *The Naval Architect* was published under the auspices of its first editor, Robin Burnett. This month, some forty years and a few months after that first ever publication, Robin returns with an extract from his latest book published this year that sheds some light on those early days for this magazine.

As a celebration of that first issue we have also reproduced a story, about the design of the Liverpool Bay container ships, which appeared in that first edition and have asked a container ship design expert, in this case Lloyd's Register's global manager for container ships David Tozer, to comment on this original story and provide a modern version of the story describing where we have come from and how we came to be in the position that we are in today.

The Naval Architect also asked Mr Tozer to put his neck on the line and make a prediction as to where the industry will be in 40-years time. Opinions on such matters can be as numerous as stars in the night sky, but Mr Tozer takes an informed, if somewhat cautious, approach to his vision of the future.

However, container shipping is a single sector in the maritime field and to predict what the next 40 years of evolution for the maritime industry as a whole will bring would be much harder. So here goes!

Technology always evolves as the commercial need arises and in this respect shipping is no different. On the whole shipping spent the first couple of thousand years largely without the burden of regulation. That changed with the industrial revolution and regulation was increased significantly during the twentieth century, mainly, but not exclusively, to make ships and those working and travelling on them safer.

In the third millennium the focus of new regulation has changed as fears of global warming are driving a raft of new rules that will fundamentally alter the maritime industry over the coming years. Those regulations which seek to reduce the levels of NOx, SOx and particulate emissions as well as reduce CO_2 levels will be a challenge to designers, but when we include the expected global economic growth the size of the challenge becomes much clearer and more daunting.

Some observers believe that shipping's share of global CO_2 emissions could rise to as much as 18% by 2050, from 2.7% in 2007, and this will make it difficult to meet emissions targets through new technology alone. Many new technologies are being developed, lighter ships, liquefied natural gas (LNG) as fuel, bio-fuels, air lubrication and hull designs that will certainly reduce the individual ship's emissions.

Even so with more ships on order and a glut of yards looking to survive the offer of cheap new tonnage may again become a reality; this could be a disaster for existing operators who have seen rates for ships in all sectors decline significantly.

It may also mean that regulatory authorities will need to introduce significant extra cost into the shipping of goods through market based measures, a greenhouse gas tax or emissions trading.

That extra cost along with the increase in the price of labour in regions such as China and other parts of Asia could alter the economics of shipping to such an extent that globalisation, which was built on the premise of cheap shipping, may give way to localisation.

In this new trading environment instead of building ever larger vessels that call at fewer ports with a fleet of smaller feeder ships to distribute cargo locally, direct services operated by smaller ships at slower speeds will distribute cargo within a locally defined region.

Goods will, therefore, need to be manufactured in several locations, Asia, Americas, Africa and Europe. Raw materials will still need to be shipped in bulk, but manufactured goods and food would not be so readily shipped as they are today, with some goods moving six and seven times before they are sold.

Less shipping means fewer ships and fewer yards to build them in. Consolidation of shipyards is likely to begin soon with existing orders being finalised and few new orders coming in. New yards expected to evolve in several locations, India, Vietnam and Indonesia are likely to be backed by established shipbuilders from 'high cost countries', such as Europe, Japan and Korea.

Underpinning these changes would be a new banking reality where the financing of new ship projects would come from Asian banks which would have very strict regulation and terms imposed on owners and yards, this too would act as a limit to newbuildings.

In short the next 40 years could see a decline in demand for ships if the cost structure for producing and delivering manufactured goods is increased beyond a certain, as yet undetermined, level. New technology will reduce the emissions from ships further, but ultimately those technological gains will need to be allied with economic measures so that shipping will meet its targets. Perhaps this view is not new, but the extent of the measures necessary are more draconian than many in shipping appear willing to contemplate. *NA*

Yards

Bangladesh seeks partners

Venture capitalists in Bangladesh have appointed Dr. Karim Mohammed Rezaul, Senior lecturer at St Peter's College in London, as a consultant as they search for shipbuilding partners to invest in new projects.

Dr Rezaul said that the investors are already talking to potential investors from Denmark, Sweden and Norway about either a franchise or joint venture propositions and his contacts, who would like to remain anonymous for the time-being, are also looking for more partners in the UK.

"Shipbuilding in Bangladesh is a very interesting proposition," explained Dr Rezaul, "you can build a vessel in Bangladesh for around 40-50% of the cost of other countries, mainly due to the very low labour costs."

As an example of the savings that could be made he pointed to a 12-ship order made by German operator, Grona Shipping, for 5056dwt bulkers which were contracted at around US$10.68 million a piece. The fifth and sixth vessels of this order were delivered in July and the remaining six vessels are expected to be delivered during 2012.

In finding a shipbuilding partner the Bangladeshi investors are offering up to 24hectares of suitable land, investing 40%, or more, in the capital cost of establishing the endeavour, providing technical staff, including naval architects and managing a skilled, but low cost, workforce.

According to Dr Rezaul there are four prerequisites that any country must fulfil before it can emerge as a shipbuilding nation: It must meet "international standards for shipbuilding practice, quality management systems, coastline and riverine landscape, and infrastructure including manpower resources. Bangladesh has already covered all these avenues along its eventful shipbuilding history."

Shipbuilding market

Analysts fear newbuilding slump

Over-tonnaging in every sector and stagnant global markets are combining to reduce confidence amongst those in the maritime sector. Shipping professionals fear this will lead to a decrease in orders unless demolition of existing ships picks up.

Respondents to a Moore Stephens survey on confidence in the shipping industry showed that the industry was more pessimistic now than at any time over the last two years.

One respondent said that the "severe oversupply of tonnage in every sector is biting hard,"and supply will remain ahead of demand for at least a couple of years". Another remarked, "Too much yard capacity will result in an adverse oversupply of tonnage".

Some respondents concluded that the only viable answer to the oversupply issue was demolition. "Given the current almost stagnant economic conditions in much of the developed world, and the oversupply of tonnage," said one, "the main hope for any upward movement is the demolition market."

That appeared a forlorn hope in the tanker and container ship sectors which are expected to see something of a boom in the next year at least. Shipbroker, Braemar Seascope predicts that 2012 will see the greatest container ship delivery spree in history with up to 1.55 million TEU being delivered through the course of next year.

According to the broker some 230 boxships are due for delivery with some 59 vessels having a nominal capacity of 10,000TEU or more. "Fleet growth for the 10,000TEU plus size bracket is expected to reach 70% year on year for 2011 and a further 57% in 2012. Bearing in mind that the vast majority of ultra-large containerships are currently deployed on Asia -Europe services, next year's delivery influx would be sufficient tonnage to create another five loops deploying ten x 13,000TEU vessels," reported the broker.

The outlook for the tanker market is marginally better, but Braemar believes that the sector will remain chronically over-tonnaged despite growth in demand. Some 26 VLCC's were due for delivery in Q1 and a further 21 were expected in Q2, however, of these only 19 and 15 respectively were actually delivered giving some relief to the markets.

On 1 July Braemar said that the VLCC fleet consisted of 559 ships with a further 150 on order, while the total tonnage deployed was 169.9 million dwt, an increase of 5.6% on January figures.

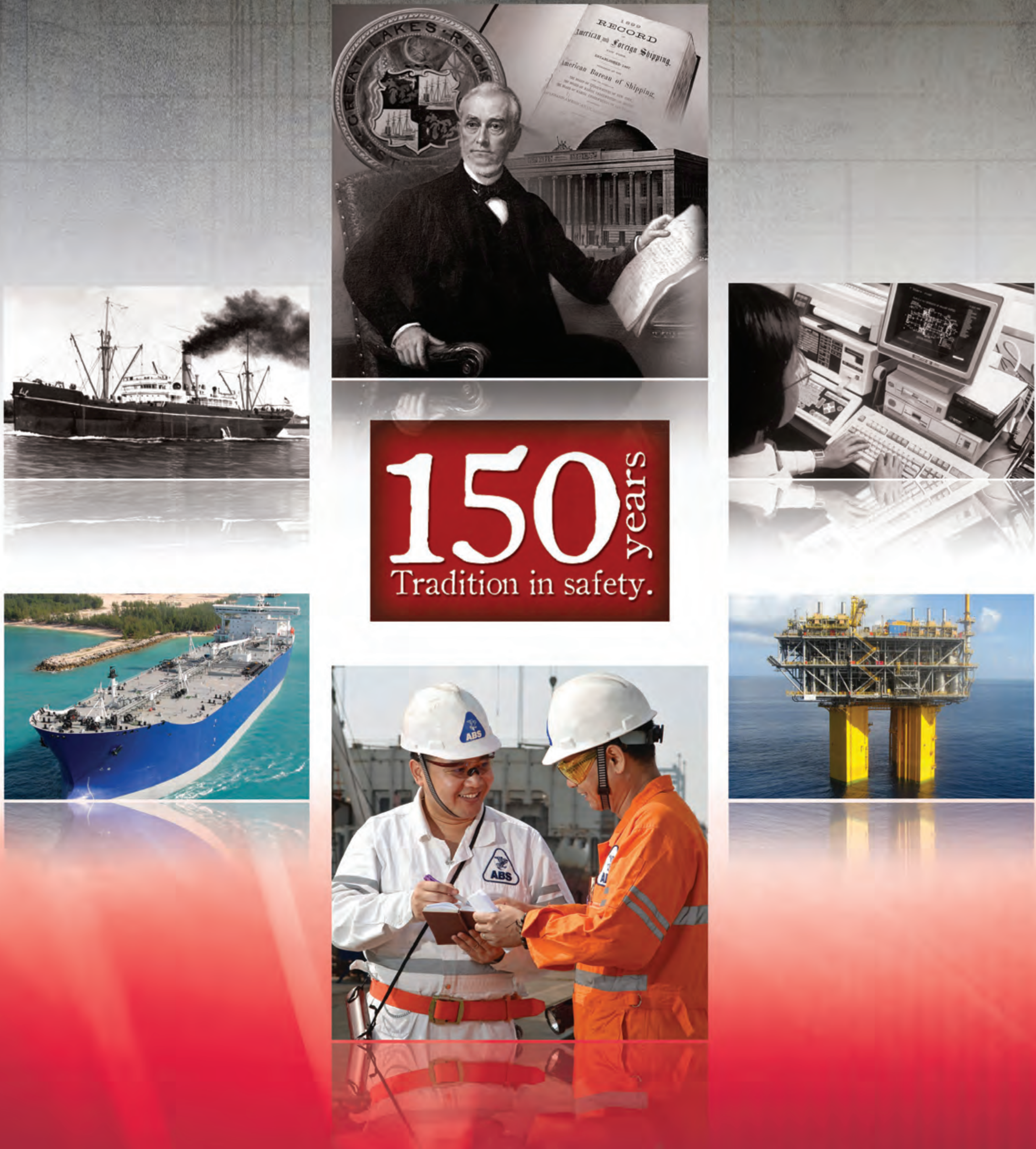
Engines

Daihatsu in Asian alliance

Japanese engine manufacturer, Daihatsu, has entered into a five-year licence deal with Kirloskar Oil Engines Ltd of Pune, India.

Signed on 21 July the deal allows the Indian engine builder to produce Daihatsu DK 20, DK 26 and DK 28 engines under licence. "Although the deal is for an initial five years it will be automatically extended if the agreement performs well," said Toshio Matsuka, executive advisor at Daihatsu.

Kirloskar Oil Engines Ltd has now changed its name and is known as Kirloskar Industries Ltd, the company remains a part of the Kirloskar group of companies incorporated in India and listed on the Mumbai stock exchange and the National Stock exchange of India, Atul Kirloskar is the chairman of the company.


150 years
Tradition in safety.

BWTS

Tokyo approves MOL BWTS

Japanese ship operator Mitsui OSK Lines (MOL) has received the certificate of compliance, from the Japanese Government, for the FineBallast OZ ballast water treatment system (BWTS) that it has developed with a number of other companies.

Developed in conjunction with Mitsui Engineering & Shipbuilding Co (Manufacturer and sales company), The Japan Association of Marine Safety, Shinko Ind, Marine Technology Institute, Laboratory of Aquatic Science Consultant Co, and MOL Marine Consulting, Ltd FineBallast OZ is only the second BWTS to use ozone to eliminate micro-organisms, most other BWTS use either UV light or electrolysis.

In order that the BWTS was awarded the certificate tests of the system were carried out on *MOL Express* as well as tests carried out on land that verified that the system meets International Maritime Organization standards for BWTS operation.

The system needs to treat water once only, at the time the ballast water tanks are filled, there is no need for a chemical agent for ozone supply and storage—the system produces the required amount of ozone as needed, extracting it from air, micro bubbles of ozone are poured into the system. This achieves a high absorption efficiency and high contact efficiency against plankton and bacteria. And harmful substances remaining in ballast water are extracted by activated charcoal. This has no impact on the environment, said MOL.

BWTS

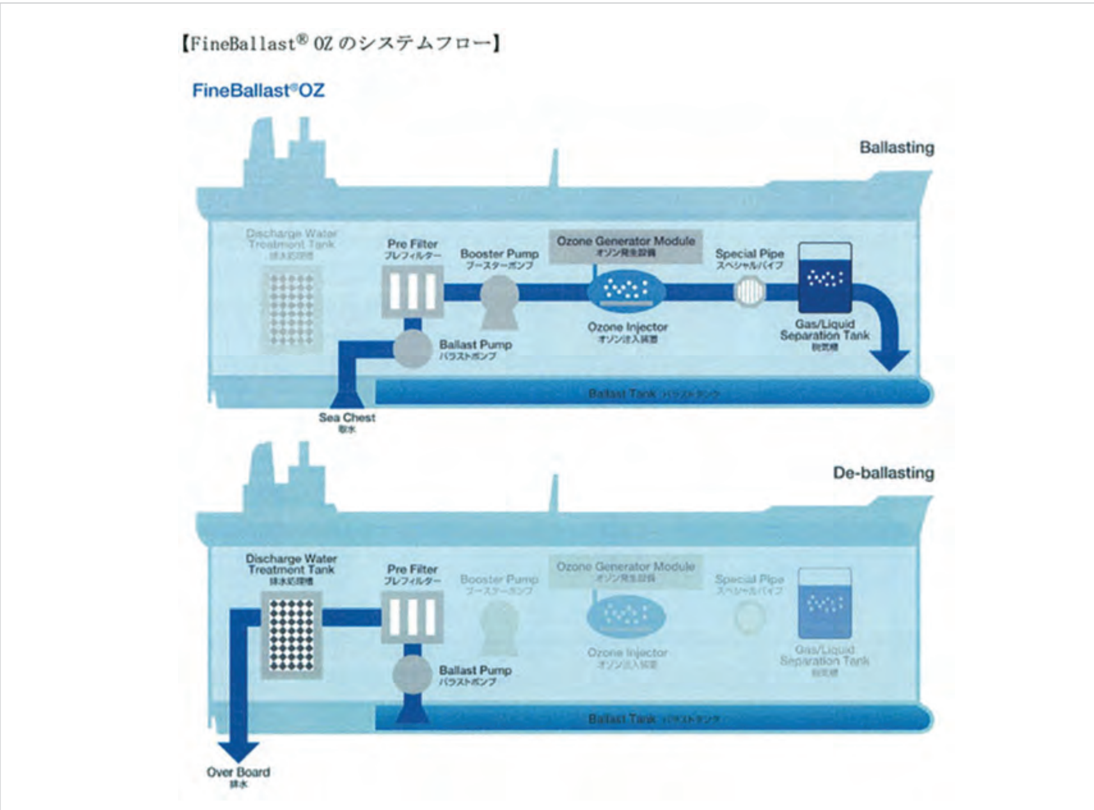
IMO approves BALPURE BWTS

Another ballast water treatment system (BWTS) to receive International Maritime Organization Type Approval is Severn Trent De Nora's BALPURE system which uses electrolysis to cleanse water.

The company said it uses a "slip stream approach in which 1% of the total ballast water flow is used to generate the hypochlorite disinfection solution, the BALPURE system can be operated in low-salinity, low-temperature environments. The slip stream approach also enables the system's remote mounting away from ballast lines. The BALPURE system is commonly supplied in six small, sub-assembly components to further facilitate its ease of installation."

Severn Trent says the system can clean up to 20,000m^3/h of ballast water and is particularly suited for oil, chemical and gas tankers.

System Flow of FineBallast OZ



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Ancillary equipment

VISION T5 makes it simple

The launch of ESAB's latest, UK-based ESAB Cutting Systems is making its cutting machines even more productive and easier to use. This innovative controller allows untrained personnel to program the machine for cutting, marking and bevelling processes via the touch-screen in just a few steps.

The VISION T5 controller has been designed with a clear emphasis putting the user first. No in-depth knowledge of cutting technology is required to programme the controller thanks to an "Operating Wizard" which intuitively guides the operator through each operational step.

UK-based ESAB launches its VISION T5 NC Control System.

All important information is visualised on the 16:9 format bright, touch-screen which is around 30% larger than conventional industry displays. The VISION T5 not only significantly shortens the programming time, but also makes it possible for inexperienced operators to configure quickly complex processes and select the optimum cutting programs for fully automated production cycles, the processing of complex inner contours and precision small holes. The input of incorrect parameters, which could result in production errors, is prevented.

The VISION T5 controller also includes an easy shape parts library and the option of remote maintenance and technical support from ESAB.

www.esab.co.uk

Engines

MAN goes large in China

Seaspan Corporation has placed an order for seven + 18 newbuildings of 10,000TEU container ships at Jiangsu YangZiJiang Shipbuilding. These ships will be powered by new super long-stroke engine type MAN B&W 10S90ME-C9, which will be built by the Chinese engine builder CMD.

MAN Diesel & Turbo investigations indicate an overall efficiency increase of about 7% when using the S90ME-C9, compared with existing main engines, depending on the propeller diameter used.

Canada-based Seaspan Shipmanagement Ltd. chose the super long-stroke 10S90ME-C9 type on account of its fuel savings, a choice that required a redesign of the newbuildings' aft-ship to accommodate the lower engine rpm and larger propeller diameter.

Ole Grøne, senior vice president Promotion & Sales, MAN Diesel & Turbo said: "We continuously keep a close eye on developments and trends within the shipping sector and have watched with interest the increasing demand for lower engine speeds and larger propeller diameters within the container segment. While our portfolio of engines already matches a broad reach of requirements, we have specifically introduced the super long-stroke S90ME-C9 to market to satisfy current trends and are very happy with its immediate adoption in the major shipbuilding markets."

www.mandieselturbo.com

Ancillary equipment

New anchor from SEC

SEC Groningen has announced the launch of the redeveloped HHP TWM anchor.

Discussions with many clients combined with SEC Groningen's research and long-established expertise have resulted in a number of major improvements to the existing HHP TW anchor.

The upgrades and benefits of the new HHP TWM anchor are: side skirts, which reinforce the flukes and reduce tension on the welds, making the anchor more durable, a stopper plate welded between the side plates, giving a tighter fit between hull and anchor and stabilising the anchor, double lay-up of the anchor house shaft, so it takes away the tension on the anchor pin, reducing wear and tear. Its new shape also allows the anchor to dig in much faster.

The new anchor has recently been granted a Dutch patent, and the European patent will follow shortly. Lloyd's Register, ABS have all given type approval.

www.sec-groningen.nl

Ancillary equipment

OceanSaver gets first order

OceanSaver, manufacturer of ballast water treatment (BWT) systems, has announced the successful commissioning of its first fully operational system onboard Höegh Autoliners Pure Car Truck Carrier (PCTC), *Höegh Trove*.

"*Höegh Trove* is the first vessel in the world to have a fully operational OceanSaver BWT system. OceanSaver cost-effectively complies with pending International Maritime Organization (IMO) Ballast Water Treatment regulations," said Oistein Dahl, president of Höegh Fleet Services and Head of Ship Management at Höegh Autoliners (Höegh).

The OceanSaver delivery consisted of the supply and installation of two sets first generation ballast systems, each with a treatment capacity of up to 500m^3 /h. Höegh Trove features two C2E disinfectant units, two 50 micron filters and two C3T cavitation units. The system is fully integrated into the existing vessel automation system.

"A retrofit installation is challenging from many points of view for a vessel trading worldwide; but we are happy to see that OceanSaver system works very well. The crew find the system very easy to operate", said Mr Dahl.

www.oceansaver.no

Ancillary equipment

SMART sense from Rivertrace

As the number of ships having to switch between Heavy Fuel Oil and Marine Distillate rises as they enter and exit Emissions Control Areas, Rivertrace Engineering (RTE) has launching a new Viscosity System that the company says addresses key industry maintenance and operational concerns.

The SMART Sense Viscosity System has been designed to monitor oil viscosity and temperature accurately at all times to prevent engine wear and higher emissions attributable to feeding through fuel of the wrong viscosity.

Mike Coomber, RTE managing director, said: "Viscometers are recognised as critical equipment, but the demands being placed upon them are growing as ship owners increasingly need to switch between fuels to meet environmental legislation and drive down running costs."

The density of bunker fuel varies globally and therefore, relying upon a temperature measurement alone will not guarantee that the oil injected into the engine will achieve maximum combustion efficiency.

"To address this, The SMART Sense Viscosity Probe is an Electro Magnetic vibrating rod operating at resonance frequency – a simpler, more robust and reliable alternative. It is now possible to measure temperatures and viscosity with improved accuracy, particularly apparent at low viscosity when switching between HFO and MDO, and without frequent calibration or maintenance.

"The SMART Sense PID (proportional-integral-derivative) module consists of two separate controllers, one measuring viscosity and the other measuring temperature. In case of failure of one controller, the unit can be switched to the other to maintain operation, while the faulty controller is replaced", he added.

Offered with an 18-month warranty, the SMART Sense features standard flanges for easy installation. It also operates at a low frequency, outside the ranges generated by engines and generators. "Avoiding these bandwidths improves the signal, enhancing accuracy and makes SMART Sense immune to shipboard vibrations," said Mr Coomber.

www.rivertrace.com

Ancillary equipment

RWO gets order for CleanBallast

Germany-based RWO Marine Water Technology has received an order for three of its ballast water treatment systems CleanBallast from the Japanese shipyard Sumitomo Heavy Industries Marine & Engineering Co. Ltd. (SHI-ME).

The ballast water treatment plants from RWO will be installed in 2012 in three Aframax tankers which will be built for a European ship owner.

The CleanBallast ballast water treatment system, with a maximum capacity of 3000m^3/h, will be equipped with several of RWO's advanced disinfection systems operating in parallel. This will allow for the system to cater for differing rates of ballasting and de-ballasting. "Besides its very low energy consumption, high product quality and simple system configuration, its disinfection performance in low conductivity water without dosing chemicals and no risk of re-growth of organism during voyage are the reasons SHI-ME decided to apply CleanBallast," says Akihiko Masutani, project manager of SHI-ME. "In addition, CleanBallast also works in intermittent operation or even in turbid water and has a number of further positive features" he added. The shipyard has already signed a letter of intent for two further RWO ballast water treatment plants with discussions for additional ships in the series at an advanced stage.

www.rwo.de

Three aframax tankers being constructed at Sumitomo Heavy Industries Marine & Engineering Co. Ltd. will have CleanBallast systems fitted.

Ancillary equipment

Saft offers alternate power supply

Saft manufacture of high-tech industrial batteries is focusing on its advanced Li-ion (lithium-ion) battery technology.

Li-ion battery technology can offer a number of key advantages for designers in the marine industry including: high-power and/or energy storage in a compact space and weight-saving package, high-efficiency, long calendar and cycle life – even when operating in extreme temperatures, zero-maintenance requirements.

Saft expects that Li-ion technology will be of particular interest for hybrid propulsion systems in which the batteries work in conjunction with diesel (or possibly gas turbine) generators and electric motors. The specific advantages of this hybrid power approach will vary according to the type of application.

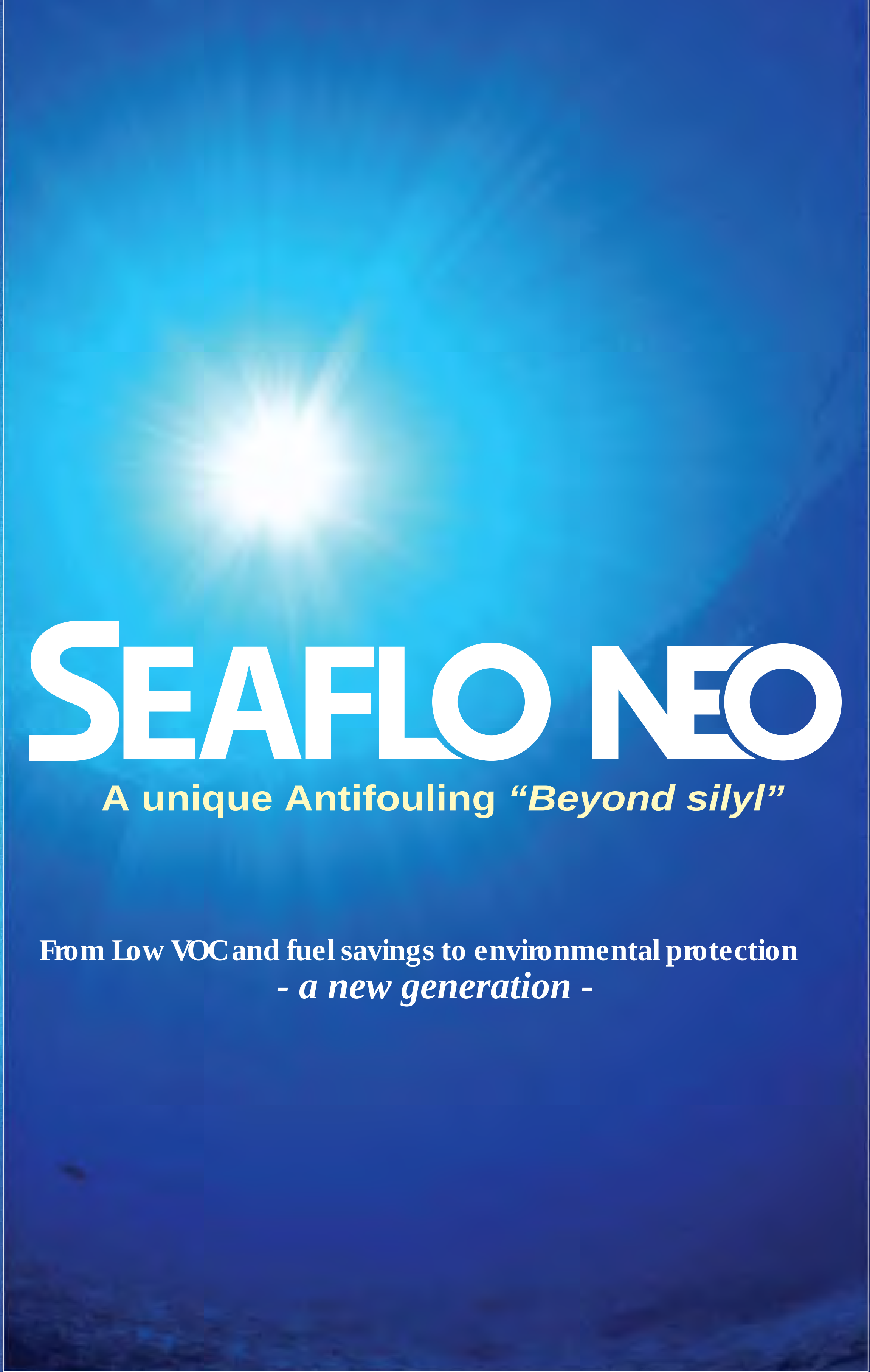
Hybrid or full electric mode could be an attractive option for passenger ferries and shuttles that spend much of their operational life in harbour for docking and undocking. Switching to clean electric power when in harbour could save considerable CO_2 and NOx emissions, helping port authorities to meet their environmental targets; it also offers much quieter operation that will reduce the impact on the local community.

www.saftbatteries.com

Ancillary equipment

Evac introduces ORCA III

Evac, the supplier of advanced wastewater collection and treatment solutions has announced its latest product to come onto the market, ORCA III, a small



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Evac introduces Orca III on to the market.

footprint physicochemical advanced wastewater treatment unit.

The ORCA III can be used on merchant vessels, navy and patrol vessels, ferries, offshore supply vessels, service vessels and platforms, and for mega-yachts, requiring a compact design, small volume and footprint and fully automated operation.

The ORCA III comes in six different sizes, with a hydraulic loading capacity ranging from $20m^3$/day down to $1.5m^3$/day. It is ideally suited for efficient wastewater treatment for vessels which stay idle part of the time, thanks to its physicochemical treatment technology. The system meets the requirements of MEPC 159(55) of the International Maritime Organisation (IMO).

"With the ORCA III now in production, Evac offers the whole range of advanced wastewater treatment systems for the marine industry," says Mika Karjalainen, general manager of Evac Oy. "Its predecessor, the ORCA II unit, has been installed over the years on several hundred vessels, and it complements our MBR biological membrane wastewater treatment units, also installed on several hundred vessels to date, which also fulfils the MEPC 159(55) requirements."

In the ORCA III wastewater treatment system the sewage from the holding tank for black and grey water is transferred, using a macerator pump, to a sedimentation tank through a static mixer and flocculation dosing. In a separate second tank section the clarified liquid is re-circulated through a disc filter and the organic matter is oxidised with hypochlorite, after which the clean wastewater is discharged overboard.

Being fully automatic the ORCA III is safe and easy to operate and maintain. The operation costs are low. The complete package includes also the transfer/macerator pump.

www.evac.com

Ship economy by design

The recently established multi-disciplinary research project ECONSHIPS has been set up by the Cooperative Research Ships (CRS) forum to take a closer look at making vessels more fuel efficient, writes Jan Otto de Kat, head of innovation at Maersk Maritime and CRS chairman.

To predict ship performance properly an integrated approach is necessary with regard to the propulsion train, propulsor, resistance, fouling effects and operational conditions. A joint research project was started three years ago to develop a set of coupled engineering tools that could be used for the design and operation of fuel efficient ships throughout their service life.

Work elements of the prediction model comprise the following areas: propulsion characteristics of different types of propellers, propeller-hull interaction, influence of degree of hull and propeller fouling on propulsion characteristics, all of which are embedded in an energy systems model. Long-term performance monitoring is taking place onboard a number of selected ships, including a container ship, a tanker, a frigate and a ferry.

The full scale data serve to verify the performance predictions. Besides fuel efficiency, the project also addresses the prediction of ship emissions, including CO_2, NOx and SOx, as a function of ship characteristics, machinery, fuel and operational profile.

This project, named ECONSHIPS, runs under the auspices of the Cooperative Research Ships (CRS) forum. The CRS was started in 1969 by The Netherlands Ship Model Basin (now MARIN) with the intention to obtain general data about the hydrodynamics and related problems of large and high-powered ships.

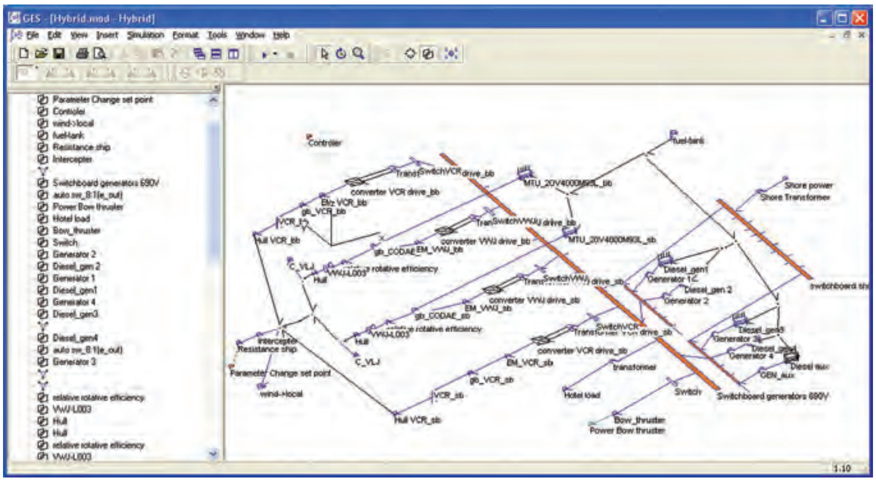
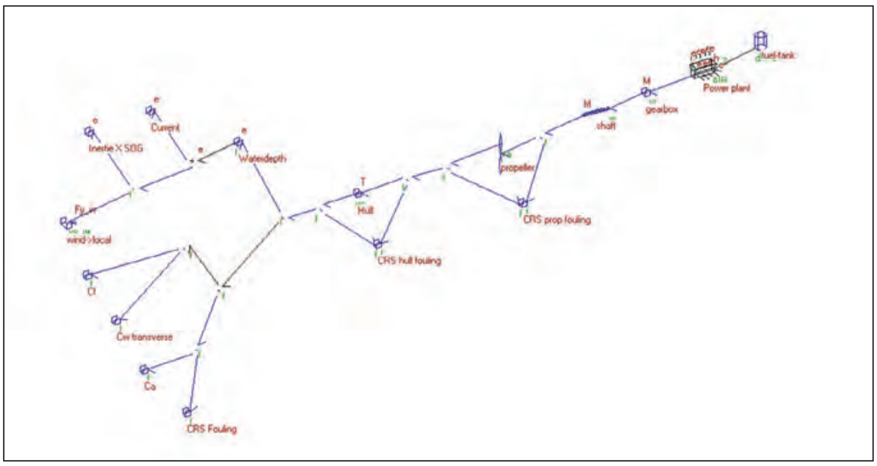


Figure 1: Example GES layout.

In the beginning the work program focused on the hydrodynamics of tankers and bulk carriers. This changed over the years and today the research carried out by the CRS is focused on hydrodynamics, structural and related problems of various ship types from a fundamental, design and operational perspective. The ship types include full block ships, but also container ships, frigates and high-speed mono-hulls and multi-hulls.

Today, the CRS consists of 25 member organizations and companies carrying out a joint work programme, sponsored equally by the members. The main parties contributing to the ECONSHIPS project are A P Møller-Maersk, ABB Azipod, Berg Propulsion, Bureau Veritas, DGA Hydrodynamique, Lloyds Register, MARIN, TNO and Wärtsilä The Netherlands.

Figure 2: Ship performance model.



General Energy Systems (GES)

GES is an object-oriented simulation programme for analysing energy systems. It was created initially as a preliminary design tool for ships, in order to model the ever increasing equipment that was being integrated into the propulsion system. However, the programme has been kept general so that it can be applied for system calculations in many fields of application.

The open structure of GES enables a ship design concept to be created in which

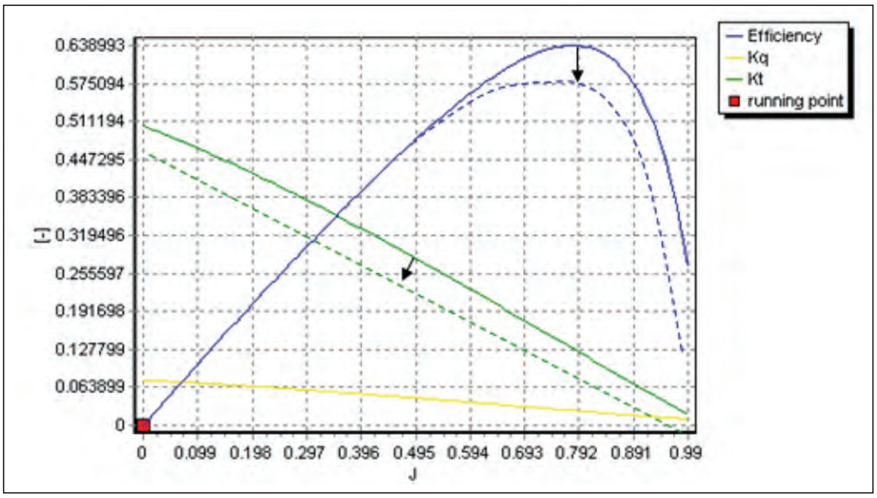


Figure 3: Propeller thrust (Kt), torque (Kq) and efficiency under the influence of fouling.

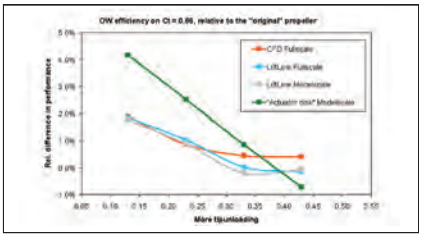


Figure 4: Benchmark validation on real propeller.

all the key ship systems can be entered, so it allows for an operational profile analysis to be made. This method is especially useful in comparing different preliminary designs. For example, in designing the onboard energy management, a fully comprehensive system analysis of all the relevant energy components is necessary.

How these components work together in various operational situations is the sum of countless possibilities. The design process of such complex energy systems is often a very intensive task. It is sometimes difficult to achieve because of the great complexity of the system and the lack of component performance data of the individual pieces of equipment. GES enables immediate insight to be gained into the energy management of the complete installation in a preliminary phase of the design.

The GES technology derives from the bond-graph method, a general method for describing systems for various physical domains. In GES, a hybrid form of the bond-graph method is used: the components of the system can be presented in their real form. This leads to a simple representation of the interaction between systems and system components. A component can have several output gates, for example describing the emissions of a diesel engine as well as its mechanical output. The methodology is applied using a graphical user interface. Dragging and clicking operations can manipulate the visible icons, each of which may contain more detailed models.

The object structure allows extremely large systems to be developed and specific components to be highlighted without losing sight of the problem at hand. GES is able to calculate separate energy systems at the same time. A graphical environment makes it possible to cluster, copy and position components. Depending on the structure GES can make static and dynamic solutions of the model.

The ship performance evaluation module consists of the power plant, shaft, propeller, hull interaction, ship resistance, wind and wave force models. In addition, the influence of fouling on the hull resistance and propeller characteristics is quantified based on input from other work elements of the ECONSHIPS project. Figure 2 illustrates the various components that make up the overall ship performance model.

As an example of fouling influence, for the propeller the open water curves are corrected based on open water tests with fouled propellers; see Figure 3.

Propeller performance

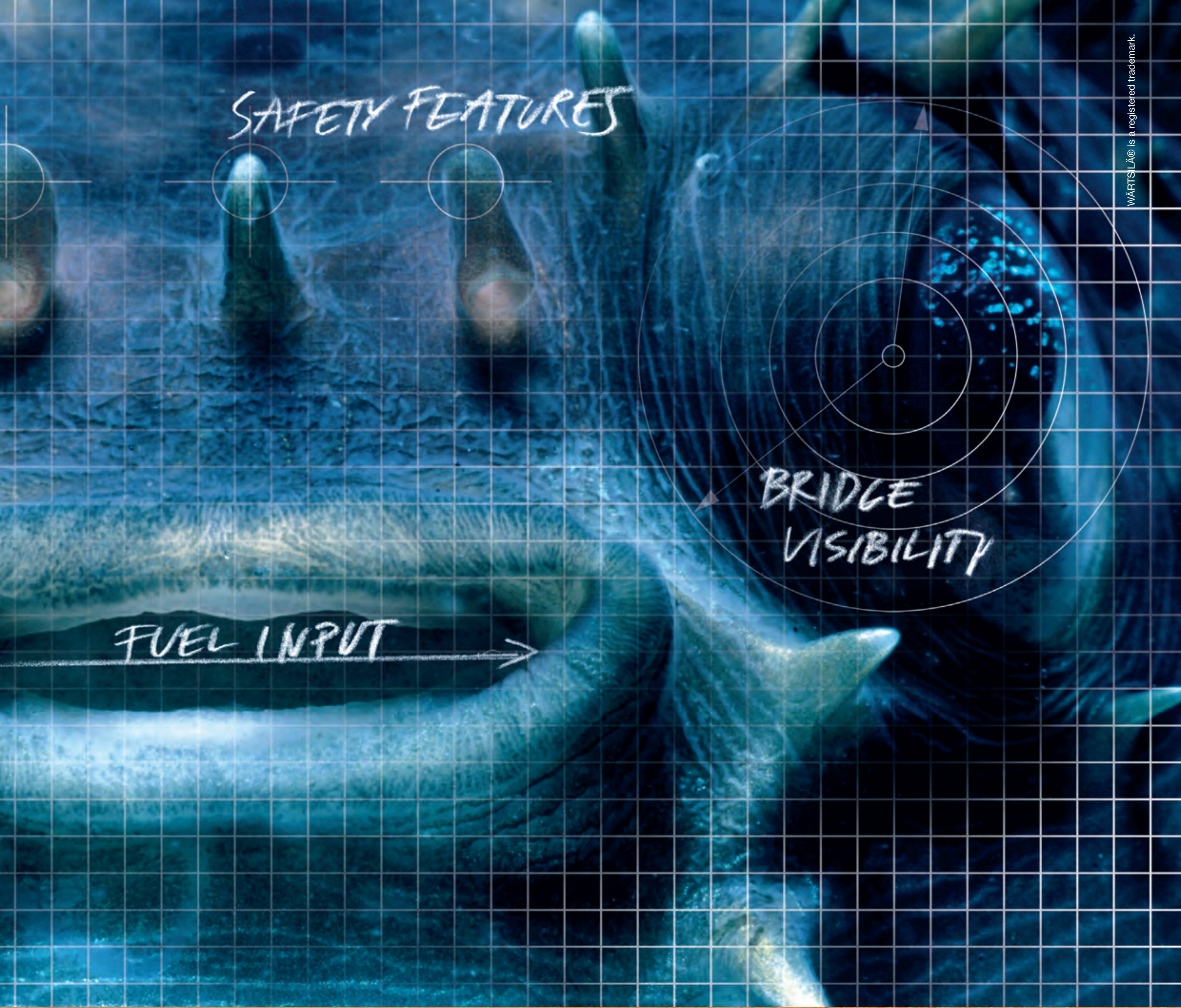
A propeller performance tool was created as part of the coupled set of engineering tools. This tool is able to calculate (conventional) propeller characteristics starting with the real propeller blade geometry. The calculations are based on the well-proven lifting line theory and corrected for the performance, based on model test results and computational fluid dynamics (CFD) calculations. The objectives of the tool were set as the following:

- Investigate "how much more efficient" an already existing propeller theoretically could be
- Evaluate the design of a specific propeller when comparing it with a reference population of propellers
- Quantifying what a typical design constraint would cost in terms of efficiency loss
- Determine efficiency loss of propeller in service due to roughness and marine growth.

Available analysis options are to compare a propeller with either alternative propellers or with already existing propellers. For this latter purpose an extendable database with real existing propeller geometries is added to the programme. This allows for new designs to be easily added in the future. Furthermore, B-series geometries can be created and processed with a mouse click, meaning that changes to these well-known geometries and the effect on propeller performance can be investigated as well.

Finally, the programme allows the calculation of so-called loss components of the propeller. Not only the efficiency is of importance; for good design practice it might be convenient to know whether the losses are due to axial momentum losses, rotational losses or frictional losses. These can be split by the software to assess the cause of a lower or higher propeller performance.

Extensive validation of the software was part of the task scope and has been carried out. About 30 existing propeller geometries and 30 B-series geometries have been calculated with CFD and compared with the results by the lifting line programme. This validation study shows a satisfactory correlation between the used calculation methods. Figure 4 illustrates that variations in geometry, such as tip unloading of the propeller, can also be modelled with the tool.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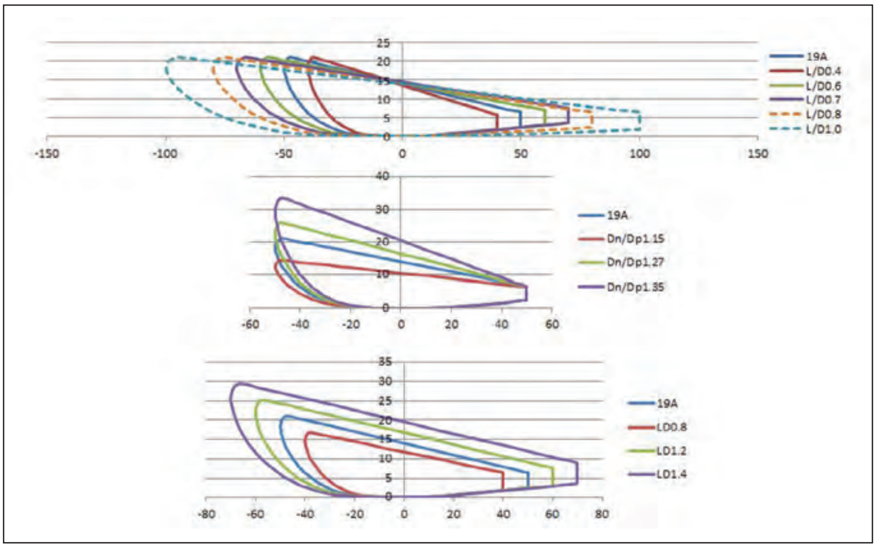

Figure 5: Investigated nozzle profiles, ranging from 0.8 to 1.2 times the 19A length and from 0.95 to 1.08 times the 19A outer diameter.

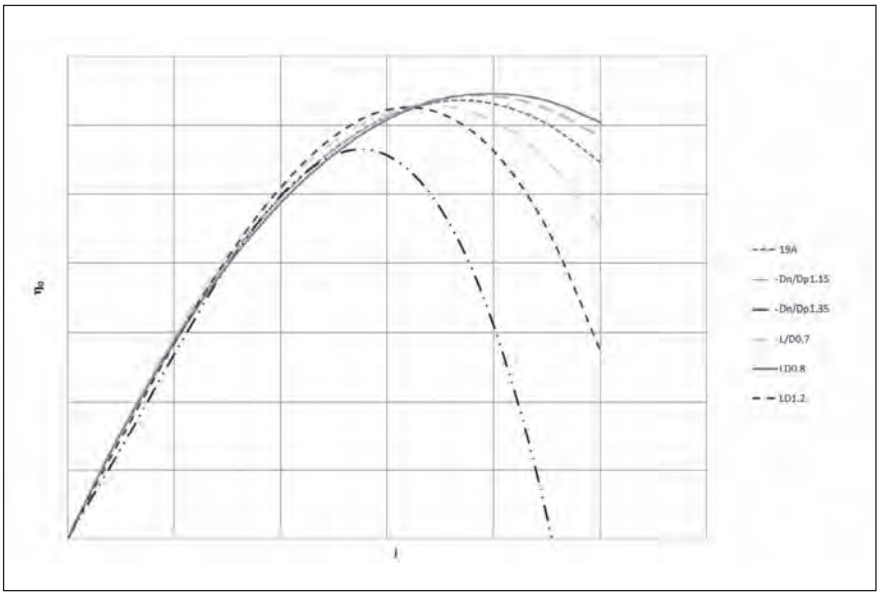

Figure 6: Open water efficiency for different nozzle sizes; in free running condition, a small nozzle size is clearly favoured.

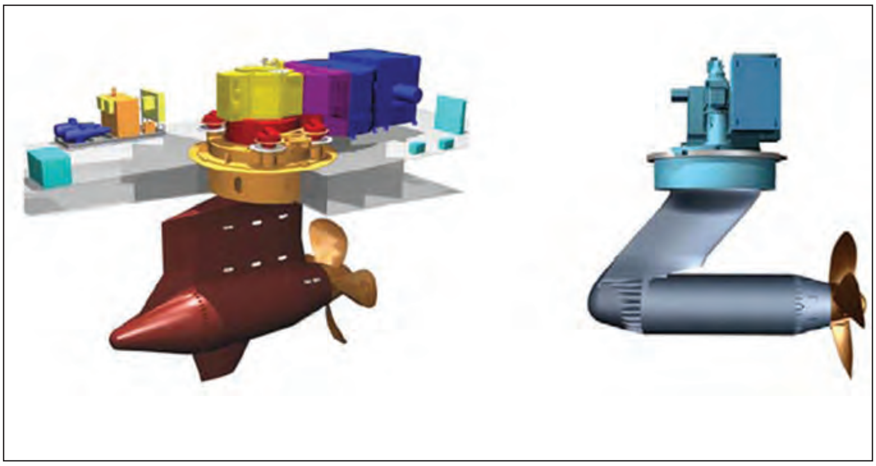

Figure 7: Azipod configurations.

Propeller choice and efficiency

To further increase the prediction capability related to propellers, besides the conventional propellers a number of alternative propeller arrangements have been considered, including nozzle geometry for ducted propellers and influence of thruster housing for podded propulsors.

Nozzle geometry for ducted propellers

The Wageningen systematic propeller series include both conventional propellers, the B-series, as well as ducted propellers, the Ka-series, where the influence of nozzle geometry has been investigated. The most commonly used profile is the Wageningen 19A nozzle, which is part of the systematic series. The 19A nozzle is a modification of nozzle 19 with a modification for good producability. This nozzle is used as a basis for the investigation and the overall size of the nozzle is varied, including nozzle length and diameter.

The difference in performance is studied using computational fluid dynamics (CFD) and the result is related to the systematic series. The general result of the investigation shows some significant results regarding performance of the nozzle operated in different conditions. For good performance in bollard pull condition, i.e. high power operations at low or zero speed, the nozzle should be big, i.e. have a long length, large diameter or a combination of these. At full speed operation the nozzle should be made smaller, shorter and with a smaller diameter. The investigated nozzles range from 0.8 to 1.2 times the length of the 19A nozzle and from 0.95 to 1.08 times the nozzle outer diameter, see figure 5.

The result from the investigation shows one strong indication, for low speed, high power operations the nozzle should be big, i.e. large outer diameter and longer length, while for high speed operations should the nozzle be smaller, i.e. smaller outer diameter and shorter length. The open water efficiency from some of these profiles is shown in figure 6.

In free running the smaller nozzles are clearly performing better as compared to

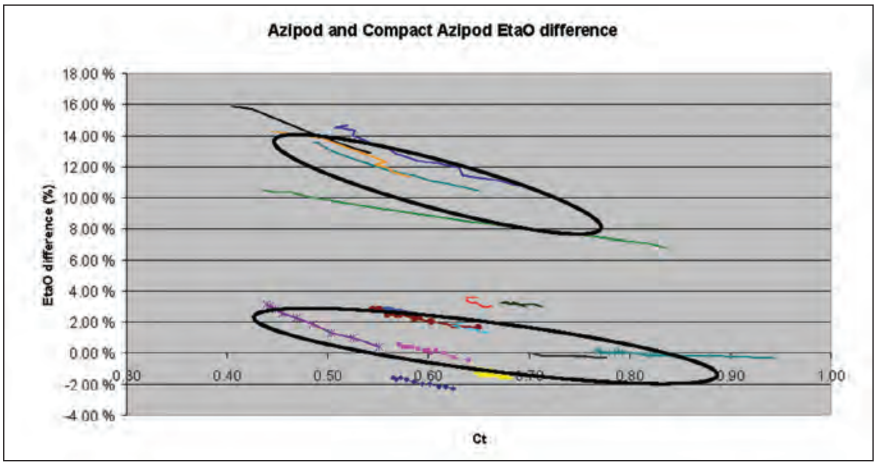

Figure 8: Efficiency comparison of two Azipods types in relation to Wageningen B-series.

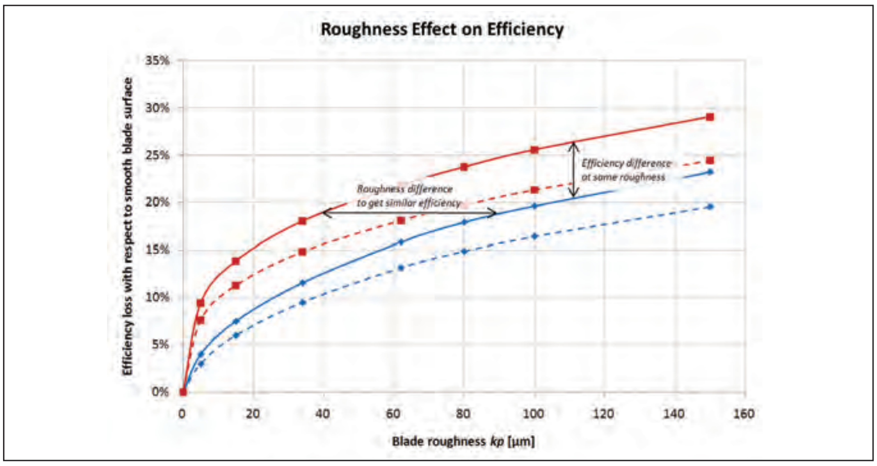

Figure 9: Roughness effect on efficiency.

the larger by a couple of percent. It should, however, be noted that the relationship is reversed in low speed, high power operations, i.e. at or close to Bollard Pull condition. Here the larger nozzles are performing better as compared to the smaller nozzles with approximately the same relationship. Azipod and Compact Azipod EtaO difference-4.00 %-2.00 %0.00 %2.00 %4.00 %6.00 %8.00 %10.00 %12.00 %14.00 %16.00 %18.00 %0.300 .400.500.600.700.800.901.00CtEtaO difference (%).

Podded propulsor efficiency prediction

One of the subtasks focused to study the level and difference of podded propulsion efficiency if it is estimated with Wageningen B-series data. Two types of podded propulsors were studied – Azipod and Compact Azipod, see figures 7.

The aim was to determine so called Δ–efficiency mean value or function that can be used to correct performance calculated with Wageningen B-series. Podded unit efficiencies measured in scaled models that were further scaled to full scale we compared to B-series predictions. While maintaining the same propeller diameter, thrust and RPM correct pitch ratio of B-series propeller could be found. The outcome was delivered power i.e efficiency difference.

The study showed clearly that the geometrical difference of these propulsors have significant effect on the Δ–efficiency values. For the more streamlined Azipod this difference was predicted reasonably well with B-series (1.5%) but the difference for the Compact Azipod was significant (10%), as illustrated in Figure 8. It is recommended to find for each propulsor type its own corrections if this kind of approach is used to estimate performance in the early phase of a project.

Hull efficiency

An important element in the total efficiency of a ship is the hull efficiency, the ratio of thrust deduction against effective wake. The Holtrop-Mennen method is capable of predicting these parameters, but it derives the results from the main particulars of ships and a general description of the aftbody. Hull efficiency, however, is very sensitive to local changes to the hull and the optimum hull efficiency is a delicate balance between the position of the propeller and the shape of the hull. Within the CRS a prediction programme has been developed, which is able to take these specific hull characteristics into account. Within the ECONSHIPS workgroup the equations of this programme are updated to increase the accuracy of the calculated thrust deduction and the effective wake and to ensure that the results are valid for modern ships.

Propeller and hull fouling

Within the GES Ship Performance Model the hydrodynamic characteristics, such as resistance and power requirement can be determined by means of the well known Holtrop-Mennen method or model tests. The output of these methods is valid for clean ships in ideal trial conditions. The performance of a ship in service can, however, be substantially lower. For instance the condition of the hull surface is known to have a significant influence on the ship's fuel consumption. The deterioration of the hull and the build-up of fouling during service can cause a significant decrease in the ship's performance, resulting in a higher fuel consumption and speed loss.

A well chosen anti-fouling coating can delay the growth of fouling, but regular maintenance and hull cleaning is still needed. But, these measures have their price. Ship operators must, therefore, try to find an economical optimum in hull treatment by weighing the additional fuel costs due to hull deterioration against the costs of regular hull cleaning. In order to find such an optimum it is of major importance that up to date information on the effect of fouling and deterioration is available.

Figure 10: Rotating disk test set-up.

Figure 11: *Clementine Maersk*.

Within the workgroup it was recognised that application of the new generation anti-fouling coatings (for instance SPC and Foul Release coatings) and regular hull maintenance, measures which are nowadays commonly carried out by ship operators, will usually prevent growth of severe fouling such as barnacles, tubeworms and seaweed. It can, however, not prevent the growth of slime on the hull. Slime is the first type of fouling which appears on the hull, and it is known from literature and from earlier work by the CRS that it can have a significant negative effect on vessel performance, even when it is hardly visible. It was, therefore, decided to concentrate on the effect of these first stages of fouling, the so-called soft fouling.

In a previous CRS workgroup the effect of slime was investigated by means of a flat plate test set-up. In order to obtain a high enough Reynolds number the flat plate had a length of 8m and was tested up to speeds of 12m/s. Due to the size of the plate it was difficult to grow an even distributed layer of slime producing bacteria on the plate. Although the tests were successful and showed a substantial negative effect on the frictional resistance, the number of tests conducted were very limited, due to the above described difficulties.

Using the lessons learned from the past it was clear that a smaller surface is needed to enable easy replication of evenly distributed growth of slime on sufficient number of samples in order to derive a reliable relationship between slime and the added resistance it may cause. The rotating disk test set-up known as Friction Disk Machine (FDM) was considered to be a good option, although it was recognised that the flow over the disk differs considerably from the flow along a hull.

A literature study revealed that the differences in torque as measured for the various disks can be translated to frictional resistance coefficients with the calculation methods developed and described by Granville (1978; 1982). Granville's method is an indirect similarity law characterisation method for any arbitrary irregular roughness covering a circular disk. Slime can be regarded as such roughness. In this method the measured torque differences and rotary speeds of this rough rotating disk is converted into a relation of non-dimensional friction coefficient depending amongst others on a (surface roughness) Reynolds number. This relationship can subsequently be used to determine the increase in ship and propeller resistance associated with this arbitrary irregular roughness.

This method has been verified within the ECONSHIPS workgroup by performing tests with disks with known surface roughnesses and to compare the results after application of the Granville method with the results of the well-known Nikuradse sand roughness experiments. A good correlation with the Nikuradse results was found.

Subsequently several polyester replicate disks were exposed to growth of diatoms and the subsequent development of a biofilm. The biofilm characteristics on each of the disks were determined in the laboratory and after this, torque measurements were performed in the rotating disk test set-up.

The differences in measured torque were translated to differences in drag due to the presence of slime fouling. This same procedure was also used for measurements on coated disks that were exposed to natural fouling in the sea. In this test three commercially available coatings were used, one Self Polishing Coating (SPC) and two Fouling Release Coatings (FRCs). This provided interesting new insight in the effectiveness of coatings and the added drag that slime fouling may cause on these coatings.

From the results of these tests frictional resistance coefficients that have relevance for slime covered hulls will be determined, which subsequently can be used in the Holtrop Mennen method and for CFD calculations. The latter is used as the


Werner Kallweit,
Deputy manager of the technical department, B. Dettmer Reederei, Bremen

last step of the translation from a slime covered disk to a slime covered ship surface. Due to its three-dimensional shape the velocity of the water along the hull varies constantly, leading to substantial local differences in roughness Reynolds number. Even if the roughness height has the same value all over the hull. The newly determined frictional resistance coefficients will be used in the CFD calculations for one selected hull form, in order to determine the real effect of slime on a ship's hull.

In that respect not only the increase in resistance is investigated, but also possible effects on the wake to the propeller. Besides this, additional critical fouling positions will be determined. These are locations on the hull where slime fouling has a relatively large effect on resistance. With this information ship operators can make well founded decisions with respect to the locations which should be cleaned, in case partial cleaning is envisaged.

Besides the hull, the propeller is also exposed to fouling during operation. Furthermore, surveys on propellers show that a large number of propellers have damage, predominantly on the edge. In addition to that, the blade surface roughens in time due to erosion. All these phenomena lead to a decrease in propeller efficiency. In this study these effects are investigated by means of experiments and numerical analyses. Figure 9 illustrates the efficiency loss due to blade roughness for a certain propeller.

Data is collected from large propellers which have been in service for a number of years. Surface roughness is measured and both marine growth and edge damages is photographed. This way it was found that surface roughness can increase to 10μm Ra, and that often similar species are found on bronze propellers. Marine growth mainly consists of barnacles, macro-algae, tubeworms and slime.

For quantification of the drag contribution from marine growth, the aforementioned rotating disk test set-up was used. Repetitive tests were conducted with bronze discs, which were set out in the sea, in order to get disks covered with slime and barnacle fouling. Also laboratory grown seaweed was used to get available disks with algae.

Comparing the results from the pristine discs with the fouled discs an estimation is made for the added friction coefficient of (different kinds of) fouling. Besides an effect on drag on the propeller performance, the lift may be affected too. Therefore, a model propeller has been exposed to marine growth and open water tests have been carried out.

The relation of surface roughness and friction has been studied extensively for flat plates and tubes, for instance by Nikuradse. The use of this theory on propellers is, however, not validated in relation with scaling rules and application of CFD code. Since the efficiency loss on full scale is needed the following sequence is followed. Open water tests with a model propeller with a smooth and roughened surface are conducted. The selection of the surface roughness is based on field experience. For the same case CFD calculations are conducted. Comparing the results, experiment and theory a constructive validation set is obtained for model scale. However, when model scale CFD results are validated, full scale simulations can be expected to betrustworthy. It appears that the efficiency loss at full scale is larger than on model scale.

Finally, typical leading edge damage has been applied to a model propeller. Open water tests have been subsequently performed to investigate the influence and sensitivity of this kind of damage. The above experiments and results will be summarised in a global friction model for propellers, aimed at the prediction of thrust, torque and efficiency loss due to surface roughening, fouling and edge damage, occurring during service life.

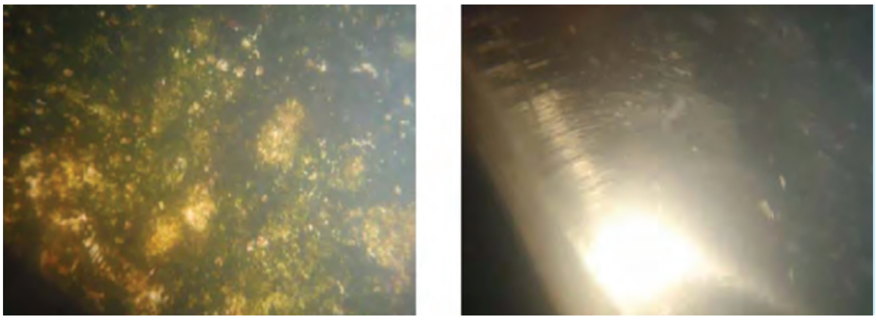

Figure 12: Propeller blade before (left) and after cleaning (right).

Performance monitoring on the hull and propeller of a vessel

Knowledge on marine fouling on the hull and propeller is essential for accurate performance prediction of a trading vessel. The development of marine fouling on the hull and propeller is dependent on a large range of external factors which are not always easy to control. To save fuel and minimize CO_2 emissions, A P Møller Maersk has developed a performance system that keeps track ff the hull and propeller condition. Using the system allows better planning of e.g. docking and hull or propeller cleaning intervals. The current project aims at developing an alternative methodology.

Figure 11 illustrates *Clementine Maersk*, which uses the Maersk vessel performance system and which has been equipped with an additional auto-logging system as part of the ECONSHIPS project.

Using live recording of carefully selected response signals, the actual fouling condition of the hull and propeller can be predicted. Figure 12 illustrates an example of a propeller with moderate marine growth before and after cleaning.

Using the Generic Energy System program (GES), a detailed model of the vessel can be developed and based on the recorded response signals, the growth in hull and propeller fouling can be estimated by analysing the recorded data from the auto-logging system and compare various performance indicators against expected performance indicators in a reference model.

Figure 13 illustrates a conceptual example of the GES system output where the development of fouling roughness, Ks, is determined as a function of time.

Ship emissions prediction

The international regulations regarding air pollution from ships seek to minimise airborne emissions (SOx, NOx, and particulate matter) and their contribution to global air pollution and environmental problems. In addition, regarding the greenhouse gas (GHG) emissions, international shipping is estimated to contribute about 2.7% to the global emissions of carbon dioxide (CO_2).

IMO MEPC in recent years has developed a set of energy efficiency technical instruments for the control of GHG emissions including EEDI (Energy Efficiency Design Index), EEOI (Energy Efficiency Operational Indicator) and SEEMP (Ship Energy Efficiency Management Plan). These have given impetus to technological developments in all aspects of shipping emissions.

The objective of the Emission Prediction work is to be able to predict and quantify the influence of design and operational parameters on ship emissions comprising CO_2, NOx, SOx and PM, for existing vessels and newbuilds. It is anticipated that this predictive tool will provide exhaust emissions over a ship voyage and thereby will be used as a tool not only for ship's conceptual design but also operational management scenario analysis.

Using the GES model it will be possible to estimate optimum ship particulars from an emissions perspective. It will be possible, for instance, to modify the main dimensions of a ship to show their influence on the propulsion power and the associated exhaust emissions. The model will enable designers to investigate different engine types (diesel engine, gas turbine etc.), alternative propulsion systems different propeller types and fouling influences, and different engine equipment configurations, to assess the emission's corresponding data.

The emission factors according to the choice of engine technology, equipment, propellers and fuel type will be calculated based on input from ECONSHIPS.

The ship emission module will fit inside the CRS GES model. The operational profile will be derived from onboard measurements. A simulation model of the energy chain will be built and compared with measurement data. The output will be absolute data and/or statistical data pertaining to CO_2, NOx and SOx. The GES tool will be used to predict EEDI and EEOI. *NA*

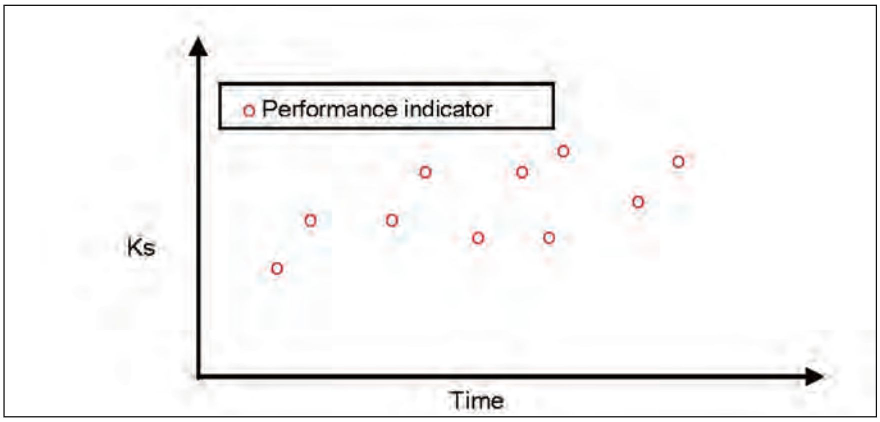

Figure 13: Conceptual development of fouling (Ks) as function of time.

ABS and LR form CSR joint venture

CEO of Common Structural Rules Software LLC, Aidan O'Donnell writes about the importance and immediate future of common rules software.

ABS and Lloyd's Register (LR) recently released jointly-developed software that will be used to assess bulk carriers and oil tankers designed to comply with IACS (International Association of Classification Societies) Common Structural Rules (CSR).

The common software draws upon the technical strengths of ABS and LR and will be used to evaluate new designs presented to either society. The two leading societies established a new company, Common Structural Rules Software LLC, in April this year which is now responsible for moving the software forward.

CSR Software LLC CEO Aidan O'Donnell (on the right) with COO Robert Spencer.

A new era began in April 2006 when, following five years of development activity, IACS introduced Common Structural Rules for tankers and bulk carriers. The agreement to develop common classification rules was of course common sense but moving from the idea to reality involved many challenges. Classification turned a corner with the CSR and ensured that, in principle, the rules for structures would be the same for all the leading societies. Headlines such as, 'Scantlings should not be a matter of negotiation', published in one maritime paper in 2001, should be a thing of the past.

Having established the CSR the most important challenge that still remains is to support the rules with ever better common software so that, in practice, the same rules will produce the same result from ship design and assessment software. This is not yet the case today. But it can and should be.

We believe that the establishment of Common Structural Rules Software LLC by ABS and LR now offers the industry the common software solution that it has been asking for and it is our hope that other IACS members will join ABS and LR in supporting such a common approach – an approach that would be in the best interest of shipbuilders, owners and, most importantly maritime safety. Designers and builders will have greater confidence that they are complying with the rules before they start cutting steel. Owners will have confidence that a common rule set will produce the same results, eliminating concerns over different results emerging from the computer coded calculations or differing interpretations in the application of the rules through software.

Developing the common software is a large, technically challenging and expensive job. CSR software now has a team of eight core employees headquartered in Houston working with a wider, globally dispersed team of more than 50 involved in the various aspects of the software development lifecycle.

It has been a two-stage challenge. The company has provided an immediate common software solution for bulkers and tankers. This software is now available for download and the benefits should be immediately apparent to those using it.

But for the future it has also been working on harmonised software that will support the harmonised rule set in 2014.

Helping the industry understand the new software and getting their input is vital. The company has have concluded the first round of industry training with key stakeholders in Shanghai and Europe. More than 30 designers representing 12 Chinese shipyards and a group of European based specialist design consultants were involved in full immersion, five day courses to gain insight into the technical nuts and bolts of the software. And the feedback so far has been positive.

This awareness process will continue in other design centres. Further training in the key North East Asia shipbuilding communities will begin in September and carry on through October and November as we cover the designers and builders in Korea and Japan.

The other societies have been invited to join Common Structural Rules Software, LLC and some have displayed substantial interest although none have yet committed to the venture. But, we are optimistic that soon we will see other societies joining ABS and LR in this common programme.

It's not easy to step away from years of in-house software work but, having established the principle of common rules, the precedent is there – we have moved beyond developing our individual rules to support a common standard. Between LR and ABS there has been substantial give and take. It is right that we have done this and we very much hope that others will join us. Just as it was in the best interests of safety to eliminate potential competition on scantlings, so it must be in the interests of all with a stake in marine safety and efficiency that we ensure design assessment software produces the same results. Common Structural Rules Software LLC is already independent of ABS and LR with respect to daily operations and this independence will be furthered by additional classification society participation.

That something should be held 'in common' for the greater good - for the benefit of all is an old idea - but one that is as relevant today as it ever was. *NA*

The risk-based approach to Polar Code

Growing shipping activity in Polar waters, whether driven by tourism, cargo operations or oil exploration has become one of the most significant trends in ship safety over recent years.

The International Maritime Organization (IMO's) Sub-Committee on Ship Design and Equipment (DE) is working on a mandatory Code for ships operating in Polar waters - widely known as the Polar Code, to supplement other regulatory instruments, including SOLAS and MARPOL. The Code will seek to address the specific risks relating to operations in Polar waters, taking into account the extreme environmental conditions and the remoteness of many locations.

The International Association of Antarctica Tour Operators (IAATO), set up in 1991, to advocate and promote safe and environmentally responsible private sector travel to the Antarctic, represents over 100 private sector companies – the majority of which are passenger ship operators. It has expressed its concern that any new rules should properly reflect the diversity of operating conditions in Polar regions. Consequently, it has been working with UK-based Safety at Sea Ltd on a risk assessment - based study of passenger vessels operating in Antarctic waters.

Dr Kim Crosbie, environmental operations director of IAATO, says: "We wanted to take into account all the diverse elements associated with operating in the Antarctic, including the geography, climate, seasonable variables and the diversity of the fleet, to evaluate the hazards, risks and possible mitigation methods. Our goal is to create a tiered risk approach which could be used in the development and application of a mandatory Polar Code."

IAATO has aimed to develop a framework for voyage risk assessment which could be used in voyage planning, preparation and execution, and for managing and authorising activity in line with safety requirements.

The organisation also wanted to get involved in the process because it was concerned that the Polar Code could become overly prescriptive using a broad-brush approach. This might have some advantages, in being relatively easy to understand and implement, for example. However, inflexibility might have an adverse impact on shipping, without any corresponding benefits in terms of safety. For example, rules that might appropriately be applied to vessels operating in the dark winter months or heavy ice conditions might not be as relevant for operations the continuous daylight of summer in ice free waters. Again, a relatively large cruise vessel that sails through ice free waters and does not land passengers, faces different safety issues to a small expedition type craft that can land up to 100 persons onshore at a time.

Cold comfort

Luis Guarin, director of Safety at Sea, comments: "Based on the research we have carried out together with IAATO, we are now strongly advocating that IMO takes a goal-based and risk-informed approach to developing requirements under the Polar Code. What we want to avoid is a 'one size fits all' set of rules and regulations. The core concept is that the requirements of a Polar Code should be based on an understanding of the level of risk implicit in particular circumstances."

An initial study carried out by Safety at Sea at IAATO's request reviewed the current operational activities of IAATO members and created a preliminary risk assessment of passenger ship operations in Antarctic waters that could be used in the planning, preparation and execution of a voyage. The process involved defining key problems, identifying potential hazards, analysing risk and assessing various Risk Control Measures (RCMs).

The description of the activities of the

Passengers exploring from *Nordkapp* on Deception Island.


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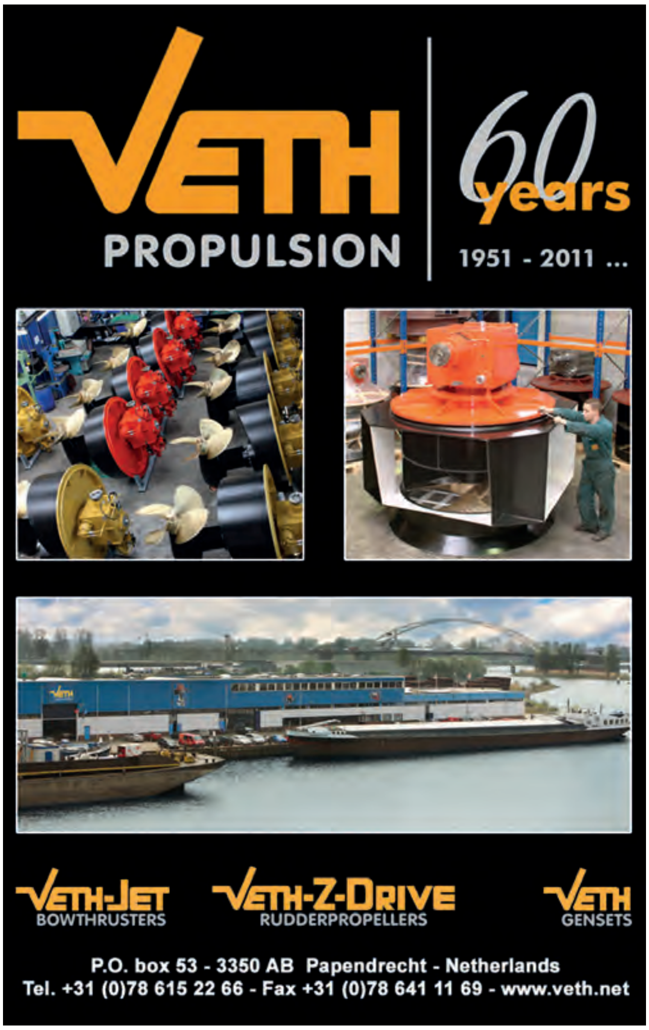
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IAATO members and their operational environment set the scene for the study and involved both an overview of the IAATO fleet and a detailed analysis of a representative vessel. The patterns of tourism were assessed and a representative voyage was identified and used as an example for the risk assessment.

In addition seven key environmental and defining features - sea ice cover, sea water temperature, sea conditions, air temperature, traffic levels, Search and Rescue (SAR) response and navigational chart coverage and availability - were evaluated and used to define five representative sea areas within the Antarctic region.

A qualitative risk assessment was undertaken to assess the potential influence of identified factors and hazards on the level of risk. A total of 25 hazards were identified including, for instance, sea ice, unknown bathymetry, and poor surveys. Subsequently, Safety at Sea assessed the potential influence of various factors and events on potential risk, specifically in terms of the impact on people, associated with passenger vessel operations in Antarctic waters.

The Safety at Sea study concluded that a high risk to human life was posed by grounding, contact with ice and medical emergencies; while a moderate risk to life was presented by a vessel becoming stranded in ice, a collision with another vessel and heavy weather damage. The most significant hazards contributing to overall risk were inexperienced crew and poorly maintained vessels. Other significant factors included localised, extreme weather; large seas and swell; and having limited assets available to carry out a rescue.

Historical analysis

The risk analysis carried out by Safety at Sea used historical casualty data and a sample voyage itinerary to assess the frequency of incidents and the incidence of exposure to grounding and ice hazards. The process also involved modelling to estimate the probability of all possible outcomes in the event of grounding or contact with ice. This included, for example, structural vulnerability, flooding vulnerability and exposure and vulnerability to environmental factors. The historic data analysed by Safety at Sea covered more than 630 ship years and 74 incidents, including 45 medical evacuations (although these were not specifically related to the operating environment), 14 groundings and five incidents of heavy weather damage.

Some 66 Risk Control Measures (RCMs) were identified, analysed and ranked. These included RCMs already implemented through international legislation such as SOLAS, STCW and ILO and IAATO's self-management systems. They also included specific requirements implicit in the IMO Guidelines for Ships Operating in Polar Waters.

The analysis assessed the extent to which RCMs were operational, as opposed to being factors related to vessel design and construction or equipment specification. It also looked at whether they were related to crew experience; associated with poorly maintained vessels; or were related to significant Antarctic environmental hazards.

The study found that over half of the identified RCMs are operational in nature, with the remainder relating to ship construction and equipment. Similarly, more than half the RCMs are for mitigation, to influence the consequences of an eventual accident, and 36% for prevention. The remaining 12% have elements of both prevention and mitigation.

At least 15% of the identified RCMs related to inexperienced crew and 12% to measures relating to significant Antarctic hazards such as localised, extreme and unpredictable weather conditions and not having SAR assets readily available. None of the measures explicitly addressed the hazards associated with poorly maintained vessels, although Safety at Sea points out that this is clearly one of the most significant factors contributing to risk.

One of the key conclusions was that the risks associated with certain events are proportional to the exposure to ice. This, it was pointed out, varies on a month to month basis within areas, and between areas of the Antarctic.

Ice strengthening

The study observed that the probability of exposure to ice hazards could be reduced to a negligible level by means of an ice routing service and by implementing effective training for ice navigation. It also came to the conclusion that it was 'reasonable' that any SOLAS vessels intending to operate in areas and times of the year where the probability of meeting ice hazards was high should be ice strengthened to some degree.

However, Mr Guarin observes: "Ice strengthened hulls could mitigate the severity of the consequences of contact with ice. However, measures to prevent the occurrence of grounding or contact with ice should be prioritised."

Given that in Antarctica SAR assets might not be readily available, damage stability standards for vessels in Antarctic waters should be consistent with the principle that the vessels is its own best lifeboat. This requires the level of survivability of a vessel to be subjected to realistic ice damage and that raking damages are fully evaluated and understood.

According to Mr Guarin: "Current damage stability standards, including those implicit in SOLAS 2009, do not cover such items. These standards are based on damage characteristics relating to collisions with vessels and do not explicitly address the issues of survival time, an important consideration in the Antarctic."

Risks associated with other events, such as grounding, are voyage-specific and are almost independent from exposure to ice. The study also pointed out that factors such as the availability of search and rescue assets vary both geographically and seasonally and that this has implications for RCMs. It further recommended that measures aimed at increasing crew understanding and competence should be prioritised.

"Even slight variations in factors such as itinerary, destinations, month and so on can lead to big variations in risk. These variations have to be accounted for in any regulatory framework," suggests Mr Guarin.

In the opinion of both Safety at Sea and IAATO the findings of the study justify taking a risk-based approach within the development of the Polar Code. Mr Guarin says: "If the Code is too prescriptive then there will inevitably be some inconsistencies in how it is applied and we believe the approach we are suggesting would avoid that."

The study has now been submitted to IMO as a 'case study' to assist with the development of the Polar Code. Dr Crosbie concludes: "Discussions within IMO have started and, while it is early days, we are hopeful that the strength of this analysis will be recognised by the regulators." *NA*


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Champagne on hold

Market dynamics have ensured China's one year reign as the world's leading shipbuilding nation will end for the time being. Korea's more high-tech offerings are in vogue in 2011 and Chinese yards have hit many speed bumps this year.

The China National Shipbuilding Association (CANSI) has repeatedly voiced concerns about the difficulties facing Chinese yards this year.

CANSI noted how demand for large boxships, offshore vessels, LNG carriers and greener ships had dominated orders in 2011 to date. China's major focus, however, is on bulk carriers, tankers and small and mid-sized container vessels. Moreover, CANSI has noted how many bulker newbuild contracts had been rescinded this year as the sector faces huge overcapacity.

Another key issue facing Chinese yards is Beijing's decision to rein in loans from banks.

An official from Minsheng Financial Leasing concurred, saying: "From this year, Beijing and the central bank adjusted interest rates and deposit reserve ratios more than once, which has reduced circulating capital, and also makes the banks more cautious on issuing loans. The banks will asset risk each project more carefully and pick up some more profitable ones to provide funds."

Sunset over Chongqing but not over China's shipbuilding industry. Yards in China have slipped behind their Korean competitors again but, expect to make up ground in the coming years.

An official from Import and Export Bank of China agreed, saying: "Yes, the central bank and government's policy have not brought obvious influence till now, but it will make it more difficult for owners seeking funds now."

An official from the Korea Shipbuilders Association (Koshipa), which represents the country's nine leading yards, told *The Naval Architect*, "Korean shipyards believe they can reclaim top status in 2011 despite many uncertainties. We are optimistic on demand for containerships and offshore. Also regulation on fuel efficiency of ships could give us a chance to retake top position."

Korea was the largest shipbuilder by both volume and value from 2003 to 2009, but it relinquished the volume part of this mantle last year.

The Koshipa source, however, noted, "Chinese yards have hit difficulties with sluggish demand for bulkers, reorganisation of the top yards, rising labour costs and the erosion of price competition."

According to CANSI in the first half the completed shipbuilding volume in China stood at 30.92 million dwt, a slight increase of 4.4%. Newly received orders were, however, down by 9.2% at 21.6 million dwt, giving a total orderbook of 181.76 million dwt, down 1.4% year-on-year.

CANSI's first half report noted nearly 50% of researched companies had not received a single order in the first half. CANSI predicts that some shipbuilders will have no ships to build in the first half of next year, some might even dry up by the final quarter of 2011.

CANSI reckons consolidation among China's vast yard empire is inevitable. Ben Zhang, an independent shipbuilding analyst in Shanghai, told *The Naval Architect* that of the current 400 facilities building ocean going ships in China, there will be no more than 50 in the coming years.

CANSI's chairman, Zhang Guangqin, said at a recent forum: "Market analysts predict in the next three years the whole international shipbuilding market will decline, and there will not be a peak season like 2007 and 2008. We generally agree with this." Zhang went on to predict, "It will be difficult to receive new orders this year. We forecast the order volume will decrease 20%-30%."

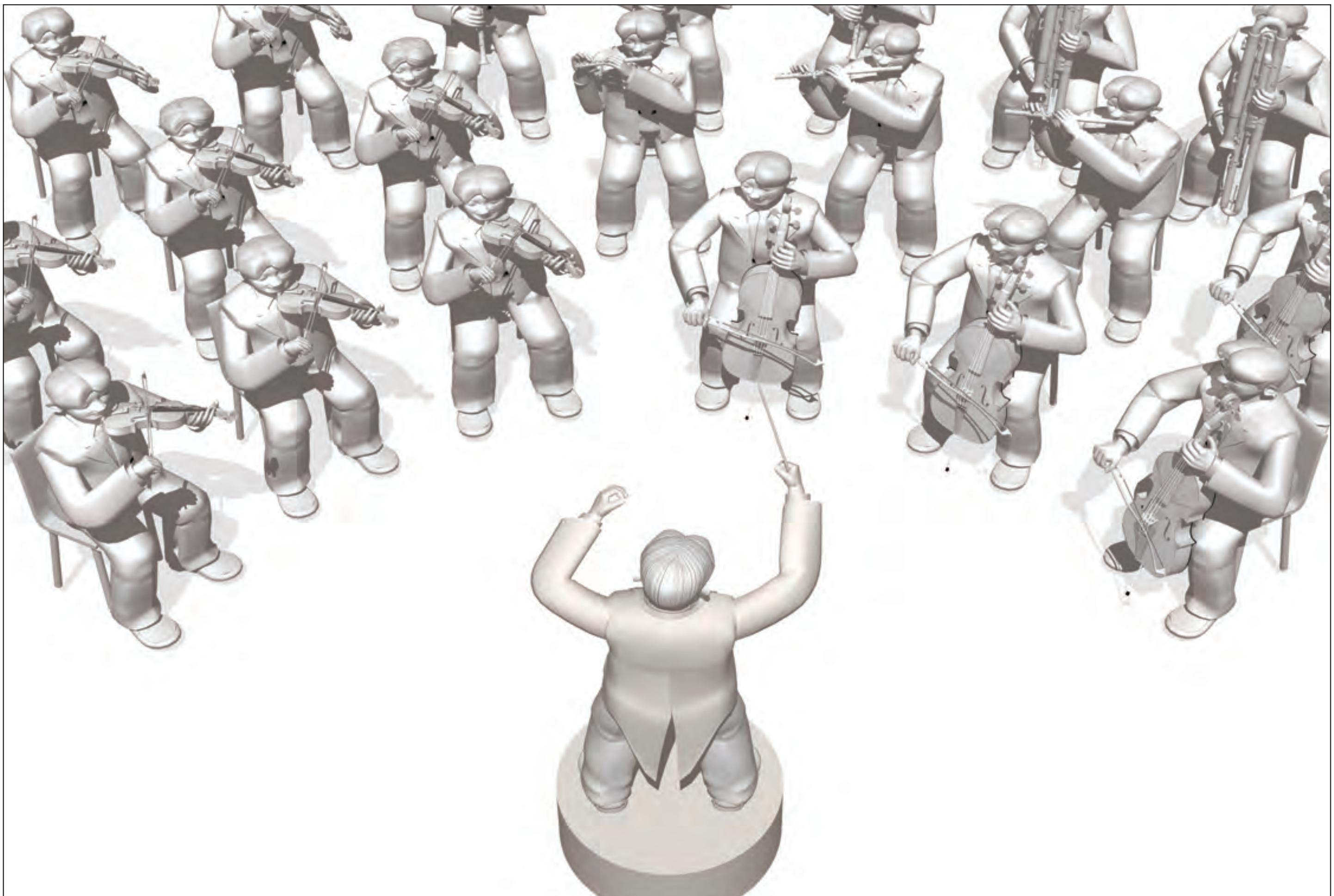
The yards are hurting. Irrational expansion across the board in the boom times have come back to haunt them. Moreover, the trickle of orders seen this year could turn to a total drought coming up.

In the first half of this year, it has been difficult for shipbuilding companies to receive new orders, but the worst period for the sector is likely to be between 2013 and 2014, according to Xu Cai, general manger of one of China's fastest growing private shipbuilders, Zhenghe Shipbuilding.

Zhenghe Shipbuilding, located at Zhoushan in Zhejiang, is a middle-sized shipbuilding company, backed by Zhenghe Shipping, focusing on handymaxes and panamaxes.

With the Baltic Dry Index so depressed Xu said the yard was contemplating offering container designs.

Currently, Zhenghe Shipbuilding is cooperating with a Japanese ship design institute to develop a new type of 67,000dwt bulker with larger capacity but lower fuel costs. *NA*



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Korean yards' China operations power ahead.

Korean yards, wary of losing competitiveness, are investing heavily in China and are successfully developing their operations into established operations, Lou Briquant reports.

Korea has entered a long tussle with China for supremacy in shipbuilding, one that both sides acknowledge can only end one way – with the Chinese on top. In the meantime, far sighted Koreans have invested in Chinese facilities, many initially as block builders that are this year graduating to fully fledged shipbuilders. With Beijing loosening the strict guidelines for foreigners investing in Chinese yards, whereby they can now build ships above 100,000dwt, the path is clear for many Koreans to cash in.

In February this year Daewoo Shipbuilding and Marine Engineering's relatively new Chinese joint venture in Shandong province won a debut order from Greece. Rethymnis & Kulukundis opted for two 58,000dwt bulkers for delivery next year in February and April. The Greek owner is thought to be paying around US$60 million for the pair at DSME Shandong Co (DSSC).

Nearby DSSC in the former British concession of Weihai South Korean shipbuilder Samjin Shipbuilding Industries inked a newbuilding contract for two 4700TEU ships this June. The owner is thought to be a large German company with the price in the region of US$59 million per unit.

The vessels will have a length of 251m, a breadth of 37.3m, a depth of 19.8m and will be delivered from mid-2013.

Samjin has penned new orders for 16 ships so far this year, including four 33,500dwt bulkers, six 36,000dwt bulkers, four 58,000dwt bulkers and two 4700TEU containerships. The South Korean shipyard expects to win around 30 ship orders this year.

Qingdao Hyundai Shipbuilding shipyard, meanwhile, in August held a delivery signing ceremony for the second multipurpose dry bulk vessel *Agate* of a series of 10 ships of the project DCV36, ordered by holding company VBTH. Qingdao Hyundai was bought out a year ago by mighty Hyundai Heavy Industries.

The Project DCV36 vessels with 5200dwt, load capacity of up to 5000tonnes are

STX is expected to become the first Korean company lised on Hong Kong's Hang Seng stock exchange.

designed to carry general and bulk cargo between ports of the Black, Mediterranean, Aegean, the North and Baltic Seas. The ships Ice3 class allows operations in the Baltic and White seas during the winter season. The vessel project was designed by Marine Engineering Bureau.

No Korean firm has invested more in China than the fast evolving STX Group. Across South Korea CEOs from myriad industries fete Kang Duk Soo for his aggressive attitude to business, his roll out of IPOs to fund countless acquisitions, even his tag line for his STX Group – 'World Best' – is now adopted by many aspiring Korean industrial concerns.

Celebrating its tenth anniversary in May the STX chairman made clear the second decade of this maritime powerhouse will be just as stratospheric. Mr Kang chose Dalian in China, where he has an enormous

"...far sighted Koreans have invested in Chinese facilities, many initially as block builders that are this year graduating to fully fledged shipbuilders"

yard, to celebrate the group's tenth anniversary. At the ceremony Mr Kang pledged to make STX Group one of South Korea's seven largest conglomerates in terms of assets by 2020. The group's new 'Vision 2020' business plan aims for KRW 120 trillion (US$112 billion) in annual revenues by that date.

The group also aims to raise its operating profits 12-fold from last year to KRW 8 trillion (US$7.47 billion) by 2020.

Last year the company's assets were valued at KRW32 trillion (US$29.88 billion), and revenues hit KRW26 trillion (US$24.28 billion).

Founded by re-establishing Sangyong Heavy Industries as STX, much of the growth seen in the past 10 years has been achieved through a series of acquisitions.

It is now mulling listing its Dalian yard, with Hong Kong viewed as the most likely bourse. This would be the first ever Korean IPO in Hong Kong.

The Dalian yard will likely deliver 31 vessels this year, compared with 22 last year, Mr Kang said, as it ramps up production following its first ship handover in 2009.

The Dalian yard, which operates the world's biggest drydock, had an order backlog of 4.52 million dwt, or 77 vessels, at the end of March, according to Clarksons.

"We are working to improve our core strengths as well as boosting Dalian shipyard's profitability and sales before seeking an IPO," Mr Kang said. "We believe there will be a significant change in profitability this year."

STX, which listed an offshore arm in Singapore last year, has said it may also hold IPOs for units making cruise ships and marine engines to help fund expansion. *NA*

Container breakthrough

Yangzijiang is putting the Koreans on edge as it becomes the first yard in China to win orders for 10,000TEU container ships.

What really happens behind the gates of most of China's shipyards, especially the state run ones, is often opaque, hard to get a full, clear picture. Even listed entities can be pretty economical with details.

Not so Yangzijiang Shipbuilding, however, the Singapore-listed, Jiangsu province based yard that has become the darling of China's banks as well as the government, is keen to promote private enterprise to compete with established state run players across countless industries, not just shipbuilding.

Yangzijiang is made up of two yards, Jiangsu Yangzijiang Shipbuilding and Jiangsu New Yangzijiang Shipbuilding, on opposing banks of the Yangtze River. The older yard was established in 1956, while the new one came into being in the latter half of 2007. The older yard focuses on smaller ships with its three 50,000dwt slipways while the new one is producing some of the most talked about ships in China at present.

Yangzijiang became the first yard in the nation to get export orders for ships of 10,000TEU class, first from Canada's Seaspan for a giant seven plus 18 options deal which was swiftly followed by Germany's Peter Dohle coming in for another eight a fortnight later in June.

These giants, the largest boxships to be built on the mainland up to now, will be powered by the new super long-stroke engine type MAN B&W 10S90ME-C9, which will be built by the Sino-Japanese engine builder CSSC-MES Diesel (CMD).

Traditionally, MAN Diesel & Turbo K98-type engines have been used as prime movers by 8000-10,000TEU capacity container vessels.

Following efficiency optimisation trends in the market, where container ships have increasingly adopted lower ship speeds, the engine designer evaluated the possibility of using even larger propellers with a view to using engines with even lower speeds for propulsion.

Investigations revealed that container ships are indeed compatible with larger propeller diameters than current designs, and the high efficiencies that follow an adaptation of the aft-hull design to accommodate the larger propeller.

The new, higher-powered, super long-stroke S90ME-C9 engine type meets this trend in the market.

Seaspan initially considered the MAN B&W K98ME-C engine, but ultimately settled for the super long-stroke 10S90ME-C9 type on account of its superior fuel savings, a choice that required a redesign of the newbuildings' aft-ship to accommodate the lower engine rpm and larger propeller diameter. The yard and its design partner changed the design accordingly. Seaspan has previously built ships at Yangzijiang Shipbuilding with 6K80MC-C engines built by CMD in China.

Ole Grøne, senior vice president Promotion & Sales, MAN Diesel & Turbo, said: "We continuously keep a close eye on developments and trends within the shipping sector and have watched with interest the increasing demand for lower engine speeds and larger propeller diameters within the container segment. While our portfolio of engines already matches a broad reach of requirements, we have specifically introduced the super long-stroke S90ME-C9 to market to satisfy current trends and are very happy with its immediate adoption in the major shipbuilding markets."

The ships are 337m long, 48.2m wide and are 112,000dwt and all of them should be delivered between 2014 and 2015.

The 10,000TEU design was developed by Yangzijiang and China Shipbuilding and Marine Engineering Research and Design Institute with completely independent intellectual property rights.

Ren Yuanlin, chairman of Yangzijiang, claims: "Our ships are more advanced than those made abroad. Now, Yangzijiang Shipbuilding is developing from a national private shipbuilder to a world-class large sized shipbuilding company." For its size, Mr Ren said, the design loads 10% more boxes than ships with equivalent measurements today, and boasts a 20% decrease in fuel consumption.

Yangzijiang is set to own the largest drydock in China as the Singapore-listed company, which holds a 60% stake in Yangzi Xinfu Shipbuilding, is building a 543m by 147m dock that will be ready from 2013.

The new dock will overtake Hong Kong-listed China Rongsheng Heavy Industry's No 4 dry dock, which measures 530m by 135m and is currently the largest of its kind in the country.

Earlier this year Yangzijiang announced it was taking a 60% equity interest in Singapore marine technology and ship design consultancy CS Marine Technology Pte Ltd (CSMT).

CSMT's wholly-owned subsidiary in China, Barber-CS Marine Technology (Shanghai) Co. Ltd., specialises in marine consulting, designing and engineering for the shipbuilding and offshore sectors.

Yangzijiang Shipbuilding says the acquisition will enable it to tap into leading ship design expertise to consolidate and strengthen its current in-house design capabilities and will give it an edge over other shipbuilders by offering high value added turnkey ship-design services.

In July the yard invested US$6.54 million to take a majority stake in a Chinese steel company and its subsidiary as it seeks to lower its business costs over the longer term.

Yangzijiang's subsidiaries Jiangsu New Yangzi Shipbuilding and Yitian Investments have collectively acquired 54.47% equity interest in Runzhou Heavy Industries and its subsidiary Jiangsu New Yangzi Gas.

Runzhou's core business is steel structure and paint surface preparation and coated related business while Jiangsu New Yangzi Gas deals with the supply of gas. "This investment is expected to reduce the company's dependency on the steel structure, paint surface preparation of steel as well as coating related business," commented chairman Mr Ren at the time of the acquisition.

Aware of a likely slow up worldwide in newbuild orders, Yangzijiang this summer announced plans to get more into offshore engineering, ship repairing and even ship breaking as part of a huge diversification programme. *NA*

Rongsheng diversifies

China Rongsheng Heavy Industries only delivered its first ship four years ago, yet it is already the nation's top yard, reports Lou Briquant.

China's number one shipyard, according to shipbrokers Clarkson, is a privately held one; and just six years old. China Rongsheng Heavy Industries' rise is remarkable and well tracked. Its product mix continues to evolve though its 400,000dwt very large ore carrier (VLOC) strengths continue to grab most headlines. The yard delivered the first of 16 VLOCs this July, while it has recently grabbed orders for a series of self-designed shallow draught 205,000dwt bulkers that use less fuel. While its bread and butter products have been large bulkers and suezmaxes (the world's largest orderbook for the latter) it is diversifying, taking orders this year for 6600TEU containerships. With seven cargo holds before the engine room and one in the stern, the container layout sees nine rows and 14 columns in the cabin and seven rows and 16 columns on deck.

It is a B type freeboard. Maximum speed is a snappy 25.6knots with a 15% sea margin. Its endurance ability is 20,000 nautical miles under design draught and the main engine normal power of 51,480kW. In other words, it is both fast and reliable.

"Our 6500TEU boxship design is both very flexible and very economical to operate," comments Zhang Yong Ping, vice director at the Marine Engineering Research and Design Institute. This is down to its highly ergonomic design.

Following the successful completion of this design Rongsheng's engineering team set about adding further size options for owners to select from. Thus far, a 4250TEU and an 8500TEU design have been completed.

Having cracked the suezmax market the yard has spread its wings in tanker design and come up with an 113,000dwt aframax design and a huge 320,000dwt very large crude carrier design, both certified by ABS, the latter ranks among the largest VLCC designs in China.

In May Rongsheng delivered the world's first-ever 3000m deepwater pipe laying crane vessel (DPV); offshore will be a growing obsession.

New designs to go alongside Rongsheng's now famous pipelayer include offshore installation and removal vessels (in which Rongsheng is in discussions with AllSea from The Netherlands), FPSOs, FSOs, LNG-FPSOs, PSVs, AHTSs, jack-up rigs for shallow waters, oil platforms capable of drilling to 3000m, and semi-submersibles.

While others have struggled to get a single order this year Rongsheng continues to weave its way serenely through the drought, picking up orders left, right and centre. Chen Qiang, the company's executive president, maintains Rongsheng will receive more than US$3billion in newbuild orders this year. And even if the ship orders do dry up, there's the engine side of business that is picking up with more than 100 engine orders still to deliver and plenty more to offer following April's takeover of Anhui Quanchai Group Corp for RMB 2.15 billion (US$336.39 million) allowing Rongsheng to enter the high-speed diesel engine market.

The company plans to get 40% of sales from shipbuilding by 2015, 20% from marine engineering, as much as 25% from machine engineering and the rest from making engines, its president said earlier this year. Last year, about 94% of the company's RMB12.7 billion (US$1.98 billion) of sales came from shipbuilding. *NA*

Rongsheng's diversification into offshore and engineering sectors will bolster the yard against global recession.


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Power drive

Beijing wants more ships powered by Chinese engines. By Lou Briquant.

While China is producing far more engines than it did a decade ago, it is still not enough to satisfy Beijing's drive across countless key industries for greater self-sufficiency.

As it stands less than one in two engines for ships built in China comes stencilled with the words MADE IN CHINA. Given the future predicted turmoil of China's shipbuilding industry central government has recently issued a 'Restructuring and Revitalisation Plan for the Shipbuilding Industry'. This optimistically calls for 80% of all low- and medium-speed marine diesel engines for ships being built in China to be built domestically.

While production capacity across China's marine diesel engine industry has accelerated, there is still a big gap in technical expertise for domestic manufacturers to overcome. Wang Jinlian, general secretary of the China Association of National Shipbuilding Industry (CANSI), details the progress and pitfalls: "The domestic medium-speed diesel engine industry is developing fast. There might be a breakthrough development this year, but domestic manufacturers still need time to develop the brands, and that is even harder for low-speed diesel engines which don't seem likely to have any big breakthroughs soon."

As ship orders have dried up this year, diversifying into greater equipment manufacturing, including engines, has become a vital mantra for the many of the most adroit shipbuilding players in the world's most populous nation.

Beijing has issued a directive that 80% of all low and medium speed engines for Chinese built ships should be manufactured in China.

Sino-Norwegian LNG innovation

On 21 April 2011, Guangzhou Diesel Engine Factory and the Norwegian maritime research institute Marintek signed a co-operation agreement for the development of an innovative LNG ship engine for the Chinese market.

LNG eliminates sulphur emissions, significantly reduces NOX emissions and cuts CO_2 emissions by at least 20%.

Based on a test model of an LNG ship engine created in the research institute of Marintek in Norway, Guangzhou Diesel Engine Factory has built a corresponding engine for the Chinese market. It is expected to become popular in China for several reasons.

Firstly, using LNG as fuel does not reduce the effect of the engine compared with conventional diesel engines, something which is a common problem for other engines run on LNG. This Norwegian-Chinese 6230SG LNG engine will perform as well as a diesel motor.

Secondly, ships need to meet new International Maritime Organization (IMO) emission standards that will come into effect by 2016. These entail, among other things, that NOx emissions cannot be larger than 2 grams/Kw/h. The 6230SG LNG engine meets these requirements, and gives a 20% reduction in CO_2 emissions compared to a diesel engine with the same effect.

Thirdly, even though an LNG fuelled engine is more expensive than a conventional engine, LNG is less expensive than diesel; choosing LNG engines is an investment which pays back over time.

The Guangzhou Diesel/Marintek LNG motor is now ready for certification by DNV, and will be available in the Chinese market this year. Expect it to have a strong showing at the nation's pre-eminent shipping show, Marintec China.

Shipping's carbon footprint is under ever greater scrutiny and Norway has positioned itself as a nation with strong green maritime credentials.

"As a significant shipping nation with a clear position on climate change, Norway has made reduction of CO_2 emissions from maritime transport a priority. The co-operation between Marintek and Guangzhou Diesel makes for a concrete contribution to this aim. It also illustrates the potential in Sino-Norwegian co-operation in the maritime sector", says Consul General Tormod C. Endresen. *NA*

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Heavy-lift is a rare bright spot

China's yards are well placed to handle heavy-lift orders with a number of designs available from yards, it is the one bright spot in a bleak newbuilding landscape, reports Lou Briquant.

While most areas of shipping look overtonnaged, one that is definitely not is the heavy-lift / multipurpose sector, and that's good news for China which has myriad yards offering a wide variety of these designs.

"I cannot think of a sector in actual genuine need of more tonnage apart from the heavy-lift one," commented a depressed newbuild broker in Hong Kong.

CSC Jinling Shipyard has a 30,000dwt multipurpose heavy lift vessel design as well as a 146m long semi-submersible. Sister firm CSC Jiangdong Shipyard is offering a 12,000dwt heavy-lift version while CSC Qingshan Shipyard has just started marketing 502 and 818TEU multipurpose (MPP) ships.

Huanghai Shipyard, meanwhile, offers 25,000 and 28,000dwt MPP designs while Jiangsu Sainty has 12,000 and 25,000dwt heavy-lifters marketed at present.

Xiamen Shipbuilding Industry has seen quite a few takers for its 30,000dwt MPP container vessel, while Chipolbrok has a 30,000dwt heavy-lifter on order at Shanghai Shipyard, following on from its series of similar-sized ships ordered previously at Cosco Shipyard. Cosco's Nantong subsidiary is building 50,000dwt semi-submerisbles for a few clients including Hong Kong's United Faith. They feature a fully open stern, DP-2 dynamic positioning capability and optimised ballast tank design. They will be capable of float-on/float-off, stern load-out and float-over operations. Cosco Dalian also has a very popular 30,000dwt design that has hit double figures in orders thus far.

Chinese heavy-lift owner Cosco Shipping Co Ltd (Coscol) opted to split its 10 ship order for 27,000dwt heavy-lift ships between Taizhou Kouan Shipbuilding and Guangzhou Huangpu Shipbuilding. Coscol then booked another eight 28,000dwt newbuildings at two other domestic yards, Sino-Japanese yard Nantong Cosco KHI Ship Engineering (NACKS) and state-owned Shanghai Shipyard.

Shanghai is home to one of China's pre-eminent yards, Hudong Zhonghua, which offers a huge array of designs, 10 in total ranging from 4400dwt to 20,000dwt MPPs.

Over at Mingde Heavy Industry is one of the larger designs in the People's Republic, a 40,000dwt MPP that has attracted much market interest.

On offer at Ouhua Shipbuilding is a 16,800dwt MPP and a 31,000dwt MPP boxship. The yard has successfully developed a 29,000dwt MPP design and is developing designs for a 16800dwt offshore heavy-lift vessel and a 12,500dwt MPP.

Finally down south is Guangzhou Wenchong which has seen a number of series orders for its 20,000dwt MPP. *NA*

Another Chipolbrok ship is christened in Dalian.


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Owner backed yard takes off

HNA Group, parent of the world's fastest growing owner Grand China Logistics, bought the Jinhai yard a couple of years ago, writes Lou Briquant, and that yard has been propelled up the ranks, unsurprisingly.

Jinhai Heavy Industries owes much of its remarkable rise to being bought out by the powerful HNA Group, whose Grand China Logistics is just about the fastest growing ship owner in the world and one very loyal company to its sister firm. As well as its VLCC, capesize and kamsarmax offerings, Jinhai entered the containership business this May. Jinhai's six drydocks give it an annual capacity of six million dwt. And the company is now looking to enter the offshore market.

Jinhai has firmly placed itself as the third largest builder in China and ninth in the world, according to Clarkson's statistics.

Formerly known as Jinhaiwan Heavy Industries, the seven-year-old yard, located on Changtu Island in the Zhoushan archipelago, was acquired by HNA Group in 2009.

Its increasingly popular 229m long, 81,500dwt kamsarmax has been ordered by owners across the world, while the 180,000dwt capesize is competitively priced and the first of five 320,000dwt VLCCs is set for delivery early next year.

Chairman Jia Hongxiang has added the Titan Quanzhou Shipyard to the HNA Group's portfolio of companies.

In 2010, the company delivered 23 ships, valued at RMB14 billion (US$2.19 billion) and this year, Jinhai expects to deliver 30 ships. It entered the containership sector this year in spectacular style, winning an order from Britain's Graig Group, which, including options, totals a rarely heard 26 ships. The fuel efficicient 2000TEU ships, classed by DNV, are deemed the green feedership of the future.

Jinhai's parent HNA Group spent US$280 million this January adding another yard, Titan Quanzhou Shipyard, to its empire.

"After the purchase of Jinhai Heavy Industry, we have made detailed plans for it. Currently, it is gradually transforming from traditional shipbuilding only to become a comprehensive world-class equipment manufacturer," says a well placed source within Grand China Logistics. *NA*

Guangzhou rising

The China State Shipbuilding Corporation (CSSC) is the majority shareholder in a burgeoning large tanker and bulker building business.

The Guangzhou Longxue Shipbuilding yard, a joint venture in which CSSC is the major shareholder with China Shipping and leading steel mill Baosteel, has expanded and now has an annual capacity of 3.5 million dwt with two VLCC-sized dry docks and four 600tonne gantry cranes.

VLCCs of 308,000dwt and 230,000dwt VLOCs litter Longxue's orderbook, many for the account of minority shareholder China Shipping. Last October it started taking orders for 206,000dwt capesizes and has since taken more than 10 of this ship type. Its 76,000dwt panama tanker design and its in demand 82,000dwt kamsarmax bulker help fill the docks, while it has recently won a debut ship type, a self-designed 115,000dwt tanker.

Shanghai NorthSea Shipping became the first owner to ink a contract for this new design earlier this year. "We reckon there is a big market for this design, which has a very good load ratio," said a spokesperson.

Around 30km away from Longxue, which is an island in the Nansha district of Guangzhou, lies a smaller yard, Guangzhou Huangpu Shipbuilding which also falls under the CSSC umbrella. Huangpu is working on what will become the two largest ocean rescue vessels in China.

The Rescue and Salvage Bureau of the Ministry of Transport (MOT) ordered the high tech pair for delivery in 2012. The vessels will be equipped with hangars and landing platforms for helicopters.

According to Song Jiahui, director of the rescue and salvage bureau at the MOT, the vessels were designed and developed by Shanghai Ship Research and Design Institute and are 116.95m long, 16.2m wide and 7.8m deep and able to accommodate 200 rescued people. *NA*

Graig´s MARLIN series aims to fill feeder gap

In partnership with Wärtsilä and DNV, Graig is looking to service the next generation of ultra-large container carriers with modern feeder tonnage, reports Lou Briquant.

In a busy year of design firsts for engine maker Wärtsilä in China, the manufacturer was tasked on 14 July with supplying the ship design for a series of state-of-the-art new generation container feeders. The Cardiff-based Graig Group has ordered up to 26 fuel-efficient new generation MARLIN 2000 Blue design container feeders to be built at Jinhai Heavy Industries in Zhoushan. The first two vessels are scheduled for delivery in August and September 2013, with subsequent vessels to be delivered in pairs every two and half months.

Wärtsilä Ship Design has been in close co-operation with Graig and the DNV classification society to develop the MARLIN series which is a major leap forward for the container feeder section. The design marks a new era in the container industry's standard for environmentally sustainable, competitively priced and fuel efficient feeder vessels.

The design offers cutting edge features for container vessels. The MARLIN series delivers approximately 30% improved fuel efficiency per TEU carried, improved capacity and slow steaming potential, better loading flexibility for different container types, including a high reefer intake, and lower emissions when compared to vessels currently in service.

"This series responds to the industry's needs. There is a gap in the containership market for quality, fuel efficient, competitively-priced and environmentally-friendly feeder ships to service the ultra large containerships now being brought into service by the major lines. This advanced MARLIN family of designs will fill that gap, and we expect this order to be the first of several series of larger capacity future-proof vessels, backed by the strength of the MARLIN consortia," says Hugh Williams, CEO, Graig.

The MARLIN 2000 Blue design is intentionally targeted towards the current needs of the high growth intra-Asia trade routes, and there is demand for a series of these vessels. There are two further MARLIN concept designs, which will become more attractive to charterers as air emission standards tighten and bunker costs rise. The MARLIN 2500 Jade design is slightly larger and diesel powered, but is delivered with either scrubber or SCR emissions reduction technology, while offering similar fuel and efficiency gains. MARLIN 2500 Green is aimed at the market for feeder vessels in ECAs (Emission Control Areas) and offers dual fuel and LNG power options. *NA*

The Marlin Blue series of container feeder ships boast a 30% fuel efficiencies and will fill a gap in the feeder ship market.

China's FPSO build up driven by CNOOC

Beijing's national oil production company is leading the drive to offshore supremacy.

China National Offshore Oil Corporation (CNOOC) is at the centre of the flourishing demand for FPSOs in the People's Republic. CNOOC is the largest comprehensive oilfield service provider in the China offshore market. Its business covers from upstream to middle and downstream of marine engineering. CNOOC will develop and construct another 50 million tonnes of oil and gas production facilities in China's fast expanding offshore sector in the coming five years including the start of operations in three deepwater oil and gas fields. The aim is that by 2015 up to 100 million tonnes of oil and gas will be self-produced.

As it stands CNOOC has 17 FPSO units on its books, these include 11 newbuilds and six converted from tankers. Indeed, so rapid has CNOOC's build up of offshore infrastructure been of late, that this year it leapfrogged both Petrobras and SBM to become the world's largest operator of FPSOs. CNOOC was behind the 'Haiyang Shiyou' FPSO design which has been taken up by just about all China's offshore builders. The design comes in three production sizes: 1 million, 1.2 million or 2 million barrels of production capacity.

CNOOC will construct 50 million tonnes of oil production facilities over the next five years, including 17 FPSOs.

Its engineering branch COOEC is fast making a name for itself too building platforms both for itself and for export.

Other major FPSO builders in China include Yantai Raffles, Dalian Shipbuilding Industry Co, Shanghai Waigaoqiao and COSCO Shipyard.

While Chinese yards have no problem, these days, in building hull structures for FPSOs there are still issues on the engineering and outfitting sides, which sees many top-sides being imported from more high-tech construction firms overseas.

Yard specialists in China continue to report that the two weaknesses shipbuilders in China face when it comes to offshore construction are welding and non-destructive-examination. Nevertheless, just as the People's Republic became the world's largest shipbuilder by output volume last year, expect it to assume a similar position in offshore in the coming years. *NA*

Green's the name of the game for CCS

Green shipping is becoming a reality for China's class society as the programme to develop its green shipping rules nears fruition.

China Classification Society (CCS) has a very clear message at events around the world this year – Green Ships.

"It is not only a concept, we are working hard to achieve this goal, even though it will be a long way to go," Zhou Liwei, an official from CCS, said.

CCS started making rules for its Green Ships programme nearly two years ago. The draft is expected to be completed at the end of this year or early next year.

"Currently, most domestic companies such as shipyards, ship design teams, owners, relevant manufactures, etc don't pay much attention to environmental issues, but the Green Ships rules must be a development direction for our shipping industry. So, we need to work together with governments, associations, owners, etc to promote it," Mr Zhou said.

CCS is also promoting LNG-fuelled engines for a range of vessel types. CCS has started a trial programme and helped build two LNG refuelling stations close to Wuhan, a port city on the Yangtze River.

China Classification Society is working hard to promote green shipping developments within China.

"LNG refuelling is a new technology. It is not easy to be applied on ocean ships at present, so we have started our trial along the Yangtze River. We have built LNG refuelling stations in this area and also built ships designed for it but not big ships," Mr Zhou said. "We cannot say the LNG engine will be the trend for shipping industry, but we are sure that it must be one solution for this industry as we have responsibilities to protect our Earth. We know it will take a long time to fully apply the Green Ships rules in China, because we have so much work to do with each sector of this industry, but we will do it."

Meanwhile, a partnership announced earlier this year between ABS and CCS will focus on the offshore industry, as well as research and development and software development relating to large and technologically-advanced ships.

The two classification societies will also host training and industry seminars in areas of mutual interest including deepwater activities. *NA*

Nantong arrives en masse

Nantong, one of China's busiest cities for shipbuilding, is expanding its footprint on the global map.

Increasingly the myriad of Nantong-based shipbuilders and ship equipment manufacturers club together at big international events to promote their Yangtze city's shipping credentials.

For Nantong Changqingsha, the yard has upgraded its 35,200dwt double-hull bulk carrier design this year, and has been rewarded for its efforts with a four plus four order from a Hong Kong owner to be delivered from June next year.

"It is the hottest one we are marketing now, plus some offshore vessels," a company official said.

Jiangsu Hongqiang is planning to enter the platform supply vessel field this year.

Nantong Jiaolong, a professional on ship fitting, delivered a 120m accommodation crane barge to a Singapore owner in June. "The Singapore owner has one option, we may receive more orders from them, but it depends on their demands," said an official. Jiaolong has four business branches including shipyard and equipment manufacturing. The company has already established good relationships with Singapore clients.

Meanwhile, the yard Nantong Tongde, another expert on barge and offshore sectors, is keen to diversify into building bulkers and containerships for worldwide owners. "Currently, we have many clients based in Asia, especially from Singapore. We build barges for them, if we can bag some bulker or boxship orders that would be nice," an employee said.

Nantong is home to foreign yards too (see article on NACKS, page 56, the Kawasaki jv). These include Nantong Keppel Shipyard, a subsidiary of the Singapore offshore and repair yard Keppel. The Nantong yard focuses on offshore support vessels and tugs. Building on a single slipway, it has capacity to produce up to 35 specialised small ships a year.

Cosco Shipyard has a site in Nantong, which produces the most high tech offshore offerings that the shipbuilding subsidiary of China's largest shipping line has on its roster.

Nantong Mingde Heavy Industry offers a vast array of ship types, though the order drought has not been kind to it, and it suffered a number of cancellations. The privately held yard, founded in 2004, has more than 6000 employees and an in-house design team of 150 staff. Initially it had three slipways, one of which was dedicated to offshore. In 2009, it added a massive 400,000dwt drydock. Mingde's track record includes multipurpose vessels, offshore supply vessels and mini capesizes of 110,000dwt. In May Mingde signed a deal with Finnish naval architect and marine engineer Deltamarin to handle the design of seven bulkers of 38,000dwt for Algoma Central Corp and the Canadian Wheat Board.

The vessels are offshoots of Deltamarin's "B.delta" standard bulker design and boast both lower operating costs and greater cargo capacity. The ships will have five cargo holds and take $39,000m^3$ of cargo (see June issue, *The Naval Architect*, pg 46).

Founded in 2002, 20km from Nantong airport, Nantong Yahua Shipbuilding is a private firm focusing on geared ships and barges. Its 29,200dwt handysize bulk carrier is a popular item as are its 900TEU boxships.

Huatai Heavy Industry is a stone's throw away from mighty China Rongsheng Heavy Industries, situated in Rugao, a suburb of Nantong. Founded in August 2006 by Hong Kong investment firm Huatai Development, the comparatively small yard has 1100m of quay-line on the north shore of the Yangtze River, one slipway measuring 200m by 38m and it focuses on bulk carriers ranging in size from 30,000dwt to 37,200dwt.

Finally, manufacturers such as Nantong Masada-Mitsubishi and Nantong Liwei have enjoyed strong starts to the year, with orders on hand for the first half doubling over last year's. *NA*

Chengxi squeezes the cargo in

Yangtze River-based Chengxi yard continues to innovate with its vessel designs, as its partnership with Graig group evolves.

A good smattering of international owners on its books shows Chengxi Shipyard is one of the best thought of Yangtze River based shipbuilders. With four floating docks and a slipway, this member of the CSSC group has been a specialist in handysizes ranging in size from 10,000dwt to 45,000dwt. It then progressed to the Diamond 53,000dwt design espoused by the UK's Graig Group.

Chengxi has constantly looked to push the design envelope, squeezing as much cargo into the holds safely as is possible. It's 57,000dwt design proved a hit last year and now, this August it inked an order from Hong Kong's Jinwei for three ships of a new design, a 64,000dwt bulker, essentially an update of the 57,000dwt ship. The design was done in partnership with Shanghai Merchant Ship Design & Research Institute. Claimed to be environmentally friendly the ships are 199.9m long and 32.26m wide. The first of the trio – all classed by DNV – will be delivered in 2013. "We believe there is no other ship design out there in the market that can take as much cargo for a vessel under 200m in length," says a source at the Jiangsu province yard.

Graig China is also supervising the construction of four self-unloading 45,000dwt bulkers for Shanghai Xiang An Electric Power Shipping Co being built at Chengxi Shipyard. *NA*

Chengxi specialises with help from Graig.

Rolling on the river

Shipyards need to take note of key Chinese port data of late, and up their focus on river trading vessels.

A glance at overall port trends in 2010 and first half 2011 shows two important facets, manufacturing is moving inland and salaries are rising across the nation. This is borne out by the fact that river traffic growth outstripped coastal growth.

According to consultancy China Intelligence Online (CIO) cargo throughput on China's rivers exceeded 1.5 billion tonnes in 2010. Container throughput grew by 26.2%.

Chinese yards need to follow the trend of river trading vessels.

The Yangtze, that giant strip of water that divides the world's most populous nation in two, is the engine for this growth.

China is pumping vast sums of cash to bolster its fast growing inland water transport systems. The Ministry of Transport announced in late March it would spend RMB200 billion (US$31.28 billion) through to 2015 to ensure far smoother river journeys. There will be a total of 3000km of high-grade inland channels by 2015, ministry spokesman He Jianzhong said. Moreover, a further 1.3 billion tonnes of riverine port capacity will be added and thanks to vessel investment and further dredging the average size of ships plying China rivers will grow 67% to 800tonnes bringing down freight costs by around 10%. This means a huge opportunity for shipyards focused on smaller, riverine tonnage as huge swathes of older, and smaller tonnage are being scrapped these days to make the river less congested and more uniform ship-wise, making it more efficient to shift cargoes, as on the Mississippi or the Rhine.

"Another noticeable trend into the future," says CIO's founder, Lee Perkins, "will be the pairing of inland dry ports with coastal neighbours to further drive hinterland development."

Among engine makers, Weichai Power in particular has made much of this future area of growth and its R&D division is tasked with coming up with ideal engine solutions for the future Yangtze traffic.

Another strip of water is also primed to see much more traffic on it too. China is dredging its ancient Grand Canal so that ships will be able to head all the way from Beijing to Ningbo in the future. While most rivers in China are east to west, the 2500-year-old Grand Canal is a bit of a rarity heading south from the capital through five provinces to Hangzhou on the East China Sea, where it links to a river to Ningbo. Currently the canal is only serviceable from Hangzhou to Jining in Shandong province due to silting. However, a five-year dredging plan is now underway that will give shippers an alternative option to moving cargoes around the nation. Eventually, the whole canal will have a depth of 5.5m.

Inland waterway traffic will remain China's fastest growing cargo statistics for years to come; it's up to the yards to offer the right riverine solutions. *NA*

River potential

The Yangtze is the source of the highest cargo growth in China with a 26% increase year-on-year in containers along the Yangtze in 2010

Yards with designs for the Yangtze

- **Jiandong Shipyard**
- **Sainty Marine Corp**
- **Wuhu Xinlian Shipbuilding**
- **Yangzhou Sainty Longchuan**
- **Shipbuilding**
- **Jiangsu Eastern Heavy Industry**
- **CSIC Chuandong Shipyard**
- **CSIC Wuchang Shipyard**

Ahead of the LNG curve

China State Shipbuilding Corp's (CSSC) Hudong-Zhonghua yard wins more LNG orders. By Lou Briquant.


Dapeng Sun, China's first domestically built LNG carrier.

Hudong-Zhonghua tends to grab many of China's most prestigious orders. It was the first yard in China to grab LNG orders, a feat that earned it more gas orders this year in a joint venture comprising Japan's Mitsui OSK Lines (MOL) and China Shipping, becoming the first yard to build LNG ships for export.

Hudong-Zhonghua has delivered five out of a six vessel orders for 147,000m^3 LNG carriers thus far for domestic owners Cosco and China Merchants, and now has six 172,000m^3 membrane type ships to deliver for MOL/China Shipping.

While other yards have developed LNG designs, including Rongsheng and DSIC, Hudong Zhonghua is in pole position for this lucrative ship type.

China will need more than 65 LNG carriers by 2015 to transport the fuel, China Shipbuilding Economic Research Center said this year. The government has approved construction of LNG terminals in Guangdong, southeast Fujian province, Shanghai and eastern Zhejiang province and is planning others.

At the end of April Hong Kong's Orient Overseas Container Line (OOCL) took delivery of the first of eight 8888TEU containerships from Hudong Zhonghua. The ship has received many plaudits for its high eco-specs and received Shanghai Municipality's First Class Award for Science and Technology Advancement. It is widely perceived as the most advanced containership delivered in China to date.

A very popular item at the yard is its 87,000dwt post panamax bulker, as is its 76,000dwt panama tanker design.

With one drydock and three slipways room is now quite tight at the yard and it has received approval to expand on Changxing Island to the north of Shanghai. The new facility should be completed at the end of next year. *NA*

Rigged up

One of the flagships of state run China State Shipbuilding Corp (CSSC) is Shanghai Waigaoqiao Shipbuilding (SWS).

Famous for its pioneering 176,000dwt Green Cape design, SWS has been one of the more fortunate yards this year with a steady flow of orders. Among other popular designs at 12-year-old SWS are 319,000dwt VLCCs and 206,000dwt bulkers while for offshore it is among China's leaders for FPSOs and jack up rigs.

In early August Luxembourg-based Prospector Offshore Drilling SA (POD) announced it had ordered two jack-up drilling rigs with three options at SWS. The per-unit price was given as US$209 million. The two rigs on firm order are expected to be delivered in the first half of 2014. The deal followed the one made in December 2010 in which POD ordered two similar rigs.

The Chinese yard will build the rigs at its newly built offshore plant in Shanghai. The first of the two rigs ordered last December is due for completion after the fourth quarter of 2012. Including the latest ones, POD now has six rig options. POD had earlier ordered four similar rigs from China's Dalian Shipbuilding Industry (DSIC).

Shanghai Waigaoqiao has constructed a dedicated offshore plant under its policy to grow offshore structure construction as its core business.

At its original site there are two drydocks and two slipways. Expanding its territory SWS bought a majority stake in Shanghai Jiangnan Changxing Shipbuilding a couple of years ago, located on an island to the north of China's financial metropolis, giving it a further two drydocks and two more slipways.

SWS has its own design company called Shanghai Xinye Marine and Engineering Design Co.

New offshore entities

Offshore is a bright spot for shipyards the world over. Countless established yards around are setting up dedicated offshore subsidiaries, while others are starting from scratch and just focusing on what is expected to be a prolonged offshore boom.

In China many well known shipbuilding names are turning their offshore business into separate profit centres and certain new entities are taking the plunge.

Among the latter category, perhaps the most exciting is a recent announcement from the north-eastern province of Shandong where a total of US$1.56 billion is being spent by Jiangsu Eastern Heavy Industry to build what it claims will be the largest offshore yard in China once it is up and running in 2014. The facility is located in the port city of Rizhao and the money is coming from Rizhao local government and Jiangsu Eastern's parent, Shanghai-listed JES Holdings. Annual revenues of RMB30-50 billion (US$4.69-7.81billion) are anticipated.

Singapore's Yantai Raffles yard has been rebranded as CIMC Raffles following the Chinese company's acquisition of the yard.

Meanwhile, two large companies from Wuhan are joining forces to create a shipyard dedicated to building offshore support vessels. Wuchang Shipbuilding Industry is investing 72% of the total initial capital of RMB2.5bn (US$390.75 million) with Wuhan Iron & Steel Co (Wisco) covering the rest.

The new company is called Wuhan Shuangliu Wuchang Shipbuilding Industry Co and it will have an annual production capacity of 24 units.

Wuchang has had some success in the past couple of years winning offshore-related orders including AHTS and PSVs at its four slipways.

Located in Hubei province Wuchang, established in 1934, belongs to state run China Shipbuilding Industry Corp (CSIC). As well as OSVs, Wuchang builds small product carriers and does some repair work.

Finally China International Marine Containers (CIMC), the world's biggest container manufacturer, in June acquired a 51% equity stake in Penglai Zhongbai Jinglu Ship Industry.

CIMC has already acquired Singaporean-affiliated offshore yard Yantai Raffles Shipyard, now rebranded as CIMC Raffles. Penglai Zhongbai Jinglu will be converted into an offshore focused yard, further helping CIMC's bid to diversify away from straight container manufacturing, an area where it has more than 70% of the global market, but one that is not looking too healthy in the years to come. *NA*

Kawasaki/Cosco jv sign-up Dalian

Few yards in the world, let alone China, can build a very large crude carrier faster than Nantong Cosco KHI Ship Engineering Co (NACKS), the Sino-Japanese joint venture in Jiangsu province.

Kawasaki Heavy Industries' 50:50 joint venture with Cosco was created in December 1995 and now produces more tonnage than Kawasaki's main yard in Sakaide city in south-western Japan.

In August 2010 NACKS won a prestigious order from A2SEA A/S, a subsidiary company of Denmark's Dong Energy Power A/S, to build a self-elevating wind turbine installation (WTI) vessel worth US$139 million.

The length overall of the ship is 132.34m, with a breadth of 39m and depth of 9m. The new jack-up vessel, *Sea Installer*, will be able to carry 8-10 offshore wind turbines

It is able to work under sea as deep as 45m and is fitted with a DP system. On NACKS' diverse orderbook it already has two other WTIs under construction.

Now 16-year-old NACKS is bursting at the seams and a new yard in the north of the country has just come on stream.

Dalian COSCO Shipbuilding Industry (DACOS), a 50:50 joint venture between Cosco and NACKS (thus giving Kawasaki a quarter share) completed the first trial voyage of its first ship on 15 June this year, a 205,000dwt bulker for Cosco. DACOS is a massive new yard spread over 1.8miles^2 of land, far bigger than NACKS 1mile^2 site. It is not to be confused with Cosco Shipyard's flagship facility in Dalian, which is a separate business strand focusing on heavylifters, post-panamaxes and offshore installations. Also on the orderbook at DACOS are more 205,000dwt bulkers and a couple of 300,000dwt VLOCs.

Construction of the first and second docks in Dalian was completed this May and they give DACOS the capacity to build up to 10 VLCCs a year. *NA*

Incat innovates by blending techologies

Unerring attention to research and development has seen constant advance in lightweight aluminium catamaran ferry design and construction at Incat, with major advances in payload and size.

The Australian company's groundbreaking deal for the first-ever vessel built under the High-Speed Craft (HSC) Code to be powered by gas turbines running primarily on liquefied natural gas (LNG) represents a new stage in the technological evolution of such vessels and could prove seminal to the high-speed ferry mode.

While aeroderivative gas turbine machinery is an established propulsion solution in the lightweight ferry sector, albeit chosen to a far lesser degree than diesel engines, Incat's adoption of gas turbine plant fuelled by LNG breaks new ground for the industry. The move is apposite not only to the prospect of ever more exacting exhaust emission controls, but also to the requirements of that segment of the business which couples tough environmental criteria with an operational requirement for very high service speeds.

Buquebus, a longstanding practitioner of Incat technology, is to use its LNG-fuelled, 50-knot newbuild in service across the River Plate.

In fact, the 99m passenger ro-ro catamaran under construction at the company's Tasmanian premises for South American operator Buquebus reflects the owner's parallel long-term considerations of economic and environmental performance. The innovative nature of the shipbuilding project stems from its combination of proven technologies, including gas fuelling, gas turbine propulsion, and ro-ro equipped wave piercing catamaran design.

With capacity for at least 1000 passengers and 153 cars, the vessel has an anticipated operating speed of 50knots and lightship speed of 53knots. It will be deployed on the company's River Plate service linking Buenos Aires and Montevideo, offering transit speeds of an order that will allow the ferry route to compete with airline traffic between Argentina and Uruguay. The vessel is scheduled for delivery in the latter part of 2012, and is being constructed to DNV class. It will be the eighth catamaran built by Incat for Buquebus and its associated companies over a 20-year period.

The passenger spaces will include tourist-, business- and first-class seating, and the duty-free shop extending over more than 1000m^2 will rank as the largest shopping area ever installed on a fast ferry.

The power plant will be two LM2500 aeroderivative-type gas turbines capable of running on either marine distillate or LNG, designed and supplied by US company GE Energy. Propulsive effect will be engendered by two Wärtsilä LJX 1720 waterjets. The specification of one prime mover and one propulsion in each hull of the catamaran compares with the usual use of two engines and two jets per hull in diesel-powered Incat vessels.

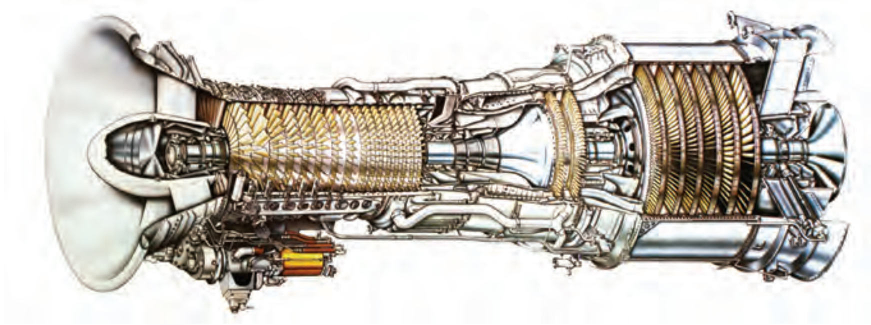
GE's modification of the fuel delivery system on the standard LM2500 design to allow the use of LNG will give Buquebus enhanced opportunities in meeting environmental goals or future emissions criteria, with anticipated companion benefits as regards operating costs. LNG will be the ferry's primary fuel, while distillate will serve as the start-up and standby fuel and will also be used for ancillary needs.

The fuel tanks for the LNG, which has to be maintained at a temperature of minus 163degs, will be installed in a compartment above the double bottom marine distillate bunker tanks. Changeover between the two fuels will be automatically controlled and will be performed as a 'seamless' operation.

The LM2500 gas turbine is derived from the CF6 family of wide-body aircraft engines. It is the power source for many industrial and electrical power generation applications around the world, using a large variety of gaseous and liquid fuels.

Incat considers that LNG will find increasing favour as the main fuel in fast ferry installations. While LNG-ingesting gas turbines may better suit those projects requiring the highest speeds, dual-fuel reciprocating engines available from a number of manufacturers provide an economic, environmentally compatible solution for applications requiring more moderate service speeds.

Within DNV, the Buquebus project is generating substantial work in the US relating to the gas turbines and LNG fuelling aspects, in Norway as regards class approval procedures, and in Australia for the follow-up with the yard and hull approval. Speaking to the society's publication 'LNG Update' about this first-ever LNG-powered high-speed vessel, Incat chairman Robert Clifford said: "We at Incat have a reputation for being first. What is unusual about this project is the combination of technologies. Each of them has been used before. That goes for turbines and it goes for gas. But, together with partners like GE and DNV, we are using the technologies in a new context."



GE LM2500 gas turbines, modified to burn either LNG or marine distillate fuel, will power the 99m Buquebus high-speed ferry due from Incat in 2012.

The plough-back of earnings into the business at the Tasmanian yard is clear both from the resources devoted to design and technological progression, and also in the evolution of the production facilities on Prince of Wales Bay at Derwent Park, near Hobart. The yard now incorporates more than 70,000m^2 of undercover production halls, with two drydock areas capable of accommodating work on up to six newbuilds. *NA*

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Seamless marine solution for rail freight

Although the number of train ferries has declined in northern Europe and elsewhere over the past decades, several new projects have been initiated in recent years as part of broader infrastructural programmes, notably in China.

Ever the innovator, and as an advocate of the benefits of such vessels in facilitating the 'seamless' movement of railborne freight across land and water, Incat has proposed a ro-ro train ferry design based on its wave piercing catamaran technology.

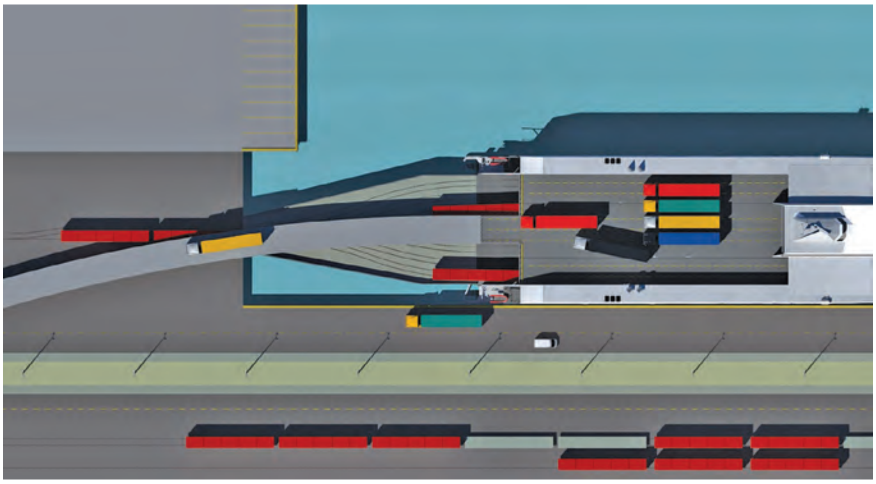
The 130m vessel would be built in compliance with the HSC Code, with a predicted speed of at least 39knots at 200dwt, and 30.4knots or more at the maximum 1700dwt.

Rails laid on the main deck would provide a total of 900 linear metres. In conjunction with the ship's deadweight, this corresponds to a maximum intake of 44 loaded rail wagons on the main deck, brought aboard over the stern using shore-based ramps. In addition, the upper deck could take 570 lane-metres of vehicles handled by way of shore ramps landing across the upper stern level, either axially or on the quarter. Passenger capacity would be nearly 200.

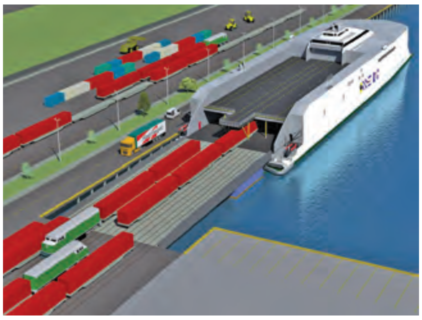
The powering arrangements for the high-speed train ferry are based on four resiliently-mounted, 20-cylinder MAN 28/33D engines rated at 9000kW apiece, or on equivalent marine diesels of the same or similar output.

Engine power will be converted to propulsive thrust using four Wartsila LJX 1500SR waterjets, configured for steering and reverse. The transmission system would comprise four ZF gerarboxes, applying reduction ratios suited for optimum jet shaft speed. Flexible couplings will be interposed between each engine and gearbox, and the shaftlines to the jets may be of either steel or composite type.

The specification includes a Maritime Dynamics active ride control system, in which aft trim tabs may be combined with an optional, retractable T-foil located at the aft end of the centre bow. *NA*



Incat has proposed a 130m wave piercer train ferry capable of making full payload speeds of 30 knots-plus.



Rail freight would be carried on the main deck, with road freight on the upper deck.

Fast Ro-Pax to strengthen Aegean network

Investments in speed requires particular business verve as well as sound project planning, since the higher power concentrations demanded put a premium on capital outlay and running costs.

In certain spheres of marine transport, and notwithstanding recent years' huge increases in fuel costs and the prospect of continued volatility in bunker prices, high sustainable speed is a vital ingredient of the competitive equation.

To an extent, the financial case for such vessels has been strengthened by design and engineering advances achieved by the specialist builders and engine makers, through improvements in the fuel cost per unit payload ratio. The business argument for renewal or expansion of the high-speed mode also gains ground where it can be shown that commitments to speed of the order ensured by today's generation of vehicle and passenger-carrying lightweight ferries exert a traffic-generating influence.

The look of speed: the 26knot *Blue Star Delos*, seen fitting out at Daewoo's Okpo yard.

TECHNICAL PARTICULARS	
Blue Star Delos	
Length overall	145.9m
Length b.p.	133.5m
Breadth, maximum	23.2m
Depth, to main deck	8.4m
Draught, maximum(summer)	5.7m
Gross tonnage	17,550tonnes
Lightship	8422tonnes
Deadweight	2270tonnes Freight, maximum 601 lane-m(plus 146 cars)
Cars, maximum	435
Max. passengers--summer	2400
Max. passengers--winter	1400
Passenger cabins/berths	32/118
Main engines	4 x 8000kW
Service speed	25.5knots
Maximum speed	26knots
Class	Bureau Veritas
Class notations	+HULL, +MACH, Unrestricted Navigation, RoRo Passenger ship, +AUT-UMS, +SYS-NEQ-1, CLEANSHIP, COMF-PAX-2, COMF-CREW-3, INWATERSURVEY, MONSHAFT
Flag	Greece

A prime example of the trigger effect of a fast ferry operation, benefiting a national economy as well as the service provider, is provided by the Maltese company Virtu Ferries, whose 107m passenger/vehicle catamaran *Jean de la Valette* represents a new stage of custom-built, high-speed ferry fleet development.

Although the owning group had started a fast catamaran service in 1988, the introduction in 2006 of the 36-knot passenger and vehicle cat *Maria Dolores* had accelerated the pace of traffic growth on the Malta/Sicily connection. Able to carry 600 passengers and 65 cars, or up to 95 truck lane-metres, the Austal-built *Maria Dolores* opened the way to high-speed transport of commercial vehicles between Malta and Italy and the wider European Union (EU) market.

The 68m *Maria Dolores* brought a step-change in capabilities, enabling a crossing time of about 90 minutes to be offered from the Maltese capital, Valletta, to the nearest Sicilian harbour, that of Pozzallo on the south coast. It also ensured that the route from Valletta to Catania, on the east coast of Sicily, could be traversed in three hours.

With *Maria Dolores*, and following Malta's enrolment into the EU in 2004, Virtu Ferries quickly attained freight levels that had originally been anticipated over a much longer timescale. In response to the need perceived in 2009 for additional international(TIR) goods vehicle capacity, Virtu returned to Austal for a larger and still faster vessel. Commissioned last year, *Jean de la Valette* provides for a ro-ro intake of 156 cars, or alternatively for 342 lane-metres of freight vehicles plus 45 cars, and for an 800-passenger complement.

Claimed to rank as the biggest HSC (High Speed Craft) Code car ferry in the Mediterranean, *Jean de la Valette* embodies Austal's Auto Express 106 design and, at 39knots, is faster than its predecessor. The capacity boost is implicit in a maximum deadweight carrying capacity of around 870tonnes. An enhanced ro-ro configuration confers the means of catering to the multi-strand evolution of the traffic. This includes the very important sector of

the freight business involving perishable produce consignments, and the growth in excursion passengers from both Malta and Sicily.

The 4.6m headroom on the main deck allows the largest trailers on European roads to be accommodated. The ro-ro spaces suit an increasingly diversified traffic, including cars, campers, coaches and vans as well as freight. Its DNV class description certifies the ferry for the bulk carriage of hazardous cargo such as LPG, diesel fuel, and petrol, widening its freight carrying scope. Ro-ro access is by way of a stern ramp and a side ramp in the portside shell just abaft the bow.

The latest catamaran's larger tunnel height is conducive to year-round operation in most weather conditions encountered in the Mediterranean.

Seating for the ferry's 800 passengers is laid out over two decks, arranged in two to three seats per row, and in a dedicated upper lounge area overlooking the vessel's forward section and bow. A central stairway leads to a first class seating area featuring natural overhead lighting and two VIP lounges. Feedback from customers has also influenced the creation of an outboard seating area for 120 passengers at the stern. Special regard has been paid to the rest needs and preferences of commercial drivers, whereby a special lounge has been provided for their exclusive use.

Punctuality and reliability are the watchwords for Virtu Ferries, and permeate all facets of the investment programme in its year-round ferry service to meet growing demand in the commercial, industrial and tourist sectors.

The track record of MTU's potent Series 8000 diesel engine as concerns reliability was one of the key factors that led to its selection for the new ferry project. Companion influences were the engine's competitive fuel consumption figure of under 190 grams per kilowatt-hour(g/kWh) and attractive power-to-weight ratio. The propulsion plant is based on four such engines of the M71L version in 20-cylinder configuration, producing a total effect of 36,400kW.

Each of the MTU engines drives a Rolls-Royce Kamewa 125SIII waterjet through a ZF gearbox. The four transmission sets from ZF Marine are of the 53800 NR2H type, and the intermediate shafts are from Centa, using FRP (fibre reinforced plastic) tubes. With the vessel's ride control system activated, the installation offers a service speed of 38.5knots at 85% maximum continuous rating (MCR). It also affords the requisite flexibility and redundancy to better ensure service dependability throughout the year and operating cost competitiveness.

The ship owner and operator has complemented its capital investment by entering into a comprehensive maintenance contract covering the MTU propulsion plant.

While minor servicing work such as filter changes and daily checks are carried out by the crew, the more extensive maintenance operations requiring specialist technical knowledge have been entrusted to MTU. The German company has assigned the actual maintenance work to Melita Power, its distributor on Malta. The contract covers the repair of components over a period of 10 years or 24,000 hours of duty, and a guarantee of parts availability for as long as 30 years.

In addition to planned and corrective maintenance, the agreement also embraces the supply over time, if required, of newer versions of genuine MTU replacement parts. In this way, the engines can be updated with the latest technical advances through the course of their working lives.

The vessel's safety outfit includes marine evacuation systems supplied by the Tasmanian specialist Liferaft Systems Australia, two Viking rescue craft mounted on the quarters, and Colbeck & Gunton passive fire protection.

Kelvin Hughes bridge equipment has been supplied through the UK company's Australian representative AMI Marine. The package includes MantaDigital radar and ECDIS(electronic chart display and information system), and features both conventional magnetron and solid state SharpEye S-band radar sensors. SharpEye solid state radar in combination with the wide-screen MantaDigital display technology and enhanced target detection suits the needs of such fast, high performance vessels especially well. *NA*

All ro-ro handling on *Blue Star Delos* is across the stern, where the two vehicle ramps are complemented by a third, narrower passenger-only ramp.


देश शक्ति
DESH SHAKTI

Latest Austal technolgy for Bornholm link

Ushering in a new phase in the development of the Scandinavian high-speed ferry network, the largest catamaran ever built by the Austal yard in Western Australia has made its debut with Danish operator Bornholmer Faergen.

The 113m *Leonora Christina* has been phased into service on the route connecting Ronne, on the Danish island of Bornholm, with the southern Swedish port of Ystad, joining an earlier product of Austal, the 86m catamaran *Villum Clausen*. The new vessel ranks as one of the world's most powerful, diesel-driven catamaran vehicle/passenger ferries, with the ability to make 40knots, carrying up to 1400 passengers and 357 cars, or the equivalent of 300 truck lane-metres of freight.

The upscaling of the concept provides its owner with increased capacity, productivity and unit cost efficiency in maintaining the concession to run the year-round island connection. The customisation of the *Leonora Christina* to fit the existing high-speed ferry berths used by *Villum Clausen* has necessitated only minimal modifications to port facilities at Ronne and Ystad, producing savings for the operator.

In addressing particularly stringent Danish regulations covering environmental noise, wave-wash and exhaust emissions, the technological standard of the Austal catamaran offering has been raised further.

Austal technology has again found favour in Scandinavia, with the 113m catamaran *Leonora Christina* entering the Bornholm traffic.

TECHNICAL PARTICULARS	
Leonora Christina	
Length overall	112.6m
Length, waterline	101.3m
Beam, moulded	26.2m
Depth	8.5m
Passengers	1400
Crew	30-35
Ro-ro capacity:	
Commercial vehicles	300 lane-m
Or maximum cars	357
Max. deadweight	1000dwt
Main engines	4 x MAN 20V28/33D
Main engine power, MCR	4 x 9100kW
Main engine power, overload	4 x 10,000kW
Service speed, 90% MCR	Approx 37knots
Maximum speed	40knots
Class	DNV

The seakeeping qualities of the design promise maximum passenger comfort throughout the 90-minute journey from Bornholm to Ystad.

Owning group Faergen's rationale for speed, and for the power margin as well as raw energy conferred by the multi-engine propulsion installation, is the need to ensure scheduling dependability as the carrier of virtually all goods, as well as the bulk of the passenger traffic, both inhabitants and tourists, to and from the island.

Although Austal makes prolific use of MTU high-speed diesel engines for its newbuild production, medium-speed machinery from MAN has been chosen for the new Danish vessel, in the shape of four Augsburg-manufactured, 20-cylinder 28/33D engines. These are among the first to have been equipped with the new TCA33 generation of MAN axial-flow turbochargers.

The maximum continuous rating is 9100kW at 1000 rev/min. However, due to a higher pressure rate, output values of up to 500kW per cylinder can be obtained, such that the engines each offer limited periods of overload at 10,000kW, running at 1032 rev/min. DNV approved the overload rating following tests at the MAN group's St Nazaire works in France.

Each main engine is connected via a flexible coupling to a Reintjes gearbox, driving a Rolls-Royce Kamewa 125 S111 waterjet. There is no cross connection between the four drivelines, and the vessel can be run at a lower speed on just two engines if required.

Villum Clausen has been transporting vehicles and passengers between Ronne and Ystad since 2000, such that owning group Faergen (formerly Nordic Ferry Services) and its predecessor Bornholmstraffiken is among the longest-standing northern European practitioners of Austal ro-ro catamaran technology.

The latest vessel project has added significance, from a commercial strategic standpoint, by virtue of the fact that the contract with Austal was sealed by the then Nordic Ferry Services during a period of acute global economic anxiety, in the early part of 2009. The nature and timing of the deal demonstrated not only a perception of continuing business promise in a niche sector, but also the ability of the designers and operator to develop a competitive solution against a backcloth, at the time, of worldwide economic and financial difficulties, and fuel price volatility. *Leonora Christina* underlines the fact that high speed remains a critical factor in the competitive equation for certain spheres of the ferry business.

The vessel maintains the tradition for high grade ferry services offered by Scandinavian operators in general, and especially well exemplified by Bornholmer Faergen, not only in terms of performance but also with regard to comfort, quality of finish, and safety.

In addition to the main deck, provision has been made for vehicles on hoistable deck sections at mezzanine level, and also abaft the superstructure on the upper deck. The maximum car intake over the three decks is 357, while the adoption of a moveable deck arrangement confers the requisite headroom for up to 300 truck lane metres, enabling a mix of freight, cars and other vehicles to be carried. Bow and stern ramps at main deck level imbue an efficient drive-through configuration, keeping turnround times to a minimum. Fire safety provisions in mind of vehicle transport include lightweight structural fire protection, zoned sprinkler systems and hydrants.

Seating for the ship's 1400 passengers is laid out over the bridge and upper decks, with the latter encompassing several distinct lounge areas. Contemporary Scandinavian design aesthetics and ample space are pervading characteristics of the interiors. Natural lighting and timber finishes deliver a feeling of light and space throughout, one aspect of which is the large skylights in the vessel's atrium.

The design and layout of the food servery is unique to Bornholmer Faergen, and reflects the aim to ensure a maximum, efficient flow of people through the food service areas in keeping with the relatively short crossing time. Efficiency of food delivery has been a correspondingly important consideration. The large galley features ergonomically adjustable bench heights and extensive food storage and preparation services, plus arrangements to enable rapid replenishment during the vessel's short staytimes in port.

The wheelhouse extends across the full width of *Leonora Christina* and provides bridge personnel with maximum visibility. Integral bridge wing stations better enable the master and officers to fulfil the task of docking the ferry in the confined ports of Ronne and Ystad, especially in winter fog, snow and other adverse conditions.

The bridge outfit includes fully integrated monitoring and control arrangements, featuring Austal's MarineLink system, affording the ability to oversee and control the propulsion, generating, safety and other operationally critical systems. *NA*

EU boosts Malta's HS ferry link

Malta's enrolment into the European Union in 2004 and strategic investments by Virtu Ferries in high-speed service connections with Sicily, accessing the wider European Union (EU) market, have brought significant increases in cross-strait passenger and freight volume.

The Sicilly link has been strengthened through the realisation of a third stage of development of the Virtu fleet, entailing the commissioning of the 107m passenger/vehicle catamaran *Jean de la Valette*. (July 2010)

Claimed to rank as the biggest HSC (High Speed Craft) car ferry in the Mediterranean, *Jean de la Valette* embodies Austal's Auto Express 106 design. Capable of making 39knots, it provides for an 800-passenger complement and a ro-ro intake of 156 cars, or alternatively for 342 lane-metres of freight vehicles together with 45 cars.

A vital commercial link between Malta and Italy has been strengthened by the 107m *Jean de la Valette*, built and designed by Austal.

TECHNICAL PARTICULARS	
Jean de la Valette	
Length overall	106.5m
Length, waterline	92.4m
Breadth, moulded	23.8m
Depth, moulded	9.4m
Draught	4.9m
Gross tonnage(ITC 69)	8045gt
Net tonnage(ITC 69)	2414tonnes
Passenger capacity	800
Vehicle capacity	156 cars, or 45 cars + 342 truck lane-m
Deadweight, maximum	870tonnes
Main engines	4 x MTU 20V8000
Main engine power	4 x 9100kW
Speed, @85% MCR	38.5knots
Crew	24
Class	Det Norske Veritas
Flag	Malta

The new vessel builds on the accelerated pace of business development fostered since the introduction in 2006 of the 68m catamaran *Maria Dolores*, constructed by Austal to Virtu's specific requirements. However, *Maria Dolores* brought a step-change in capabilities, enabling a crossing time of about 90 minutes to be offered from the Maltese capital, Valletta, to the nearest Sicilian harbour, of Pozzallo.

Jean de la Valette's maximum deadweight carrying capacity of around 870tonnes and enhanced ro-ro configuration affords a substantial capacity boost to the services hitherto maintained by *Maria Dolores*, which can take 600 passengers and 65 cars, or up to 65 lane-metres of freight. The new ship is also faster than its predecessor by about four knots, although the scheduled crossing times have not been changed.

The advance in size and payload, especially as regards road freight, as well as improved onboard facilities, belie the outward resemblance between the two vessels attributable to the common application of the Auto Express design concept. The latest catamaran's larger tunnel height is conducive to year-round operation in most weather conditions encountered in the Mediterranean.

By making a fresh commitment to an Austal newbuild during the recent period of global economic downturn, Virtu Ferries secured a relatively prompt delivery and an early start to revenue flow from new investment. *Jean de la Valette* confers the means of catering to the multi-strand evolution of the traffic.

Ro-ro access is by way of a stern ramp and a side ramp in the portside shell just abaft the bow. The ro-ro spaces suit an increasingly diversified vehicular traffic, including passenger-accompanied cars, campers, tourist coaches, vans and heavy goods vehicles. The headroom on the main deck is 4.6m, allowing the largest trailers used on European roads to be accommodated. The vessel is also certified for the bulk carriage of hazardous cargo such as petrol, diesel and LPG fuel.

Seating for the ferry's 800 passengers is laid out over two decks, arranged in two to three seats per row, and in a dedicated upper lounge area overlooking the vessel's forward section and bow. A central stairway leads to a first class seating area featuring natural overhead lighting and two VIP lounges. Special regard has been paid to the rest needs and preferences of commercial drivers, whereby a special lounge has been provided for their exclusive use.

The track record of MTU's potent Series 8000 diesel engine as concerns reliability was one of the key factors that led to its selection for the new ferry project. Companion influences were the engine's competitive fuel consumption figure of under 190 grams per kilowatt-hour(g/kWh) and attractive power-to-weight ratio. The propulsion plant is based on four such engines of the M71L version in 20-cylinder configuration, producing a total effect of 36,400kW.

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The Royal Institution of Naval Architects

INTERNATIONAL CONFERENCE ON SHIP & OFFSHORE TECHNOLOGY - INDIA 2011

Technological Innovations in Shipbuilding

8 -9 December 2011, Kharagpur

Organised by

The Royal Institution of Naval Architects
and
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Second Announcement

Today, the international maritime industry faces new challenges as it responds to the global financial crisis. It is therefore understandable that the industry's priority and attention is on consolidation and survival. However, at such a time it is all the more important for the industry to look ahead in order to respond to the continuing challenges it will face from the increasing demands of operators, regulators and society for greater efficiency, safety and the protection of the environment, as it emerges from the current crisis. This response will require innovative thinking from all sectors of the maritime industry, and particularly those involved in ship design and construction.

The first International Conference on Ship & Offshore Technology – India, will take "Developments in Ship Design & Construction" as its theme and will bring together members of the international maritime industry to present and discuss the latest developments in the ship design and construction process which will provide the improvements in productivity and cost-competitiveness necessary to respond to the demand for lower cost of ownership.

Papers are invited on the following topics:

- Design of all ship types
- Fabrication & welding technology
- Material developments; steels, alloys, composites, etc.
- Corrosion and coating technology
- Project management
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German yards keep doing what they do best

As an example of innovative projects in German yards, the RoFlex has to be a front runner and a good news story for the shipbuilding industry.

Flensburger Schiffbau-Gesellschaft (FSG) has been building the ships for Finnish company Bore and P&O Ferries recently entered into a time charter with Bore for one of the two newbuildings FSG delivered earlier this year for use on the Teesport - Zeebrugge route.

The 2900 lane metre newbuildings are extremely flexible in the kind of cargo they can carry, including containers, ro-ro freight, double stack mafis and over-sized SECU boxes that are used to carry newpaper reels. The ships have hoistable decks which make for greater flexibility for cargo handling, and are ice class IA which means they can be deployed in the Baltic all the year round.

KfW IPEX-Bank financed the two newbuildings and says that the hydrodynamically designed hull shape coupled with Warsila's common rail engine means that "they consume around six tonnes less fuel per day than comparable, state-of-the-art models at the same speed and transport capacity. This translates into a CO_2-reduction of around 10%.

"The shape of the rudder and propeller has also been optimised, enabling additional fuel savings of 5-10% at low speeds." The ships also comply with new international ballast water treatment with an innovative BWT (ballast water treatment) system that uses mechanical filters as well as UV light, and which has been installed by a German shipyard for the first time, according to the bank.

Meyer Werft launches *Celebrity Silhouette*, one of its most luxurious vessels delivered to date.

Meanwhile, July saw the delivery of the delivery of the 122,000gt *Celebrity Silhouette* at Meyer Werft's Papenburg yard. The ship is the fourth in a series of five that the yard has built for Celebrity Cruises and all the ships have been built in accordance with the new probabilistic and safe return to port rules which require redundant propulsion systems so that if one engine is put out of action by fire or flooding, the ship still has a working propulsion system. Another feature is the new bridge configuration with a safety command centre situated behind the bridge with responsibility for handling any emergency so as to leave the navigation team free to navigate. *Celebrity Silhouette*, in common with the other ships in the series, is equipped with state of the art energy-efficient systems, a solar power system, optimised hydrodynamics, a very efficient underwater hull coating and an energy-saving lighting system using LEDs to cut back on the demand for energy. Solar panels in use on generate sufficient electricity to power the ship's lifts.

Meyer Werft celebrated 25 years of cruise ship construction in May , harking back to the delivery of the *Homeric* in 1986 - the first cruise ship of its size to be launched sideways. As the yard itself acknowledges, there were many people who believed that the yard would go under as a result of this ship construction project, but it was only the start of a major cruise ship programme. At present the orderbook includes eight cruise ships and one LNG tanker at Meyer Werft and seven river cruise ships, one ferry and one research vessel at Neptun Werft. The value of the orderbook is about €5 billion (US$7.2 billion). The yard signed a letter of intent with Royal Caribbean in February for a 158,000gt – *Project Sunshine* - for delivery in 2014, with an option for a second ship in 2015.

Abeking & Rasmussen recently delivered the pilot vessel *Skrunda*, which has a length of 25.71m, a beam of 13m and a draught of 2.7m. The design is derived from the 25m SWATH@A&R Pilot Boats.

There have been some changes to the original design notably the engines, which have been installed in the lower hull in order to extend crew accommodation int the superstructure. The engine rooms are fitted with MAN D 2842 engines rated 809kW at 2100rpm, driving Servogear CPP through Servogear reduction gearboxes. With this redundant propulsion the trial speed was 21.4 knots.

P&S Werften's Stralsund yard has a contract from Scandlines to built two ferries to be deployed on the Rostock-Gedser route at a cost of €230 million (US$331.98 million). According to the company, the dimensions of the new ships enable them to make optimum use of the Port of Gedser.

"The hulls of the ferries are precisely adapted to the size of the channel as well as the water depth in the ports and at sea. Fuel consumption and emissions are reduced as far as possible," Scandlines says. The drive system on the ships means they can run on LNG - an important consideration because of concerns over the environment and the advent of the Baltic emission control area. *NA*

Reducing risk and improving performance

Classification society Germanischer Lloyd's strategic research is multi-faceted as senior vice president Dr Pierre Sames explains.

Among topics that GL addresses in its research are reducing the risks for transport, including the reliability of ship systems, crew performance and the human element and risk assessment technology including environmental risk evaluation criteria, Dr Sames says. GL also contributes to the work of International Maritime Organization (IMO) in this respect.

GL's research into green issues including CO_2 emissions, emission predictions and marginal abatement cost curves, also include the Energy Efficiency Design Index and the Energy Efficiency Operational Indicator. On the challenge side, Dr Sames says is the use of LNG as a ship's fuel as well as fuel cell technology.

Another side to GL's research involves increasing the availability of the ship and its systems, meaning higher profitability for the owner or operator of the vessel – essentially a smarter performance. GL delivers the tools to allow owners to meet their operational targets. Two of the tools GL provides to its clients include ship hull life cycle management and ship system life cycle management. GL Hull Manager has been on the market for a couple of years and has been very successful Dr Sames says. The class society is just finalising a new tool which is GL MachineryManager, which was presented at Nor-Shipping this year. For this, GL has a co-operation agreement with bearing manufacturer SKF.

As far as internal development is concerned, GL has been moving towards computer aided approval and doing away with drawings. Only digital drawings are used now.

GL started looking at LNG as a ship fuel four or five years ago when it became clear to the organisation that some form of emission control area (ECA) might be introduced. With the strict new requirements within ECAs, LNG could become a financially attractive alternative to other fuels. "From 2015 onward, I believe there is a commercial interest in using LNG as a ship fuel," Dr Sames says." GL is involved in a number of projects, whether in research and rule development, or in joint industry or commercial projects. One such is the conversion of the product

Dr Pierre Sames, senior vice president, Germanischer Lloyd.

tanker *Bit Viking* – the first order for Wärtsilä's LNGPac system. *Bit Viking* will be up and running this month, operating on LNG with an endurance of 10-12 days with two cylindrical gas tanks, and dual fuel engines. It will be the first GL class vessel running on LNG on.

In terms of joint development projects, GL has a number with ship designers and ship yards to develop the next generation of vessels with a gas system onboard. Various ship types are being looked at, not just container ships, but also other vessels like tankers. "They are all looking at different applications, different kinds of LNG tanks, different placement and location of tanks. There are many ideas as to what might be the optimal solution but I believe we have not yet identified the optimal solution." For example for container vessels, the size of the gas tank might mean sacrificing cargo space and clearly an owner would want to minimise that loss. "The question will come up for a container ship of a certain size or endurance what the optimum location for the gas tank is," Dr Sames explains.

The issue has been raised with regards to space on cruise ships, which need to maximise cabins and public spaces, but Dr Sames believes this is less of a problem as typically cruises are of short duration, so cruise ships will be able to return to a port where they can access a source of supply, which might not be the case with a cargo vessel with a longer itinerary.

GL also is involved in research projects, a number of which have public funding, looking at dual fuel engines, ship design and the LNG bunkering process. "We have done a lot on engines and systems but not a lot on bunkering." This is not just a technical issue but a procedural one, because in many parts of the world at the moment LNG bunkering is prohibited.

Other activities that GL is involved with are rule-making at IMO including the International Gas as Fuel Code and the update of the International Code for Gas Carriers. These are being harmonised, and "we actively contribute", Dr Sames says, bringing clients' experience and expectations into the debate. The key issue he says is that the proposals are practical, enter into force on time and do not compromise safety. Discussions at IMO (at the Bulk Liquids and Gases Sub-committee) will consider such issues as the location of tanks and whether these should be below the accommodation or not. This would create difficulties for container ships and "a huge obstacle for passenger ships, because on a cruise ship there is no place for a gas tank above accommodation".

These elements, he says, need to be sorted out. The intention for the IGF code is to have a code applicable to all vessels, all types of gases and all engines, Dr Sames says. This would include hydrogen for fuel cells. "In my opinion we should not limit our ambitions, otherwise we will need to re-do the whole thing. I hope the work at IMO will lead to the first revision of the IGF Code, but complete." Otherwise, he says there will be "continuous uncertainty for the other ship types. I would rather have a first working regulation in place than exclude certain ship types."

GL was the first class society to issue guidance on fuel cells and there is still one small vessel on Hamburg's lake, the *Alster*, which is powered by fuel cells. GL has two projects looking into fuel cells, but Dr Sames says the speed of fuel cell development has been reduced somewhat because people have refocused their activities on LNG systems. "We have scaled down our fuel cell activity and increased our LNG activity but we still have the project running."

The aim is to put fuel cells on a ship and have a working prototype. LNG can be used with a traditional engine whereas fuel cells are a different story and at the moment there is uncertainty whether fuel cell technology could be used to drive large vessels, hence the concentration on LNG.

The first fuel cell technology is likely to be used on cruise ships, yachts, or research vessels, Dr Sames believes, which sometimes operate in sensitive areas . "It will take a while before generator sets are replaced by a fuel cell system and the reason for doing this will be that fuel cells offer greater efficiency." There will come a time when fuel cell costs come down, fuel prices go up and the total cost of a fuel cell generation will be lower than a diesel based equivalent, he believes.

GL subsidiary FutureShip has been active in hull design initiatives and will have plenty of work ahead of them with the adoption of the Energy Efficiency Design Index and the need for every yard to reconsider their vessels, in particular as far as the hull shape is concerned. "We have the technology in place to support them, "Dr Sames says. "Not just consultancy services, but we also provide the tools for those yards and designers that want to do it on their own. I believe we will see a significant evolution of ship hull forms in the next few years, driven by the EEDI requirements. And to be honest, we have not seen any particular evolution in hulls in the past decade. The only true new vessels that were developed were the very large container vessels because there were no similar vessels you could build on."

Looking at tanker designs, he says, these have remained the same for last 20 or 30 years. GL published its new tanker design concept earlier this year - Best Plus - and it was "relatively easy for us to make the vessel 16% better than required under EEDI requirements due to enter into force in 2013". This will mean that vessels will have a hull that is EEDI compliant for many years to come, he says, so there is huge potential for hull form improvement. Not only is the EEDI improved but also the safety of the vessel, while reducing costs and increasing cargo capacity "All the nice issues we did in one go, and it was not too difficult".

Potentially he believes the same formula can be applied to almost "any bulk carrier or tanker that we have today. I wouldn't be too surprised if we could look at every tanker and bulk carrier size and only with hull form optimisation we could reduce the EEDI by 10%. I don't think that is a challenge for the industry, but changing the hull form requires additional work. You need to redo all the engineering. If you go into the aft body, if you change the form and you change the interior that requires a lot of engineering effort to bring it up to production level. This is why the shipyards don't like it." *NA*

Figures still down for German yards

Germany may have already exited the recession, but shipyards are lagging behind in their figures as second quarter results are announced.

Werner Lundt, general secretary of the shipbuilders association VSM.

Second quarter figures for the outlook for German shipbuilding are not likely to be much better than the first quarter figures, according to Werner Lundt, general secretary of the shipbuilders association VSM, although he says he is still hopeful of a revival as Germany turns to specialist shipbuilding.

"What is positive is that the German shipyards have, so far, survived when confronted with bad developments and most of them have already completed the transition to new market areas," Mr Lundt says.

The name of the game these days is specialist production, or more precisely the production of specialist vessels. "We are only concentrating on the different specialised ships," Mr Lundt explains, although these encompass a wide range of vessel types." Yards like Meyer Werft, the Lurssen group and Abeking & Rasmussen had already successfully moved into new market areas long before the financial crisis.

Germany has just delivered its last containership on order. "The containership time seems to be over," says Mr Lundt. New orders that have been coming in over the last year and at the beginning of this year are all for specialist vessels, he says. There is also the first order for a ship designed to serve the erecting of offshore wind farms. This market segment gives hope to the German shipbuilding industry, although the first orders went to Polish or Far Eastern yards. The new group P&S Werften situated in the East of Germany is constructing a crane ship that may also be used for the offshore wind farm industry, Mr Lundt says. P& S was very successful in the container segment and is one of the yards that have successfully moved into new specialised sectors.

"We are optimistic, but nevertheless, employment in the German shipbuilding market has decreased," he says. From the peak in 2007, 5000 direct jobs in the shipbuilding industry have been lost. Numbers of employers dropped from 23,000 to 18,000 but are not expected to fall further, according to Mr Lundt.

There has been a scheme in progress to ensure that German yards, and other companies, could introduce short-time work, with salaries being paid partly by the government and partly by the company. The scheme was widened during the crisis and this helped "a lot" Mr Lundt says because it enabled yards to retain key employees who might otherwise seek employment elsewhere. There was also a scheme which provided credit guarantees of up to 90% for the whole industry, but this was not extended beyond 2010, which Mr Lundt says, was "too early" for shipyards because they are still suffering. Now there are no subsidies aside from some limited assistance for R&D.

Another successful area for German shipyards before the crisis was the building of naval ships. Competition in this segment has become greater as, in common with other European countries, Germany has cut back its defence budget. There are no new national orders after the frigate programme, and competition is tough on the export front, although submarine builders in Kiel are continuing to get orders. Surface vessels are more problematic, although the Lurssen Group has had some success with offshore patrol vessels.

Constructing ships that are used to build offshore wind farms, exploration and maintenance is expected to be a substantial part of German yards' business in the future. It also has good export potential because of the development of large wind farms, notably in countries like the UK, and other European countries including Scandinavia

"What is positive is that the German shipyards have, so far, survived when confronted with bad developments and most of them have already completed the transition to new market areas," Mr Lundt says"

although the Far East may be more difficult to break into.

Building ro-ros is another area which has proved very successful for Flensburger Schiffbau-Gesellschaft (FSG). Construction of river vessels has also not been much affected by the crisis, and there are a number of smaller yards placed along the rivers that specialise in this segment. These are less commercial carriers, but more geared to the passenger and river cruise market.

Although orders for the cruise industry fell during the crisis, because of the long lead time for building cruise ships, yards still had enough work to carry them over the critical period, and now the cruise lines are beginning to order again.

The kind of ship types on order in German ship yards has totally changed, Mr Lundt says. Only four years ago 75% of the ships in the orderbook were container ships and 20% were cruise ships. Nowadays, 70% are cruise and passenger ships and yachts, with the remainder of the orderbook divided between ships to service the wind farms, tugs, ro-ro vessels and the like.

There has also been an order for a small LNG ship for Meyer Werft. German yards are also looking closely at the use of LNG for fuel, because to the new regulations due to come into force in 2015. LNG is likely to become a very interesting field which will mean modifications to engines, and also the need for LNG stations. Being in smaller LNG vessels may be a good sector. There is a lot of discussion about fixed land-based station, but there may be opportunities for the shipbuilding industry to build small LNG vessels which serve as floating LNG stations and which can be used for ship to ship transfers.

There are discussions underway in Hamburg about building a LNG station to fuel cruise ships visiting the port, however no decision has been reached and there are concerns about risks - ship to ship transfers far from the city centre may prove a more attractive option.

Mr Lundt says that ship yards are optimistic they will survive, but obviously times will continue to be tough, for the next few years. *NA*

Forjas Irizar forges ahead with latest hook

Spanish-based crane hook manufacturer Forjas Irizar has launched its latest 500tonne hook to meet the needs of the market.

The latest hook has been forged rather than cast giving the hook decreased weight.

Forjas Irizar, located in Lazkao which is part of Spain's Basque country, has been forging crane hooks to 1000tonnes SWL for almost 100 years. The 500tonne version is the latest hook of its range of 'Quad Hooks' that is in effect a double ramshorn hook.

The forged 'Quad Hook' was born from a specific client's request for a hook for a Port Crane to handle the capacity of two hooks in one. Forjas Irizar were asked if it was possible to forge it as one unit from a steel alloy, as opposed to a previous design which needed to be cast.

David Salmon, sales agent, Forjas Irizar said: "This type of hook is good for lifting large flat loads that need to keep steady, without tipping them."

In the past hooks of this design have generally been cast, but after extensive R&D, the company began to produce forged versions, with the DIN standard DIN 15402-C as a reference point. The advantages of forged hooks are a decrease in weight and size, thus a smaller crane hook being easier to manoeuvre and the use of less metal resulting in lower costs over time.

"The company has spent a lot of time refining the forged unit for the client, as previous forged projects had success in the US and The Netherlands. Forging is much superior to casting due to reduced weight of the end product and is also easier to work and gives a stronger hook", commented Mr Salmon.

During the forging process, the metal is shaped and its internal grain deforms to follow the general shape of the part. The grain becomes continuous throughout, resulting in improved mechanical properties and strength characteristics. Therefore, the parts produced have a longer life, which results in less frequent replacement

The main application for the 'Quad Hook' is as a replacement where two ramshorn hooks are used in the same block when used with four ropes, which must equally distribute the load.

These hooks are generally used in cranes with at least 150tonnes lifting capacity and usual applications are in the Ports and Offshore Crane markets but the company is hopeful; that there could be a range of other applications.

"Forjas Irizar is looking at other lifting applications at sea. The main sectors that they are looking at are ports and offshore, where there is a need for to keep heavy load levels, such as on an oil rig," said Mr Salmon.

The hook itself is load tested three times in the factories test house, which is capable of load testing to 1500tonnes. Other testing is carried out in house to customer's quality requirements. Forjas Irizar hold Quality Accreditations from Lloyds Register, Bureau Veritas, DNV, Germanischer Lloyd, American Bureau of Shipping. ISO as well as approvals from many well known crane manufacturers.

Besides manufacturing crane hooks, Forjas Irizar produces complete block assemblies, sheaves, crane rail wheels, heavy duty shackles and various other lifting forgings. *NA*

Forjas Irizar has launched it new hook with an eye on other applications.


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Liebherr joins forces

In a climate that is seeing an increase in vessel size and operational demands German-based Liebherr, along with Logmarin and Bedeschi have joined forces to create more efficient solutions for the demand of a larger market.

Liebherr has been taking a closer look at what it expects will be the demands of the future market and has seen that several issue need to addressed one key development has been the use of hybrid products.

Wolfgang Pfister, head of marketing, Lieberr said: "We have seen a very active increase in efficiency and load in the area of cargo handling. There are trends that we are looking at, one of which is more intergrated solutions." Mr Pfister has highlighted that Liebherr has recently been working on an integrated solution for an offshore terminal that both utilises a conveyor system and sprinkler system for cargo handling to minimise the effects of dust.

The floating terminal Princesse Chloe was implemented by PT Mitra, Swire, CTM along with the joint effort of Logmarin, Liebherr and Bedeschi. The terminal runs off Muara Pantai, East Kalimantan in Indonesia. The system has a daily loading rate of 40,000tonnes of coal and an annual capacity exceeding 9.5 million tonnes.

Mr Pfister says: "The Princesse Chloe project is our most recent project, previously we also worked on the Princesse Ebe. Logmarin provided the logistics and approached Liebherr for the cranes to see if the capacities could be met. The type of equipment that was used in the project was dependant on the amount of the minimum/average turnover of the terminal. It is down to the requirement of the customer and the capacities that are required, each project is different."

Princesse Chloe is equipped with two heavy-duty, four-rope Liebherr floating cranes of 30tonnes capacity each. They have been fitted with grabs of $20.5m^3$ capacity, and are strategically placed in relation to the hoppers so as to minimise the slewing movement, thereby increasing the cycle time and efficiency. These heavy-duty cranes are specifically designed for offshore operations, which means they are more robust in construction and are able to perform even in adverse weather conditions.

"Princesse Chloe has a loading capacity of 50,000tonnes per day. There are two Liebherr cranes each with a 25,000tonne a day capacity, with a peak that is higher. At the moment we hear that the vessel is averaging in excess of 45,000tonnes a day, which in not always average condition's, is still significant", Mr Pfister added.

The cargo transfer takes place when the floating terminal is safely moored alongside an ocean-going vessel, with barges transporting the coal from the mine head alongside. The cranes transfer the coal from the barges into the hoppers, which then get transported through the conveyor system and the delivery ship-loader to the ocean-going vessels, without the need of shifting Princesse Chloe alongside. The luffing mechanism of the ship-loader is used to cater for the difference in the air draft of the other vessel at ballast to fully laden.

"The biggest challenge for any crane manufacturer is to develop a crane that is suitable for dry bulk cargo handling operations in open water. The two types

Princesse Chloe with Liebherr solutions onboard.

of floating cranes currently available from Liebherr – the CBG 300 and CBG 350 – are standard cranes. However, these two cranes are the result of a many years experience of Liebherr with floating crane operation. These cranes have been specifically adapted from a mechanical point of view as well as from an electronic (control system) point of view in order to be suitable for the requirements in open sea application. A "normal" shipboard crane would not be applicable for open sea operation" highlighted Mr Pfister.

Libherr has also added that due to the success on Princess Chloe two more floating units are under construction that will also have Libherr's floating cranes onboard. "These are standard floating CPG cranes that are designed for heavy duty handling and high performance", noted Mr Pfister.

Princesse Chloe at work.

Liebherr is also working on further developments of its cargo deck cranes, with bulk vessels getting bigger the need for cranes to have larger handling capacities has arisen. Liebherr has been developing its range of MPG/MPC parallel lift cranes, for Brazilian operator, Vale, which has, the largest bulk carrier constructed to date and features these cranes onboard. *NA*

Palfinger to supply wind turbines

German crane manufacture Palfinger has announced that it has received a large order for 48 of its PSM 400 from REpower Systems.

REpower Systems SE, manufacturer of wind turbines has recently invested in Palfinger Wind's crane systems with an order for 48 cranes for its turbines. Palfinger Wind will start to deliver the 48 cranes from 2012.

In the last decade, Palfinger Wind has developed a wide range of offshore cranes for these specific applications which enable the service teams of numerous wind farms to work even more efficiently. Reducing the downtime of the wind turbines to a minimum is a top priority.

Thomas Nitsch, in charge of the Wind division at Palfinger, said: "We offer our customers a well thought-out and internationally tested service concept. It is based on a number of nacelle and platform cranes which are custom-designed and perfectly matched to each other in addition to a global service network. Thanks to our "strong assistants", loading and unloading processes from supply ships and helicopter platforms become faster and safer. Handling of loads inside nacelles and platforms is also made considerably easier for the service teams."

Palfinger Wind will deliver 48 PSM 400 cranes to REpower Systems SE from next year.

The design of the cranes has been certified by classification societies such as GL or DNV. As a long-standing partner of REpower Systems SE, Palfinger Wind supplies, among other things, cranes of the PK 40002 range for the 5M and 6M wind turbines. The 5M and 6M offshore turbines with a rated power of 5075KW and a rotor diameter of 126.5m belong to the megawatt class and, therefore, to the largest and most powerful wind turbines in the world. The PK 40002 onboard crane itself has been a permanently installed standard component of these turbines since the start of production.

Matthias Bessert, commodity manager, REpower Systems SE, is pleased with the deal that has been completed and commented: "Palfinger Wind is a reliable and highly competitive partner that offers high-quality products. Its global positioning enables it to respond to customer requirements with particular flexibility. These are strong arguments for us to continue to push ahead with our collaboration." *NA*

Ace seals the deal with Bluestone

More activity in the offshore market has meant that UK-based Ace winches secured a £1.6 million contract from Bluestone Offshore earlier this year, for the design and manufacture of two comprehensive winch packages for use on the offshore support vessel *Greatship Maya*.

The Bluestone offshore project was tailor made for the client aiming at specific requirements. The main challenge for this project was the short timescales that were given for delivery of the fully completed and tested products - "the client required delivery of the products for a specific project", said Linsey Cruden, marketing executive, Ace Winches.

The complete winch system was delivered to *Greatship Maya* in May, with each winch package comprising of an 18.5tonne SWL hydraulic drum winch, 300kW containerised electric hydraulic power unit (HPU), a central control cabin, interconnecting pipework package and associated wire rope package.

The two winch packages are designed for launching and recovering a seabed frame, fitted with geotechnical investigation equipment through the ships moonpool for working in operational water depths of up to 2500m. Each winch is designed to carry 2700m of steel wire rope and the complete package has built-in heave compensation line tensioning and computerised controls package.

Ms Cruden added: "The pumps in the Hydraulic Power Unit (HPU) are installed with pump control and swash feedback which is suitable for future AHC System interface. This Bluestone package can easily be modified into an Active Heave Compensation (AHC) Winch System with a few alternations."

Ace Winches has a series of projects that are currently running for customers that involves the development of existing products on the market. *NA*

Ace supplies Bluestone Offshore with two winch packages.

Hatlapa keeps it eye on Brazil

With the ever expanding market in Brazil, German-based marine equipment supplier Hatlapa has made the offshore Brazilian market one of its key focus areas.

The past two years has seen Hatlapa appoint a new representative in Brazil, Tridente, to extend it offshore product portfolio by developing special winches and deck machinery packages suitable for extreme offshore conditions.

"The Brazilian market is very important at the moment due to the growth that we see there, which mainly comes from Petrobras and its newbuild and exploration programmes", commented Doris Schulz, group marketing manager, Hatlapa.

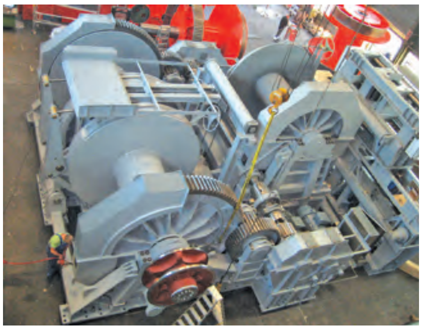
Tridente has had a long experience working in the marine and offshore market, with the company established in 1976 as a manufacturing and service business, which is what gave it appeal as a partner to Hatlapa. Tridente as a member of this latest partnership offers clients maintenance, consultancy and engineering services.

Tridente has two offices in Rio de Janeiro, Brazil one in Macae and the other in São Gonçalo. "Tridente's well-established relationships in the Brazilian market are a great asset for Hatlapa as a global business and will strengthen our position in both marine and offshore market", said Uwe Nickschat, offshore sales manager, Hatlapa.

"Everyone is focused on the oil and gas industry (in Brazil) at the moment as it will hopefully pull us out of this dip." Ms Schulz added.

Due to the rising demand of anchor handling, towing and supply (AHTS) vessels working in ever deeper water, Hatlapa saw an increase in demand of machinery onboard these vessels. To meet these needs of the market Hatlapa developed its 500tonne AHT Winch with ECO-Pull Drive Technology in 2010.

Vale Brasil gets fitted with Hatlapa's steering gear.



500tonne AHT Winch with ECO-Pull Drive Technology.

Earlier this year Hatlapa received a major contract for the supply of a steering gear to the largest bulk carrier built to-date, *Vale Brasil*. The 400,000dwt 362m long bulk carrier has been with Hatlapa's electro-hydraulic ram type steering gear Poseidon, working at a 2 x 35degs rudder angle, with a design talk of 10,205kNm.

Vale Brasil is the first in a series of seven vessels to be delivered to Brazilian mining company Vale. The vessel is the largest bulk carrier constructed to date and was launched in April this year. *NA*

MacGregor gets contract from Korea

Finnish-based Cargotec MacGregor has announced that it has signed a contract with a South Korean Shipyard for the delivery of ro-ro equipment for four deepsea con-ro vessels, being constructed for a Saudi Arabian owner.

The contract includes 1600tonnes of equipment for each vessel that consists of a jumbo quarter ramp, stern door, two ramp covers, several bulkhead doors and two levels of hoistable decks and movable access ramps, which will be delivered in 2012-2013.

"These specialist ships are designed to carry general and project cargo as well as various type of ro-ro cargo. Cargotec has great expertise and technical know-how in delivering flexible and efficient MacGregor handling solutions to our customers", said Magnus Sjöberg, sales director for ro-ro ships, Cargotec. "Furthermore, we have a long and successful relationship with the shipyard and we understand their business and processes."

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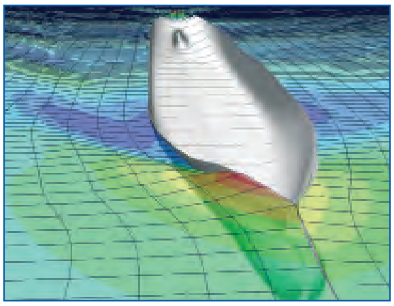

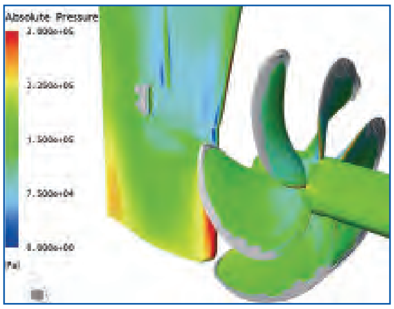

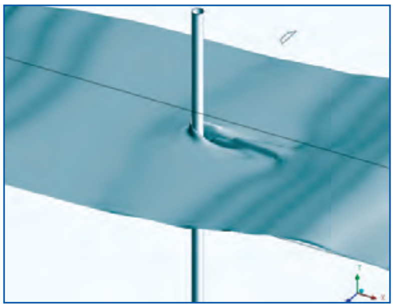

Second Announcement

Computational Fluid Dynamics (CFD) is now used to solve a wide range of maritime applications from resistance prediction to slamming loads calculation. While it may still lack the accuracy to match results obtained in real-life experiments, it can provide important insights into physical flow characteristics and offers an economic way to investigate a range of design options.

Generic CFD codes often lack some features and capabilities needed to address specific maritime applications. The presence of the free surface provides a major departure from conventional CFD applications. The need to represent this fluid interface accurately presents a considerable challenge, not least because its behaviour can vary considerably within the computational domain, and as a function of hull form and speed.

While it might not yet be possible to develop a single CFD tool suitable for all maritime applications significant progress has been made in the past two decades towards the development of the 'numerical towing tank' and 'virtual basin or cavitation tunnel'. Research and development work is still ongoing to enhance their stability, accuracy, computational speed and to integrate CFD into the overall design process.

This International conference will offer delegates an opportunity to meet and discuss the latest developments and practical marine application of CFD.

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THE NAVAL ARCHITECT

Journal of the Royal Institution of Naval Architects

APRIL 1971

Look back in wonder

In April 1971 Robin Burnett and RINA launched *The Naval Architect*, 40 years later Mr Burnett recalls the early evolution of the publication in extracts from his latest book *Water under the keel - memories of the sea.*

Graduating from his Maritime Studies degree course at Cardiff in the summer of 1969 Robin Burnett entered the cosseted world of the maritime journalist. Having qualified as a naval architect and written a thesis on developments in the design of container ships, he applied to and was elected a member of the Royal Institution of Naval Architects. Mr Burnett takes the story from here.

"At this time great strides forward were being made in the design of new roll-on/roll-off (Ro-Ro) car and passenger ferries, these were fitted with bow and stern doors so that vehicles could drive through, a novelty in deep sea vessels at the time but common enough now; the ships were stabilised for comfort and took advantage of new lightweight easily cleaned materials for outfitting public rooms and cabins.

Also at this time we were experiencing the evolution of the supertanker, initially up to 250,000dwt, first developed around 1967, and bulk carriers reaching sizes up to 150,000dwt, an evolution never dreamt of a decade earlier. Meanwhile larger than ever container ships were being designed and shore terminals built to receive them, a revolution which was to change fundamentally the carriage of dry cargo by sea.

So there was plenty to keep up with. This was an interesting life but hard work as, in addition to travelling to shipyards and ships, our editorial copy had to be ready for each monthly deadline and this at a time before we had any word processors to assist our output of copy. One had also to learn the technicalities of proof reading, setting copy and cutting and pasting the columns of print by hand, to make up pages of one's own articles to fit the designated space available.

After I had been working for IPC for about 15 months, the Royal Institution of Naval Architects (RINA) advertised for an Editor to start a new house journal. Previously, that is for about 100 years, this learned society had produced four quarterly volumes of Transactions which were verbatim reports on lectures and technical reports by eminent naval architects and engineers, complete with their ensuing discussions, thus providing a unique record of the evolution and development of ship design over more than a century.

Robin Burnett, *The Naval Architect's* first editor.

RINA had been founded in 1860 from its earlier roots in the 'Society for the Improvement in Naval Architecture' out of which the Royal Corps of Naval Constructors (RCNC) had also evolved. The original Society was founded in 1791 by a bookseller Sewell, who was convinced of the superiority of French warship design at the time; he published collected papers of the Society in 1800. The most famous works of the early Society were a series of model tests on the stability and resistance of various ship forms in which Colonel Beaufoy carried out tests in Greenland Dock, London, between 1793 and 1798 using models up to 42-foot long. The problem of estimating the resistance of full size ships was finally solved by William Froude some 70 years later.

Now RINA intended to produce more immediate news on ship design and construction along with the technical papers, which were being produced regularly for discussion at meetings. I applied successfully for the job of Editor at the RINA's headquarters, a Georgian house on the Belgravia Estate, and started work there, at the age of 38 in January 1971. I suppose you could say this was to be the height of my career.

It was certainly a challenging enough start. My first quarterly journal was to be produced by April and I was lucky enough to have the help of just one secretary, Libby Sheldon, a charming girl whom I recruited from my parents' home village of Lamarsh in Suffolk. She was the first of several editorial secretaries I had working for me over the years that followed though most chose, understandably, to move on to less technically specialised and more artistic or glamorous fields of publishing.

After much discussion with the Publications Committee we had agreed, perhaps not very imaginatively, that the journal's title should be *The Naval Architect*, but the title has survived to this day as the journal, now monthly, has become recognised as probably the world's leading journal in its field. To take on full responsibility for the production of this journal which was to serve the world's ship designers and marine engineers, was a daunting task. I did, however, have steadfast support from the Secretary of the Institution, Peter Ayling and was greatly encouraged by the President of RINA, Sir Alfred Sims KCB, RCNC, formerly Director General of Ships for the Ministry of Defence. Moral support also came from members of the RINA Council who had taken the initiative in establishing a journal, including its chairman, Alec


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Silverleaf, and other well known naval architects such as AN Harrison CB, James Paffett, then at the National Physical Laboratory, DK Brown RCNC, a great historian, and Marshall Meek, senior naval architect for Blue Funnel and designer of the new generation of Overseas Container Line (OCL) fleet of container ships which were just then coming into service.

However, no sooner were we to get down to the business of producing the first journal than there ensued a postal strike which lasted for several weeks. This was a serious worry as at that time there were no fax machines or e-mails to simplify communications. Also the budget required that we should acquire some revenue through advertising, so, in addition to writing copy and soliciting articles, because we as yet had no marketing department, I had to cajole companies into placing advertisements in a still unseen journal - I did manage to get ten though for that first issue. Then there was the production side of publishing the journal, delivering copy to our chosen printers, Unwins of Woking, setting the pages by the traditional cut and paste method and proof reading every word, again with the able help of my secretary. All was well, however, and in April 1971 we produced 7000 copies of the first RINA journal which was to my great relief well received by the Council. For the first issue I chose to display the Institution's magnificent crest in full colour on the front cover. This crest carries the inscription 'Salum et Carinae Pignora Vitae', which translates as 'to the open sea and keel of a ship we pledge our lives'.

In July of that first year I was lucky to be able to go with Sir Alfred Sims and officials of RINA to Lisbon as guests of the Portuguese institution, Ordem dos Engenheiros, where we were royally entertained, even meeting the President of Portugal. We attended joint society technical meetings, and visited shipyards including the mighty Lisnave shipyard; this had a new drydock specifically designed to build the latest type of VLCC supertankers of 250,000dwt capacity.

At that time, with the doubling of oil imports to North West Europe over the previous eight years, very large crude carriers (VLCCs) were coming into their own and naval architects had successfully faced the structural challenges of size, weight and volume in construction; indeed two tankers of 477,000tonnes deadweight capacity had just been ordered from Japan, as big as any we see plying the oceans today. There were serious design considerations for a million tonne crude oil tanker (this would have been equivalent in capacity to 16 T2 tankers like my old Stanwell, the first ship in which I had been to sea). These mammoths although technically feasible with regard to structure, propulsion, and manoeuvrability, never came to fruition due to the changing economic situation. In fact the largest tanker in service today is about 564,000tonnes. More ambitious projects of the early 1970s such as giant submarine oil tankers and ocean going air-cushion vehicles or vast hovercraft also failed to materialise.

Meanwhile, the sea transport of liquefied natural gas (LNG) and liquid petroleum gas (LPG) was, in the early seventies, a relatively new industry for which the technology was fast developing, involving high pressures and exceedingly low cargo temperatures to keep the gas liquefied in cylindrical or spherical tanks. Larger and more sophisticated gas carrier fleets were to grow rapidly over the next decade.

Oil exploration was escalating in the North Sea and elsewhere, so that a new breed of offshore vessels, drill ships, semi-submersible drilling rigs and fixed platforms were being designed and built, bringing a new dimension of marine engineering to supplement traditional ship design and cloud the divisions between the two.

In 1971 nuclear propulsion for merchant ships was at the prototype stage; the first German ship the 14,000dwt cargo ship *Otto Hahn* with a pressurised water reactor had entered service in 1968 and now the fourth, the 8200dwt *Mutsu*, was newly built in Japan. However, nuclear powered merchant ships failed to gain general acceptance. Studies around 1974 for nuclear powered German 80,000dwt containerships and US 600,000dwt tankers also came to nought due to the economics of construction. Nuclear ships were very expensive to build, maintenance was a worry and some countries, such as New Zealand would not permit them into their ports, so this technology was soon abandoned for all but a few specialised ship types such as icebreakers and naval ships.

Then there was the revolution of large container shipping as a means of transporting goods worldwide. Although British designers and shipping companies were in the forefront of this, the ships themselves were too big to be built in British shipyards. Container ships have continued to grow in size, to some four times the capacity of those original Liverpool Bay class (2300TEU or twenty-ft container unit capacity) of which I wrote in April 1971.

In fact British shipbuilding, once a proud tradition in Belfast, on the Clyde and on Tyneside was already shrinking rapidly by 1971. Britain's proportion of world shipbuilding had declined from 50% just after the war to just 10% in 1966. Elsewhere, in Scandinavia particularly, there was large investment in covered shipbuilding yards, with which we could not compete, nor could we compete with the economics of building in Japan which became the new world leader in ship construction.

The damage caused by abnormal wave conditions, and specifically freak waves, was highlighted in 1973 by severe structural damage to the Ben Line cargo vessel *Bencruachan* off South Africa, but some of the heaviest losses in high seas have been to bulk carriers. A lengthy enquiry, investigations, underwater examination and model tank tests followed the total loss of the oil and bulk carrier *Derbyshire* in 1980. Bulk carriers, which had typically grown to around 150,000tonnes deadweight in size, and could have irregular and contrasting weights of cargo loaded in adjoining holds, were liable to unacceptable longitudinal bending stresses and found to be particularly vulnerable to high seas. The formal investigation into the loss of the *Derbyshire* attributed her foundering to bow flooding and subsequent hatch cover failure. Increased strength requirements for hatch covers and corrugated bulkheads, particularly forward, have since been introduced, and double-skin construction for bulkheads were advocated by several sources including the editorial pages of *The Naval Architect*.

Double-ended roll-on/roll-off ships were becoming larger and more versatile in their carriage of lorries, containers and passengers, throughout my years working at RINA, though there were concerns expressed in the journal about the vulnerability of ships with large open car decks to instability if they should become flooded. It was not until years later, in 1987, that *Herald of Free Enterprise* disaster brought the world's attention to the horrific weakness of ro-ro ferries and prompted RINA to make a public statement drawing attention to their 'unacceptable vulnerability and the likelihood of rapid capsize when car decks are flooded`. The loss of *Estonia* in a Baltic storm in 1994 caused further shock waves and emphasised the importance of improved bow visor design and watertight bulkheads on car decks.

Another breed of ship which was just coming to the fore was the purpose-built cruise liner which succeeded those passenger ships which, through lack of regular passenger services due to air travel, had been converted for holiday cruising. The 69,529grt and 316m long Norway, which I visited and described in the July 1980 edition of *The Naval Architect* , was at the time the world's largest passenger liner with a capacity for 2000 passengers. She was in fact the old magnificent transatlantic liner *France* converted at Bremerhaven for Caribbean cruising. Since then new cruise ships have grown steadily in popularity and size with the introduction of luxurious amenities over the ensuing years, to today's undreamt of sizes, there being no better example than Cunard's 150,000gt *Queen Mary 2* which entered service in 2004. She is twice the size by volume of the well known *QE2*. But it hasn't ended there; larger ships such as the *Freedom of the Seas*, with superstructures resembling 12-story high blocks of flats, are even now coming into service.

My years with *The Naval Architect* gave me the opportunity to see a great many new cargo ships, tankers and even large cruise ships, to visit shipyards at home and abroad, and sometimes to go out on trials with new ships. Having, however, stayed with *The Naval Architect* at RINA for just on ten years while bringing out journals with what became monotonous regularity, first quarterly and later bi-monthly, I was getting itchy feet and left to take up freelance writing in July 1980. Working from home, now with a fax machine and the first Amstrad word processor to speed up communications, I enjoyed writing for several different monthly marine technical journals". *NA*

Water under the Keel - memories of the sea
by Robin Burnett Bsc, MRINA, MNI
Book Guild Publishing

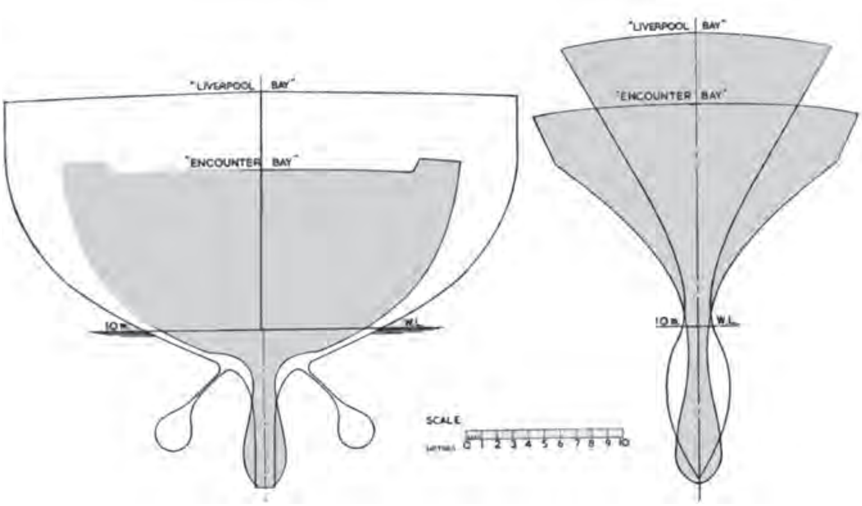
Considerations in the structural design of the new generation of OCL container ships

Experience with the 'Encounter Bays' and problem of fatigue and whipping to be overcome. (Originally printed in The Naval Architect, April 1971).

A SECOND SERIES of larger and faster ocean-going container ships was ordered by OCL in May 1969 for delivery early in 1972 to supplement the Europe and Australia trading route of the 'Encounter Bay' ships with a Far East service. The first of these five new vessels is scheduled for delivery from the Howaldtswerke-Deutsch Yard, Hamburg, in January 1972, to initiate a regular container service between Southampton, another European port, and Singapore, Malaysia, Hong Kong and Japan.

A partner on the structural design of the OCL container ships* to be read at the RINA Spring Meeting this month includes a description of the new 'Liverpool Bay' class, structural design considerations with a comparative analysis of the two classes of vessel, a report on the structural behaviour of the 'Encounter Bay' ships in service and some research into the problems of whipping and fatigue. Extracts dealing with the structural design of the latest ships and the problem of whipping stresses are given below.

The accompanying table gives particulars of the new ships compared with the earlier class. The 'Encounter Bay' class ships have been the subject of continuing study, partly to cover their satisfactory performance, and partly to provide information for the design of the new ships. It is the aim eventually to correlate for both classes the results of theoretical and model analysis, full scale static and sea-going measurements and behaviour in service.



Hull sections at 0.05 L and 0.95 L. The full beam width in the 'Liverpool Bays' is carried right aft at the upper deck to give more container space, and the flare forward considerably reduced to ease stresses from pitching.

These ships have been designed to be as large as possible. The limitations on size were those of the Panama Canal Authority, since it was thought essential that the ships should be capable of circumnavigating to and from the Far East in either direction. The overall length of 289.55m (950ft) was negotiated with the Canal Authority as the maximum for vessels transiting regularly through the 320m (1050ft) locks, and the beam of 32.30m (106ft)

PRINCIPAL PARTICULARS

	'Liverpool Bay' metres	ft	in	'Encounter Bay' metres	ft	in
Length overall	289·55	950		227·30	745	9
Length b.p.	274·32	900		213·36	700	
Breadth moulded	32·26	105	10	30·48	100	
Depth moulded	24·60	80	8½	16·46	54	
Design draught	10·97	36		9·14	30	
Scantling draught	13·0	42	7	10·67	35	
Design deadweight	34 570 tonnes			22 100 tonnes		
Block coeff. at design draught	0·595			0·60		
Displacement	58 830 tonnes			36 525 tonnes		
Max. deadweight	49 340 tonnes (estimated)			29 566 tonnes		
Design speed	26 knots			22 knots		
Design power	80 000 shp			32 000 shp		
Shaft r.p.m.	137·5			140		
Class	Lloyd's ✠ 100 A1			Lloyd's ✠ 100 A1		
Gross tonnage	45 000 BRT (estimated)			26 876 BRT		
Containers below deck (20 ft)	1948			774		
Containers above deck (20 ft)	352 (at least)			736		
Total containers	2 300 (at least)			1 510*		

* 1 300 was originally quoted but an increased deck load is now carried

The 'Liverpool Bay' ships

* 'The Structural Design of the OCL Container ships', by M. Meek, B.Sc., R. Adams, B.Sc., J. C. chapmean, B. Sc., Ph. D., H. Reibel and

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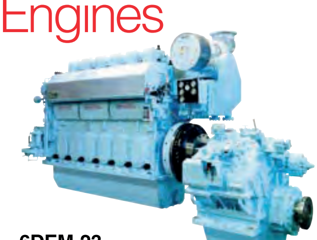

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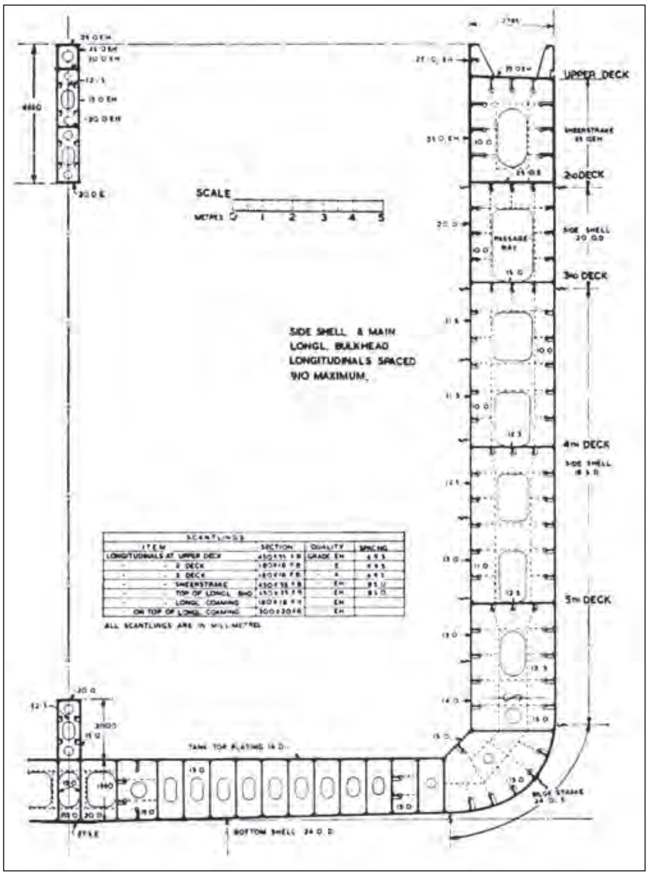
has been for some time the maximum permitted. This beam is much less than the optimum in relation to the depth, and to ensure adequate stability it has been necessary therefore to provide a capability of carrying a very large weight of liquids in the bottom, in the lower wing tanks and in the cross tanks formed at certain points by the lower portion of the double bulkheads.

The containers are carried in cells below deck and on deck. As there is not such a great requirement for refrigerated cargoes in the Far East trade, the loss of underdeck space devoted to the coolers and trucking which was necessary in the earlier class, has been obviated. Because the speed was to be as high as could be provided by a reasonable maximum power on each of two screws, the engine room was moved forward to a position between 62.3m and 98.9m from the aft perpendicular to accommodate the twin turbines and boilers giving 40,000shp each. This engine room configuration makes an important contribution towards structural strength.

The underwater hull form is conventional for a twin-screw ship and the block co-efficient is virtually the same as for the 'Encounter Bay' class. A bulbous bow is again adopted, but slightly bigger. Above water, the flare forward is appreciably reduced compare with the 'Encounter Bay' class in order to ease the forces on the hull as the bows pitch into head seas. (This will also tend to reduce torsional moments. The heavy flare of the 'Encounter Bay' class, which has also been so successful in keeping seas off the deck that not deck container has been damaged or lost, may exacerbate a form of whipping which the ships seem to experience during periods of pitching.) The 'Liverpool Bay' class have the full width of the beam carried right to the stern to give the greatest possible container capacity.

Flip-flops have again been introduced between rows of containers to give the required lead-in at the top of the guides. These devices have worked well on the first ships.

The news ships have one set of activated fin stabilisers of 80tonnes lift on each side, instead of the passive anti-rolling tanks of the earlier class, to give a more positive anti-rolling action in a greater number of conditions; also because of the number of passive tanks (four with one design and eight with another), which would otherwise have been needed, involving a large free surface of water.



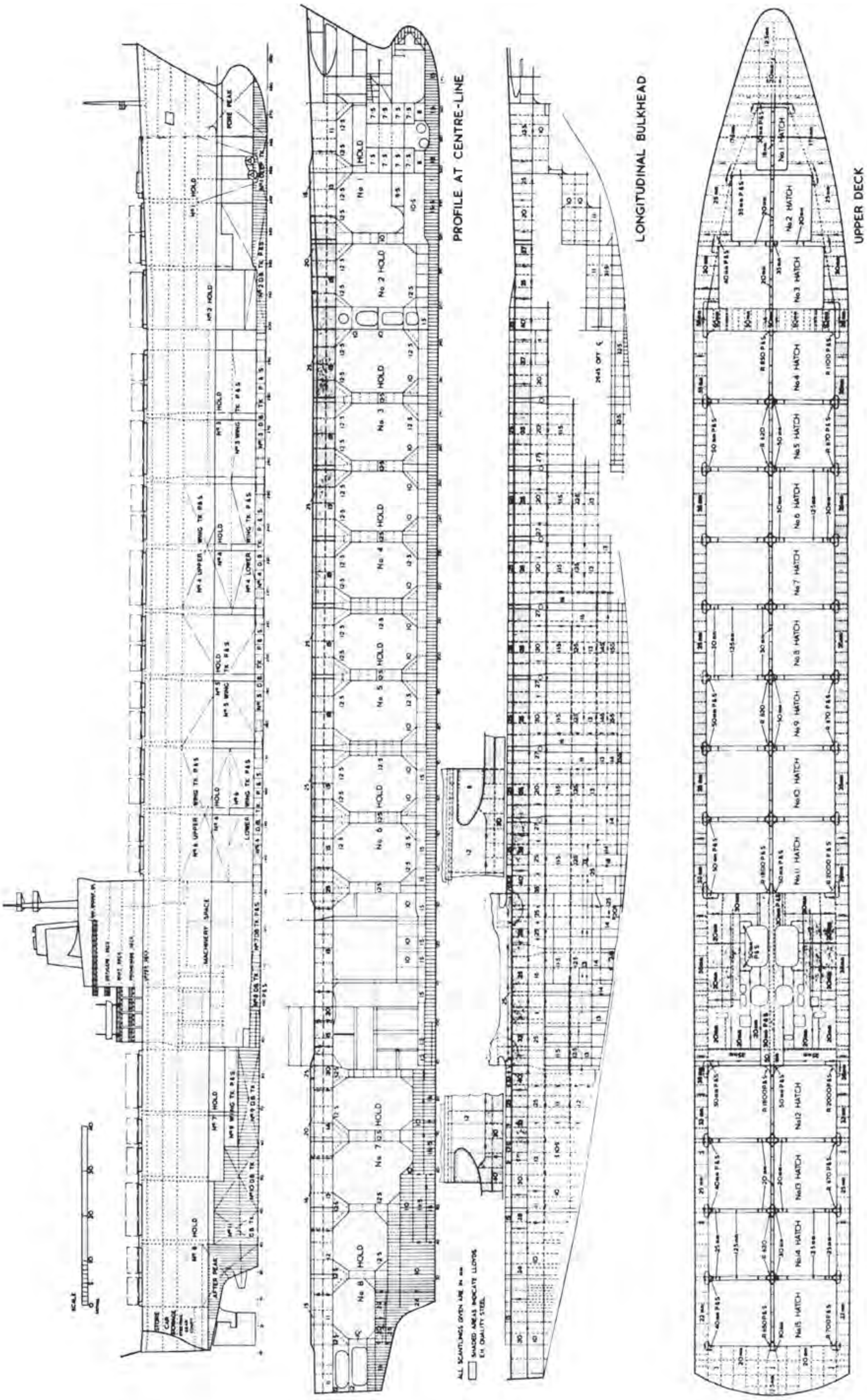
Midship section and scantlings of the 'Liverpool Bay'. The side access passageways are built in between the second and third decks; this avoids cutting through the high tensile steel of the topside structure and causing discontinuity in the transverse box girder webs near the critical upper hatch corners. Tank overflow pipes with a lower design head can also be accommodated in the access ways.

Structural design considerations

With the extra 1.78m (6ft) of beam on the 'Liverpool Bays' there was a choice of retaining nine containers abreast with an increased deck and between-hatch girder width, or of changing to ten abreast with a reduced width for structure. To accommodate more containers, and because ten abreast produced better stability, the larger number was favoured. This implied a deck width of 2.79m (9.15ft) and only a small dimension for a centre-hatch girder. From considerations of L/D ratio, the depth of the ship lay between 19.18m (65ft) (seven containers deep below deck) and 24.69m (81ft) (nine containers deep). The next step therefore was to determine whether such an open deck ship of 289.55m (950ft) in length was structurally feasible.

With the more forward position of the engine room, the uniterupted open length of ship is no greater in the 'Liverpool Bay' ships, than in the 'Encounter Bay' ships, and since the depth would be greater it appeared that the project would be feasible in respect of torsional strength; this was confirmed by tests on simple prismatic Perspex models. An important reservation was that the engine room structure should have sufficient strength and stiffness to provide restraint against warping to the open sections.

Depth of ship. To obtain a suitable modulus the use of higher tensile steel for the topside scantlings was indicated. In this material it was possible to provide the necessary modulus with any required depth within a range mentioned above. The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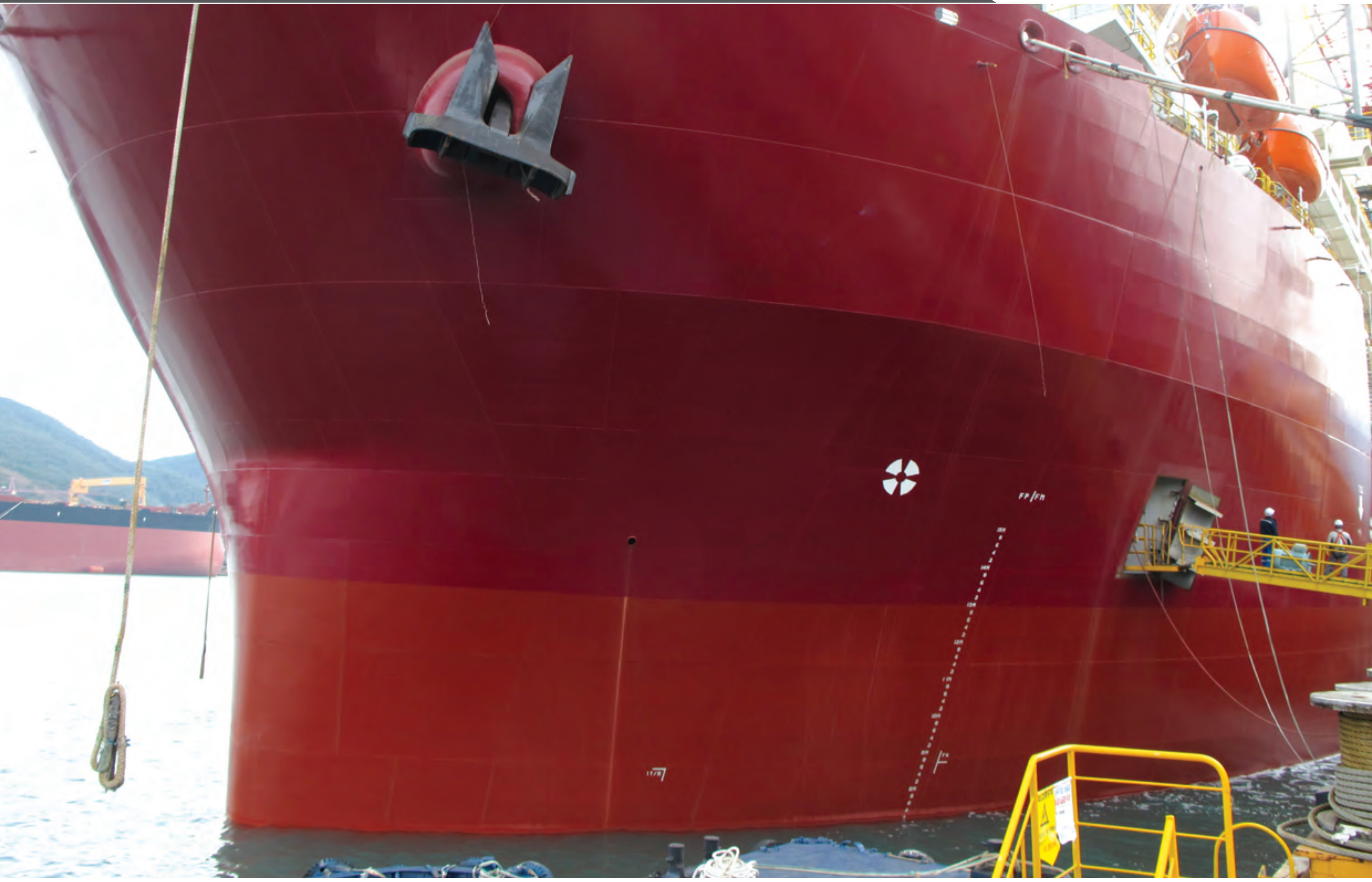

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smallest depth ship would in fact accommodate the greatest overall number of containers (because those on deck are more closely spaced) and would have somewhat better stability. But a closer examination showed that the more extensive penetration by the machinery of the strength deck of the shallower ship would probably reduce the torsional strength of the engine room structure unacceptably. Furthermore, it was felt that a deeper ship would be beneficial from the point of view of longitudinal deflection and the risk of whipping is presumably greater with a shallower ship.

In the deeper ship fewer containers are carried on deck for a given total number, and this results in faster loading because more are loaded direct into the cell guides without the need for the accurate positioning and lashing on deck; more of the containers are fully protected; and those containers which are carried on deck are, because of the greater freeboard, less liable to damage by waves. Again in the deeper ship, the smaller number of containers abreast below deck, makes it possible to use only two hatch covers in the beam of the ship. The deeper ship will also be a safer ship in terms of freeboard and damage stability.

The above considerations, of which longitudinal stiffness was perhaps the most important, led to the adoption og the 24.6m deep ship. This gives a L/D ratio of 11:16 compared to 12:96 for the 'Encounter Bay' class. Provision has been made to support the top three of the nine deep below-deck containers on a portable cradle resting on the guide structure, to avoid over-loading the containers below. Current experience of container loading suggests, however, that this device may seldom be used in the midship region, where the vertical accelerations due to ship motion are relatively small.

Draught. The design draft of the 'Encounter Bay' was 9.14m (30ft) and the maximum 10.67m (35ft). It was well that the margin was built in since the extra containers that are now being carried have resulted in service draughts considerably in excess of the original 9.14m. The same problem estimating the likely weight of containers which would produce a service draught was faced in the 'Liverpool Bay' design. Again it was thought well to build in a good margin and the maximum draught has been set at 13m (42.7ft).

Double skin construction. A further question was whether double skin construction should be adopted. For a 2.79m deck width the torsional contribution of the longitudinal bulkhead is not very great for fully restrained ends, and it can be argued that the longitudinal bulkhead material would be better employed in the deck and bottom. However, the end restraint is not accurately known and in the event of damage the double skin construction would have a greater inherited stiffness. It also gives some protection against collision. Provides tank space, increases the racking stiffness of the section, and reduces the secondary horizontal bending in the main deck box girders. For all these reasons the double wall has been adopted in the 'Liverpool Bays'.

Hatches. Because nine containers across the width suited the layout of the 'Encounter Bay' class, and because of the heavy deck container loading, it was convenient and necessary to arrange three hatches and two longitudinal hatch girders within the beam of the ship. Such hatch girders occupy space, although they can be made to contribute to the section modulus. In the 'Encounter Bays' the girders were not designed to contribute to the longitudinal bending strength of the ship, being non-continuous. Some cracking was experienced and the girders were modified after 12-18 months in service, being then made continuous and effective in sharing the longitudinal bending.

In the 'Liverpool Bays' a single centre-line girder was adopted, designed to be as effective as possible, and tying in with a box section on the tank top to form a ring structure. This results in only two large hatches in the width.

Hatch Corners. It has long been realised that the radius of hatch corners should be increased, even though such an increase adds to the length of the ship or reduces the number of containers.

In the 'Liverpool Bays' much larger corner radii have been adopted than in the 'Encounter Bays'. Circular hatch corners are used at cross deck strips because if transition or elliptical curves are postulated, opposite gradations of curvature are indicated depending on whether the longitudinal bending or the torsional stresses are being considered.

Engine room position. Mainly because of the twin screw configuration of the 'Liverpool Bays' the engine room on the larger ships is well forward of the propellers. In this way the 'open' length of the ship is divided and propeller excited vibration may be expected to be less of a problem than on the 'Encounter Bay' ships. The deck over the engine room has then been designed to contribute to the torsional strength of the ship. The opening for boiler uptakes and enconomisers and ventilation ducts in way of the engine room have therefore been carefully considered and kept to a minimum consistent and machinery requirements.

Cross deck strips. An athwardship strip of deck is needed between hatches giving sufficient access to the container lashings on deck and, of course, to support the hatch covers. In the 'Liverpool Bay' ships these cross strips have been reduced in width to the minimum necessary for access, partly to give maximum container capacity and partly to minimise stresses due to cross girder deformation over the region of maximum longitudinal bending moment.

Bulkheads. Since the container spaces are suited either for 40ft long units or for two x 20ft units it is convenient and desirable to have a form of bulkhead, at 14.70m (48ft) centres, which resist racking and support the double bottom structure.

In both the 'Encounter Bays' and the 'Liverpool Bays' the w.t bulkheads are approximately 29m (96ft) apart. Because container ships are rated

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September 26

9:00 – 10:00	Registration and Welcome
10:00 – 13:00	Papers on Ship Operation and Ship Design
13:00 – 14:30	Lunch
14:30 – 17:30	Papers on Ship Operation and Ship Design (cont'd)
19:00	Conference Dinner with Keynote Speaker

September 27

9:00 – 13:00	Papers on Future Fuels and Efficient Power
13:00 – 14:30	Farewell Buffet

Conference Fees:	If booked prior to August 20	Full fee
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simply as class VII cargo ships, there is no statutory requirement for watertight sub-division. However, for the 'Liverpool Bays' a two-compartment standard of sub-division has been adopted as a safety feature. The bulkheads are therefore w.t scantlings up to second deck level and w.t closing devices have been fitted in the longitudinal side passages. To obtain a great hatch radii within the predetermined length, space has been acquired by inclining the top 8m of the watertight and non-watertight bulkheads. Because of the reduced access across the ship in way of these inclined bulkheads the hatch end stiffeners and rest bars are then set on the inside of the end combing.

Longitudinal box girders. As can be seen from the section drawing, the side access passageways in the 'Liverpool Bay' ships are situated between the second and third decks. This position was chosen firstly to avoid cutting holes for access, pipes and electric cables in the higher tensile topside structure; secondly, it is convenient to have the oil fuel tank overflow mains situated in the passageways and the design head for oil fuel and water ballast tanks is then further reduced; and thirdly, it allows the webs of the transverse box girders to run out of the ship's side continuously and thus avoid and discontinuity near to the critical upper deck hatch corner area.

Ends of ships. The after end of the ship has been carried through at full width at upper deck level to give maximum container space, and this has the beneficial effect of contributing to torsional strength, although the torsional loading might also be increased. At both ends of the ship all internal openings in bulkheads and decks have been kept to a minimum for the same reason.

Bottom structure. Owing to the use of higher tensile steel in the topside structure, the longitudinal stress in the mild steel bottom tends to be greater in relation to the yield stress than might be expected from the geometry of the cross section. The design of the bottom structure in the 'Liverpool bays' was based on the criterion that under the combined action of longitudinal bending and bottom pressure, the total equivalent stress due to longitudinal compression, grillage action and panel bending should not exceed the yield stress.

Deckhouse. Because the deckhouse side is in line with the longitudinal bulkhead, and because the forward end of the deckhouse is in a region of high longitudinal stress and maximum warping stress, special consideration was given to the stress-raising effect of the discontinuity. A forward sweep of the deckhouse side would have interfered with the loading of containers, and a re-entrant sweep was therefore introduced.

Whipping

There is a higher than expected level of stress found in the main hull of the 'Encounter Bays'. It was difficult to see a reason for this in any comparison with other ships. However, on a winter voyage in adverse conditions in 'Encounter Bay' across the Australian Bight in July 1969, one of the authors was able to both see and feel a pronounced flexing of the ship in the seaway. This continued over quite long periods, not necessarily always associated with heavy pitching, although there was some pitching motion present at the time. The frequency of about 50c.p.m was not far from the two-node vertical vibration frequency. The flexing could be traced as it passed along the length of the ship by observing the top surface of the deck containers. The only reference, known at the time, to such a phenomenon was Bell & Taylor's report on wave excited vibration of a tanker which showed that significant stresses could be generated.

One lone-base B.S.R.A strain gauge with an autographic recording head was therefore fitted on the 'Flinders Bay' and it is clear that whipping took place. The frequency of vibration is about 50 c.p.m and the two-node vertical vibration frequency had been calculated as 45 c.p.m so that it seems reasonable to assume that this very mode is being excited. The level of vibratory stress range is quite frequently of the order of 850kgf/cm^2, so that this could well help to explain not only the higher stress levels found from the larger number of reversals. When these stress features are related to the fatigue strength of the more critical structure member and details, fatigue becomes a pressing consideration.

The pronounced bow flare of the 'Encounter Bay' class, although very successful in keeping seas off the deck containers will, it is believed, tend to worsen the whipping action, but the real significance of the flare is not yet clear quantitively. In the brief that the longer 'Liverpool Bay' ships may well be subject to the same phenomenon, the precaution has been taken of reducing their flare from that used in the 'Encounter Bays'. It is thought that the length is the primary function on which whipping depends, since the ship's natural frequency will tend to decrease with increasing length. Although not much has been reported from the long tankers now sailing, they probably do experience either wave-induced vibration or some form

The 'Flinders Bay' is the first of the earlier class to be fitted with a 19 m funnel extension and turbulator to improve smoke and flume dispersal. The vessels are being strengthened after their first year in service to overcome vibration and structural problems. A strength bulwark is being added along the whole open length to reduce whipping stresses, and to provide for the carriage of additional deck containers.

of impulse-generated whipping, but due to their slower speed, synchronous wave encounter will occur with smaller waves, and also the impulsive pitching forces will be less, due additionally to their fuller form. It is understood, however, that aircraft carriers, which have rather similar proportions and speeds to the larger container ships, do experience whipping.

A type of vibration dampener for use in such conditions has been designed at the National Physical Laboratory in Collaboration with the National Research and Development Council and was first tried out on H.M.S 'Scorpion' at Rosyth in the Autumn of 1970. It takes the form of a tank, positioned at one end of the vessel, which has a carefully dimensioned chamber where a mass of water is balanced against an enclosed volume of air. During whipping motions the effect is to produce out-of-phase damping. The success of the experiments on 'Scorpion' persuaded Ocean Fleets to investigate a design suited to the 'Encounter Bay' class. For the 'Encounter Bay' ships the tanks would contain some 110tonnes of water, of which some 40tonnes are active. In the 'Liverpool Bay' class, provision has been made in the design stages for such a device and suitable space has been allocated at the forward end in way of the deep tank.

A decision was made to increase the strength of the 'Encounter bays' at the end of their first year in service by adding a strength bulkward along the whole open ship length. Some means of supporting additional deck containers was in any case required but it was primarily the suspected effect of the unquantified whipping stresses that persuaded Ocean Fleets to recommend to OCL that a strength bulkward be added along the whole ship length, at a considerable extra cost. It is believed however that the cost is justified by the reduction in stresses that will result. NA

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The Institution believes that the safety of both the seafarer and the maritime environment begins with good design, followed by sound construction and efficient operation. Whilst naval architects and other engineers' involved in the design, construction and operation of maritime vessels and structures do not have a patent on such issues, nonetheless their work can make a significant contribution.

The Institution also believes that it has a role to play in recognising achievement of engineers' in improving safety at sea and the protection of the maritime environment. Such recognition serves to raise awareness and promote further improvements.

The Institution, in association with Lloyd's Register, is therefore introducing a new Maritime Safety Award to be presented to an individual, company or organisation which has made a significant technological contribution to improving maritime safety or the protection of the maritime environment. Such contribution can have been made either by a specific activity or over a period of time. Nominations may be made by any member of the global maritime community, and will judged by a panel of members of the Institution and Lloyd's Register. The Award will be announced and presented at the Institution's Annual Dinner.

Nominations are now invited for the 2011 Maritime Safety Award. Individuals may not nominate themselves, although employees may nominate their company or organisation.

Lloyd's Register

Nominations may be up to 750 words and should describe the technological contribution which the individual, company or organisation has made in the field of design, construction and operation of maritime vessels and structures,

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Since Liverpool Bay…

In 1999 the 18,000TEU *Malacca-Max* concept was generally considered to be impossible. Now, just 12 years later, there are ships with this capacity on order. So what have we learned since the *Liverpool Bay* class was developed 40 years ago, and what are we likely to see in the next 40 years? David Tozer reports.

The origins of containerisation are variously attributed to Atlantic Steam Navigation (John Woollam), Seatrain Lines, Sea-Land (Malcom McLean) and others. Irrespective of who or where the concept was invented, it has had a profound effect on the global shipping of all but bulk liquid and bulk dry cargoes; indeed, in recent years even some of these have been transported in containers when the economic balance has tipped in their favour.

Forty years ago the pace of design development of container ships was fast and the learning curve was steep. We should acknowledge the skills of the naval architects and marine engineers who at that time were able to anticipate the various and diverse challenges associated with these high speed ships which were, year-on-year, increasing in size and power at a dramatic rate.

A number of design milestones are indicated in the table.

Forty years ago, in the April 1971 edition of *The Naval Architect* an article was published describing the latest design of container ships – the Liverpool Bay class. There are few naval architects today who will not learn something by referring to that article.

David Tozer " Be careful when you think 'impossible'. History shows that we will probably be in for a surprise.

Panamax

Liverpool Bay class were of Panamax size, designed to the maximum dimensional limits permitted by the Panama Canal Authority, principally a beam restriction of 106 feet overall, equivalent to a moulded breadth of about 32.2m.

The maximum attained capacity of Panamax ships is now approaching 5200TEU, no mean feat for ships limited to this beam and with the small block coefficient necessary to attain the high speed requirements of the container shipping business. However, even the Liverpool Bay class with a capacity of only about 2300TEU, suffered from the Panama constraints which required the beam to be rather less than the optimum for a ship of that size. To ensure adequate stability, and to control the vertical bending moments in the hull, it was necessary to carry large amounts of ballast water. This remains an issue for Panamax container ships to this day, and is exacerbated by the modern requirements for ballast water management which make the use of ballast water even more problematic than it was 40 years ago.

"Liverpool Bay class with a capacity of only about 2300TEU, suffered from the Panama constraints which required the beam to be rather less than the optimum for a ship of that size"

Design challenges

Many challenges faced the designers of the Liverpool Bay class, including hull girder strength, torsional loading, bow flare and stern counter design, whipping and springing, vibration, motions control, container securing systems and refrigerated containers, to name but a few.

Active fin stabilisers were fitted to the Liverpool Bay class to provide positive control of rolling motions. One major container shipping line has continued to fit these to their fleet throughout the subsequent 40 years but, in general, this system is not favoured due to high installation and operating costs. Passive anti-rolling tanks may be used as an alternative but these, too, have not been popular. However, with the current strong focus on hull optimisation for minimisation of fuel consumption it is possible that roll stabilisers, passive or active, may once more prove to be a worthwhile investment.

Optimal structural design is always constrained by the operational requirements of the vessel. Operationally, the preferred arrangement would not have any structure within the container holds, thus allowing maximum space for the cargo. Forty years ago considerations of hull girder strength, strength of transverse bulkheads and the need to provide support for the hatch covers, necessitated a centreline girder at upper deck level. In fact, some designs included two girders at deck level, aligned with the edges of hatch covers port and starboard. Today these girders are no longer fitted. This is achieved by the use of heavier and higher


1920s	Containerisation journey begins.
1956	*Ideal X*, a tanker, converted to carry containers on deck.
1960s	Containerisation "comes of age" with introduction of ISO standard for size, strength, etc of freight containers.
1970	*Liverpool Bay* class, a twin screw, steam turbine powered design, stated speed 26 knots but believed to be capable of over 30 knots. Subsequently re-engined in 1981 with diesel engines following the oil crisis, maximum speed 23 knots.
1972	Sea-Land SL-7 container ships. Steam turbine powered, 33 knots. Originally built as container ships for Sea-Land Services, Inc., but because of high fuel consumption were not cost-effective as merchant ships. The first SL-7's were the fastest container ships of their time.
1980	First Panamax container ship with a capacity exceeding 3,800TEU (*Laura Mærsk*).
1984	*Sea-Land Achiever* (original name *American Alabama*) 4,600 TEU. Panamax beam (106 feet) and length nearly at the Panamax limit for container ships. Built during period of high fuel prices – hence low speed of 19 knots.
1988	First Post-Panamax container ship, APL C-10 class, entered service.
1990	*Bell Pioneer*. She was the first hatchcoverless design.
1996	First vessel over 6,000 TEU (*Regina Mærsk*).
1998	First vessel over 6,500 TEU (*P&O Nedlloyd Southampton*).
1999	Norasia 1,400 TEU fast feeder container ships. 25 knots, single screw. Built by Jiangnan Shipyard, China. Hatchcoverless.
1999	Malacca-Max concept introduced. 18,000 TEU.
2000	*Ultra-Large Container Ship* (ULCS) study published by Lloyd's Register. Study shows that largest container ship which can be built, propelled and handled using the current infrastructure at the main container terminals is 14,000 TEU capacity.
	"Fast Ship" project. Design concept for Europe-USA trade, 38 knots.
2003	Revised methodology for calculation of tonnage of hatchcoverless ships developed by Lloyd's Register.
2006	Mærsk takes delivery of *Mærsk Boston*, first of a series of 4,170TEU, 29 knot container ships.
2006	*Emma Mærsk* entered service. Declared capacity 15,550 TEU.
2006	COSCO takes delivery of the first container ships to be built in Asia with a capacity greater than 10,000 TEU.
2008	Global oil price peaks at $147/barrel, HFO $700/tonne. Global turmoil in financial markets.
2009	Asia-Europe spot box rates plunge to zero dollars. 540 container ships (11% of the fleet by number) lay idle. Very few container ships ordered.
2011	Recovery begins…
2011	A P Møller-Mærsk orders 18,000 TEU vessels.

Triple E the next step in container design.

strength steel for the topside structure – modern large container ships may utilise steels with yield strength 390N/mm² or more and thickness of the order 100mm.

One consequence of eliminating the longitudinal deck girders is increased susceptibility to whipping and springing, each of which can add significantly to the stresses experienced by the hull structure and, consequently, can reduce the fatigue life. We are fortunate today that computer power is phenomenal, compared to 40 years ago, and modelling tools are sufficiently effective to enable complex analysis of the stresses, both static and dynamic, which are likely to arise in the hull structure. There is still some way to go, though. In general terms, structural modelling can be done today with sufficient efficacy, but weaknesses remain in the areas of load prediction and fatigue analysis. Despite the large number of ship motions computational tools and methods which are used today, none is yet able to predict comprehensively the extreme non-linear motions and loads which will be experienced by fine form vessels like container ships. And from the fatigue perspective, there is a paucity of fatigue damage data on which to calibrate fatigue procedures – whilst this is a challenge for Lloyd's Register and other classification societies which class container ships, it is, of course, good news for the shipping industry as this means that containers ships are developing the fatigue cracks on which to base the data.

Today

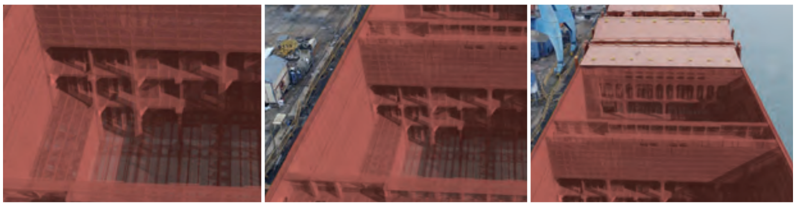
In 1988 the Panamax limitation was transcended and the post-panamax container ship was born. Since that time the size of container ships has increased dramatically. The largest capacity container ships in service today are the Ultra-Large Container Ships (ULCS) *Emma Mærsk* (declared capacity 15,550TEU), *MSC Savona* (declared capacity 14,000TEU) and *CSCL Star* (declared capacity 14,074TEU).

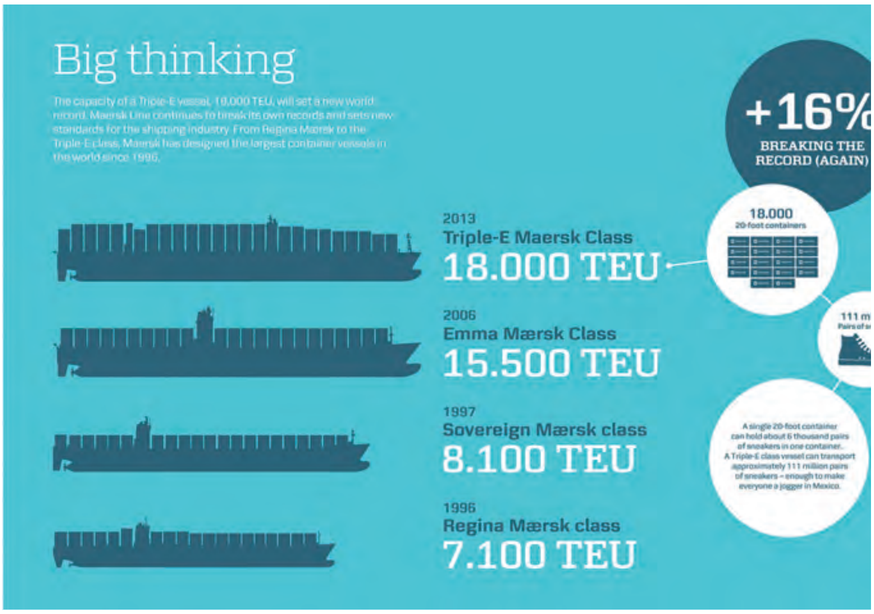
"Such vast vessels have become viable as the container trades have grown in volume, at about 9.5% per year during the last decade"

And now AP Møller-Mærsk have crashed through that concept with their order for a series of even larger ships, each of which will have a capacity of about 18,000TEU. This has been achieved principally by investment in dedicated container handling facilities at their own container terminals which enables these vessels to carry 23 containers abreast on deck.

Such vast vessels have become viable as the container trades have grown in volume, at about 9.5% per year during the last decade. The largest vessels provide economies of scale, ie. the most economical means of transporting containers in terms of dollars per box delivered which, considered in association with the relatively dependable rate of growth of the container trades, justifies the vast capital investment necessary to introduce a new fleet of container ships.

The technical challenges associated with these new designs are, essentially,





Over 18 years TEU capacity will have increased by 11,000TEU since 2006.

no different from those faced 40 years ago. Analytical methodologies and tools have advanced significantly, supported by improvements in computing capacity and by a wealth of experience of ship design and operation. Shipbuilding processes, including the extensive use of automation, have developed, and quality assurance procedures are now mature.

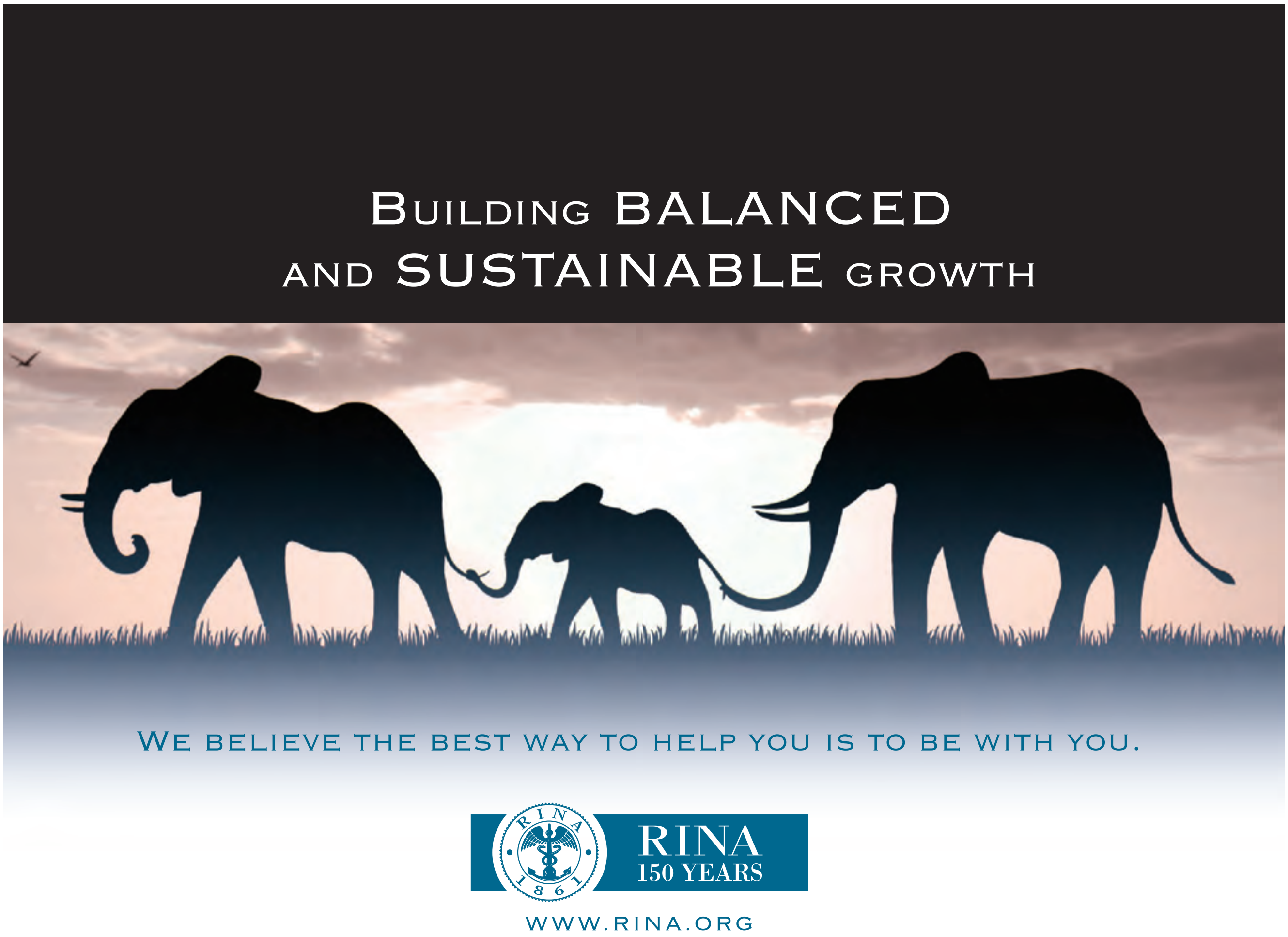
The latest "hot topic" is the need to address environmental issues, which includes the need to optimise the vessel for minimum fuel consumption. This has triggered a reconsideration of the design requirements for container ships. Until now, container ships have typically been designed for a single speed at a single draught, and perhaps requirements to be capable of operating in other speed and draught conditions. Today, owners and operators are considering more complex operational profiles, at a range of speeds, draughts and trims, determined on the basis of their prediction of the evolution of the container shipping trades over the investment period of the vessels, ie. the next 10 years or so. This is not easy, particularly with the diverse range of external factors which are facing the industry now – bunker prices, Panama Canal expansion, investment in new infrastructure by container terminals, mega-ordering of new (efficient) tonnage by the major shipping lines, environmental compliance, slow steaming, next generation mega-ships and their likely effect on today's fleet and, most interestingly, selection of fuel type – HFO, MDO, LNG, H2 or nuclear.

Third set of locks

The next step change in the container trades is likely to be precipitated by the Panama Canal's "Third Set of Locks" project, which will provide additional locks of sufficient size to accommodate container ships of 366m overall length and 49m beam. The new locks, and associated improvements to water depth and removal of obstructions in the canal, are scheduled to be complete by the end of 2014, marking the 100th anniversary of the first ship transiting the canal. Such "NPX" vessels, with a capacity of about 13,500 TEU, are being designed and built right now. Such an increase in the canal's ship size capability is likely to radically change the deployment of the global container ship fleet, even opening the possibility of an equatorial trade, a concept which was tried a few years ago but which was not viable then due to the ship size "bottleneck" at Panama.

40 years hence

There are design concepts on the drawing board with capacities even greater than NPX and ULCS. Twenty one and 22,000 TEU design concepts have been developed by Korean shipyards. Such vessels could provide excellent transport efficiency, in terms of dollars/box delivered - provided sufficient container cargo is available.



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Triple E an 18,000TEU container vessel.

These concepts may be feasible for specific trade routes, but it is unlikely that such mega-container ships will be built in large numbers in the immediate future because of the many practical difficulties associated with ships of this size, not least of which are the great time taken to load and unload and the very real risk of crushing containers at the bottom of the very deep container stacks. This latter issue remains a challenge for the industry.

The various external factors listed above are likely to delay the development of the next generation of container ships. Once they are resolved, design development of the next generation will commence in earnest.

In recent years we have seen the size of post-panamax container ships increase dramatically, but there have been few, if any, fundamental changes in the way that containers are handled and transported. Firstly, container handling remains a challenge – is there a more efficient way of shifting large numbers of containers from the quay onto and off of the vessel?

Secondly, as the volume of trade grows, is it still optimum to sail, for example, Asia-Europe with two or three port calls at each, or is there a better solution? One possibility is the introduction of a mega-hub system, where four or five mega-hub terminals are developed to handle most of the deep-sea long-haul container movements. Mega-ships would shift vast quantities of containers between these hubs, with mega-feeders moving them on to secondary, and then tertiary, ports.

"Mega-ships would shift vast quantities of containers between these hubs, with mega-feeders moving them on to secondary, and then tertiary, ports"

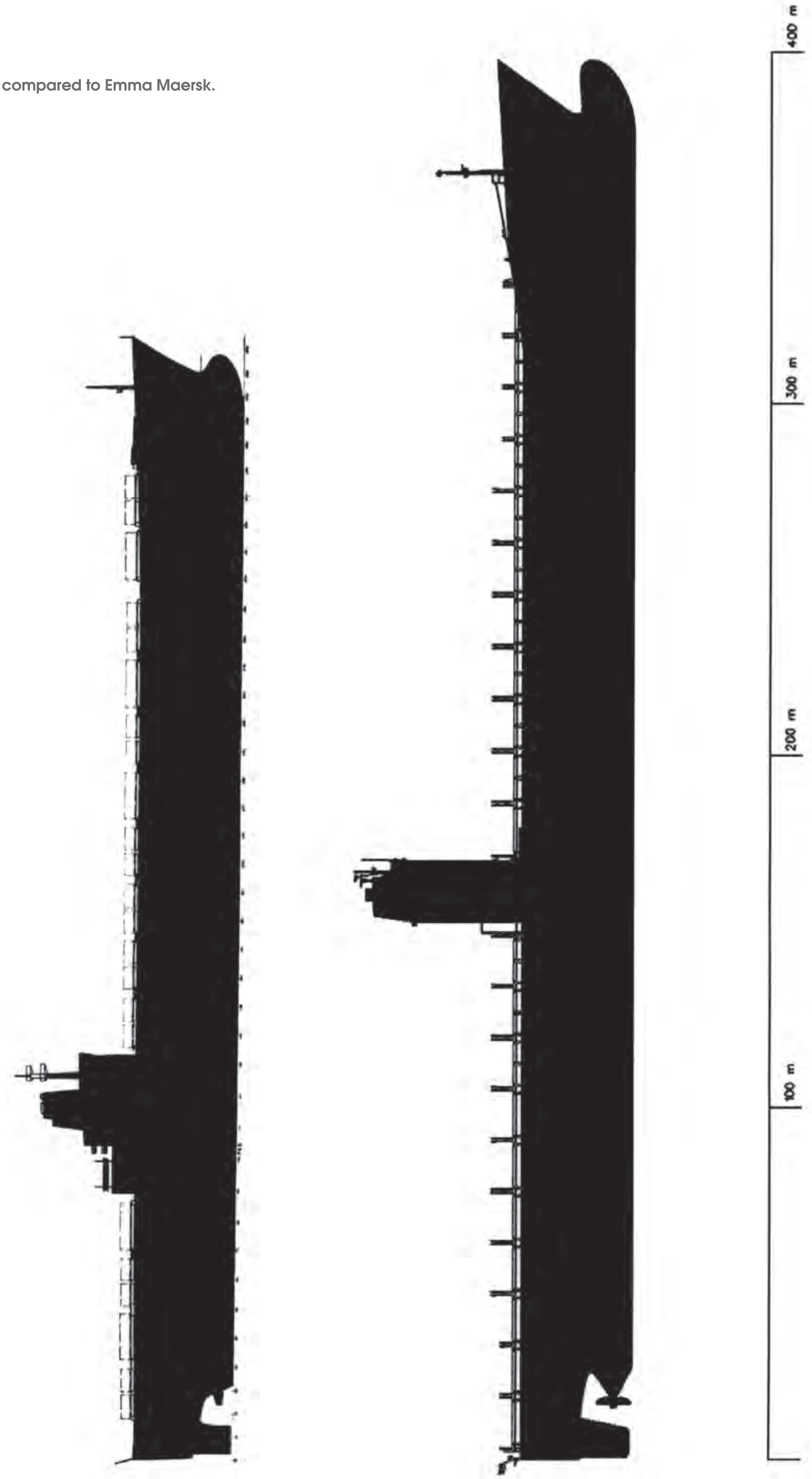
If this system were to be developed, it is likely that the optimum mega-ships would have capacities even greater than 22,000TEU, providing the best economy of scale and, due to their size, enabling investment in the best available systems for optimising fuel consumption including, for example, waste heat recovery, multi-fuel, optimum (or variable) hull form geometry and flow optimisation devices (active or passive). Speed would probably be of the order 18 knots because, if too slow, delivery times would be unacceptably long and if too high fuel costs would be prohibitive.

The nuclear variant raises further possibilities. If nuclear powered – and it can be demonstrated that this can be a viable solution if owners are prepared to accept a very long investment period and if it is acceptable to the general public for such vessels to enter their ports – there is the possibility of much greater power being available at negligible cost, so we could, theoretically, see mega-ships trading at 30knots.

It is difficult to give serious consideration to 22,000+ TEU container ships right now. However, remember that when, in 1999, Marco Scholtens created the *Malacca-Max* concept (an 18,000TEU concept based on the size limitations associated with the Malacca Straits and the Suez Canal), it was generally considered to be impossible. Now, just 12 years later, there are ships with this capacity on order. So be careful when you think "impossible". History shows that we will probably be in for a surprise!

Author: David Tozer is Lloyd's Register's Global Business Manager – Container Ships, he studied mechanical engineering at University College London and later completed a Master's Degree in naval architecture there. He trained with the Royal Corps of Naval Constructors before moving to Newcastle to work for the British Ship Research Association. David is a Fellow of both RINA and the Institution of Mechanical Engineers. *NA*

Liverpool Bay compared to Emma Maersk.



Ballast water wars intensify

One of Hyde Marine's BWTS in place, the company has sold more than 100 systems too date.

Competition to eliminate the spread of non-indigenous species via ballast water release is heating up, as new players emerge with innovative solutions while existing ones continue to fine tune their technologies to grab a share of this lucrative emerging industry.

To gain approval each ballast water treatment (BWT) system must undergo tests at a shore testing station and onpboard vessels under operational conditions. This means, the systems must be able to be installed on a variety of vessel types, with varying voyage durations and retention times of tank water. Varying temperatures, salinity and suspended solids are just some of the conditions that have to be taken into account. In addition, the treatment systems need cope with high rates of flow through the ballast water pumps yet eradicate a wide range of organisms ranging from viruses and microscopic bacteria, to free-swimming plankton.

Thus far, three main processes have emerged which use either physical separation, biocidal treatment, or a physical-chemical process. For ballast water treatment, separation is essentially limited to screen and disk filters and/or hydrocyclonic separators. The former are almost all self-backwashing designs.

Biocides used in BWT systems include chemicals such as oxidizing solutions, usually created by electrolytic processes using sea water as the source of ions. The caveat of such systems is they must be carefully managed so as not to create a new environmental problem while solving another, by the unwanted concentrations of residual biocide being discharged. A further issue is the potential for production of disinfection by-products, such as trihalomethanes and halo-acetic acids.

The most popular physical-chemical processes involve using either Ultraviolet (UV) or ultrasonic radiation. UV irradiation is commonly used on land based installations to sterilize waste water, it is considered highly effective against pathogens. Ultraviolet works by being absorbed into the DNA of microorganisms causing damage to the reproductive genes, ensuring multiplication is halted. Most UV based systems use medium pressure amalgam lamps, their effectiveness is dependent on their wattage and dosage delivered.

It is therefore not unusual to find ballast treatment systems currently on the market using a combination of physical separation plus, one other. In addition, they are usually modular based in design, to provide the flexibility of being retrofitted onto ships, since there was no requirement in vessel design to provide adequate space for BWT systems in engine-rooms. Even now, D-2 of the Ballast Water Convention applicable to newbuilds which dictates the size, number and specified concentration of allowable organisms in each cubic meter of discharge water is not yet in force.

According to the 2010 report from Lloyds Register entitled, Ballast Water Treatment Technology, around 25% of installations are those of Hyde Marine and Optimarin, while the electrochemical systems from RWO Marine and Techcross account for a further 25%.

The RWO CleanBallast system employs disc filters for filtration of particles, sediment and organisms larger than 55µm during ballast water uptakes, followed by electro-chemical disinfection. This constitutes an electrical charge applied to the electrodes arranged in a cell, it produces, among other disinfectants, reactive hydroxyl (OH) radicals which eliminate bacteria and organisms. RWO claims the produced hydroxyl radicals have an extremely short lifetime and therefore give no response to Total Residual Oxidant analysis.

For my money, I prefer the alternative systems offered by companies such as Hyde Marine, Wartsila and Alfa Laval which utilise UV irradiation. Although high levels of turbidity or cloudiness can affect the efficiency of UV, it is a natural, environmentally friendly alternative to chemical disinfection.

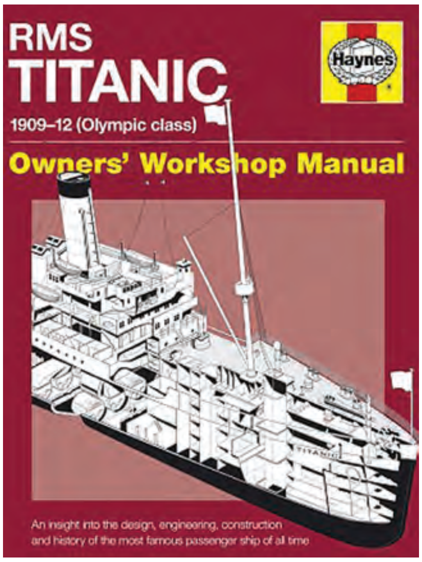
The Hyde Marine ballast water system has two main components, the auto back flushing filter that uses grooved plastics discs which are cleaned during the automatic backflush and the in-line UV system. During ballasting water is processed through both the filter and UV stages as it is pumped through the sea chest to the ballast tanks. Larger organisms or particles are separated out by the filter and back-flushed overboard at the point of uptake. Since the water and sediment is put back where it is taken up from, there are no environmental objections or regulations in existence. During de-ballasting the filter is bypassed and the water is exposed to the UV process prior to discharge.

Whether UV, electrolysis, electro-chlorination or indeed any one of the numerous choices available takes the market lead in BWT is a matter of time, but the first stumbling block still remains for the Ballast Water Convention to be ratified by 30 member states. *NA*

RMS Titanic Owners' Workshop Manual 1909-1912 (Olympic Class)

E. C. Tupper

RMS Titanic Owners' Workshop Manual
1909-1912 (Olympic Class)
By D. F. Hutchings and R. de Kerbrech, published by Haynes Publishing, Yeovil, as a hardback, 2011, 160pp. ISBN 978 1 84425 662 4, £19.99.



2012 marks the 100th anniversary of the loss of RMS *Titanic* and we must expect a number of books on this great ship and the tragedy that unfolded on its maiden voyage. The title of this book is intriguing but derives from the fact that the classic Haynes style cutaways and technical illustrations are used to show key features and equipment.

Following a brief account of RMS *Titanic's* history the book is devoted mainly to a description of the ship, its machinery and equipment. It is illustrated with over 200 diagrams and photographs – some of *Olympic*, the first of the class, or *Britannic*, the third vessel. Perhaps the most touching photographs are those taken by Robert Ballard when he located the wreck two and a half miles down on the sea bed. What a moment that must have been. A few shots are from the films of RMS *Titanic* to complete the picture. One very poignant picture shows the lifeboats in New York after being landed by *Carpathia*. These were the only parts of the great ship to complete the Atlantic crossing.

Whilst many books concentrate on the sinking and the accommodation, this one also describes the boats, engines, funnels, rudder and steering gear, anchors, electrics, ventilation and radio and navigational aids. Many of the accompanying photographs show the vessel under construction. These two features provide a more rounded picture of this great vessel. It was huge for its time and this is evident in many of the photos where humans provide an idea of the size of everything. The book also discusses the duties of the various crew members, with particular reference to the engineers. It is interesting that although the Chief Engineer was identified by four gold stripes on his arm, with the purple between them, at that time engineers at sea were not regarded as officers. RMS *Titanic's* Chief Engineer, Joseph Bell, was one of those who did not survive the sinking.

One becomes very conscious of how closely life onboard, for passengers and crew, was aligned to conditions ashore whilst making use of the latest technology. The demarcations between the grades of passenger reflected the class system of the Edwardians. The ship used electric power for many things while ashore most people still used gas or oil lamps for lighting and coal for heating and cooking. It had one of the earliest swimming pools to be fitted on a ship – the first was on *Adriatic*. RMS *Titanic* had 24 double ended and five single ended "Scotch" boilers with a total of 159 furnaces, consuming 850tonnes of coal a day. 100tonnes of ash was produced each day which was ejected at sea. Coaling ship took 24 hours. The discipline needed to ensure the minimum number of furnace doors would be open at any one time, and that no opposite doors on double ended boilers were open together is described. The routine of raising steam will seem strange to those used to the "push button" starting of diesels and gas turbines. It is refreshing to find descriptions of the work of the lowly firemen and trimmers. The routine for changing gauge glasses is described as is the repair of a leaking boiler tube – very useful for the owner of the ship with its handbook! Some of the maintenance routines call upon the experience of RMS *Titanic's* sister ships.

> "It was huge for its time and this is evident in many of the photos where humans provide an idea of the size of everything."

Those of you who attended this year's AGM of the Institution will have heard a most interesting talk on the RMS *Titanic* by Stephen Payne, a past President of the RINA. What came as news for most of those present was that in 1898 a novel (*Futility or the Wreck of the Titan*) was written by Morgan Robertson, based on a ship, *Titan*, which was "the largest craft afloat" at 800 feet long and 70,000tonnes with a speed of 25knots. This was bigger than any ship afloat at that time and compares with RMS *Titanic's* length of 882ft 9 in, 52,500tonnes displacement and 24knots. On its fourth crossing of the Atlantic the ship hit an iceberg and sank with great loss of life. Its accounts of life onboard and the lifeboats provided together with the evocative phrase "*Titan* was considered practically unsinkable" were eerily prophetic. It was re-published in 2006 by Filiquarian Publishing, LLC. *SCRT*

"Benefits" of high performance paints

Sir,

The article by Bjorn Wallentin in the July/August issue repeats the fallacy that a smoother paint surface automatically saves fuel and thus saves money and reduces CO_2 emissions. Jotun are not alone in spreading this myth - all paint manufacturers do it because it allows an easy cost/benefit analysis.

Let's get back to basics - the only way to reduce fuel consumption on a ship (assuming a well maintained engine) is by reducing the fuel flow to the engine. Even a totally frictionless paint will not do this! To achieve any fuel saving, the Master must be persuaded to reduce the engine rpm and power. If the alleged saving from the use of a high performance paint is of the order of 5%, will a Master reduce power from, say, 90% MCR to 85.5% MCR? That is the only way in which the "saving" will be converted into a reduced fuel consumption. There may be a few enlightened companies who instruct their Masters to do this, but I suspect that the overwhelming majority simply let their Masters carry on sailing at 90% MCR and take the "saving" as a small increase in speed. The benefit of the high performance paint then comes in the form of a slightly shorter voyage time and more voyages per year, meaning a higher annual income for the ship owner. Annual fuel consumption (and CO_2 emission) of course remains the same. The benefit is, therefore dependent on the freight rate - more difficult to predict and quantify.

The diagram in Mr. Wallentin's article is taken from a paper by a competitor, which is misleading on two counts. Firstly, as Mr Wallentin points out, the periods being compared are just before docking and just after docking, so it's hardly surprising that the new paint appears to perform better. Secondly, that paper goes on to claim that, if these paints were applied throughout the international bulk cargo fleet, there would be a reduction in fuel consumption of 8.2MMT/yr, a saving of between US$2.3 billion and US$4.5 billion and a reduction in CO_2 emissions of $10MMTCO_2$ equivalent per year!

Unfortunately, figures like this are seized upon at the International Maritime Organization (IMO) and if we are not careful, expensive high performance coatings will become an accepted form of CO_2 reduction.

Michael Osborne, FRINA

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By Stephen M. Payne FRINA
Stephen Payne, Naval Architect of modern day cruise ships, fully describes the Holland America line's flagship, S.S. Rotterdam, designed and built over thirty years ago and discusses her owners in his above mentioned book. Various chapters describe the building of the ship, her construction, her technical features, her passenger accommodation, and the Holland America line transition from Atlantic ferry to cruise ship operators.
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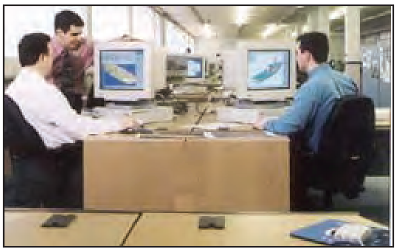

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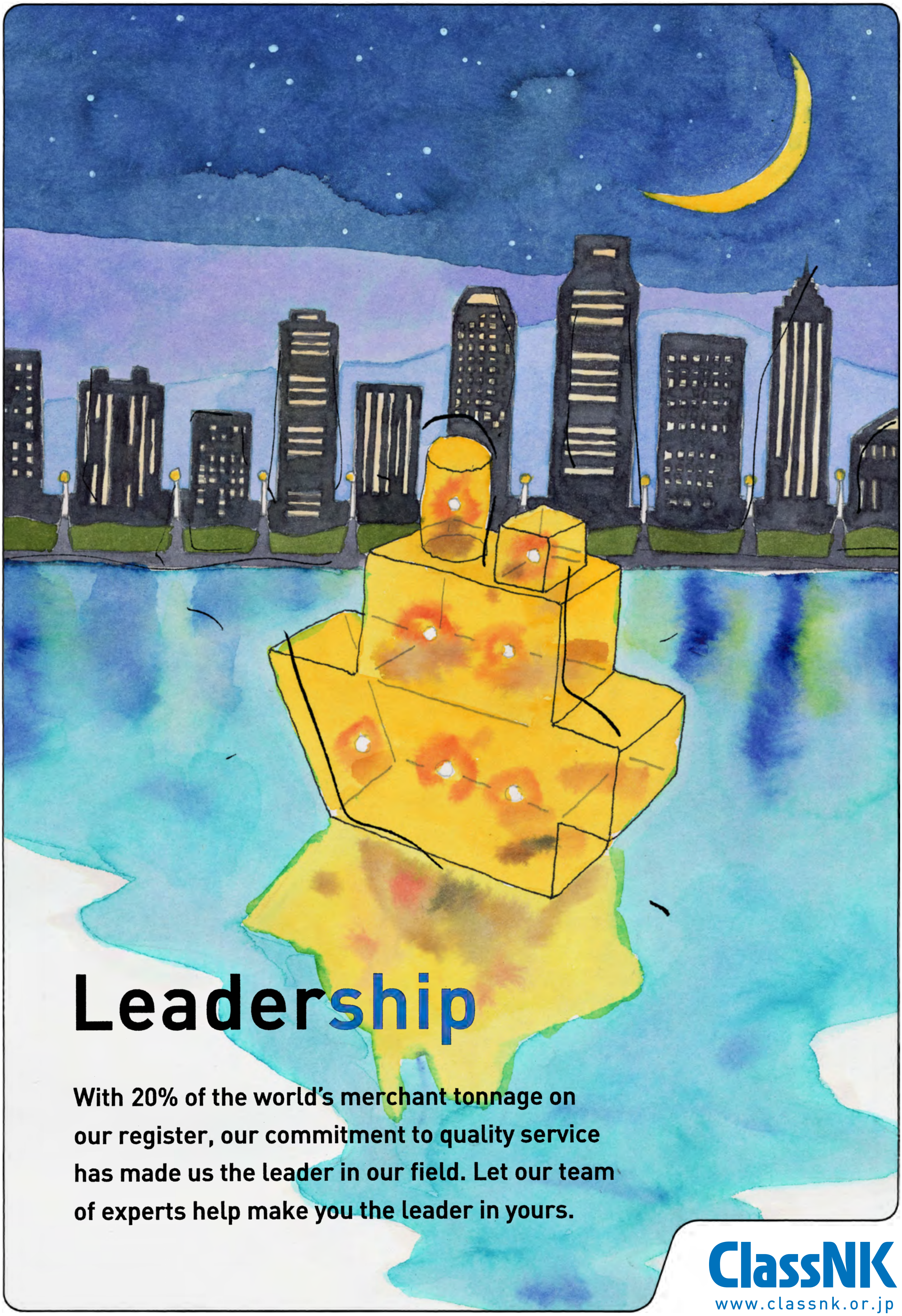
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