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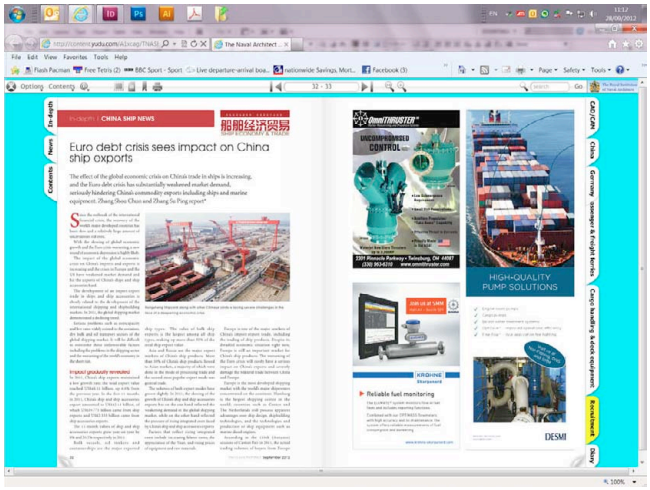

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Predicting the future; a mugs game?

Emma Maersk has already been superseded as the largest container ship in the world, but the next generation of E Class vessels will be bigger, cleaner and more fuel efficient

There is only one certainty about predictions for the future according to Lloyd's Register CEO Richard Sadler and that is that they will be wrong.

If that is the case then there appears little value in bothering to do the research that inevitably goes into a report such as Global Marine Trends 2030, which was compiled by LR with its partners Qinetiq and the University of Strathclyde in Scotland.

According to Global Marine Trends the world will be populated with more than eight billion people by 2030 with 96% of the population growth coming from the emerging economies. These are potential customers to the ship operators. Urbanisation in the developing world, declining populations in the established economies and the rise of a consumer class in China and India will see the structure of the maritime industry and its focus change.

Effectively the future, as foreseen by LR and its partners, has been divided into three possible scenarios all of which expect the population of the globe to explode. As a result of the increasing population the 'Status Quo' version of the future would include short-term fixes to global trade that see China overtake the US as the leader in GDP terms. In the 'Competing Nations' scenario growth is slightly stunted due to protectionism and localisation and 'Global Commons' sees "liberalisation and integration" that accelerates global economic growth.

In fact, according to the report shipping stands to benefit in any of the three possible scenarios. It is unsurprising that organisations involved in the maritime industry should be upbeat about the future. Mr Sadler's assertion, however, that the report's prediction of a population explosion means that its core theme is sex is a fine example of spin and the suspicion is that so are the conclusions reached in this report.

Does that make the report pointless?

Owners, do need to have an idea of what the future might hold. Sadler pointed out that, "We depend on owners to bet on the future, the bets that they are making at the moment will still be on the water in 2030, so owners have already made their bets."

Given that owners will be shelling out millions of dollars on new ships one would hope that the assumptions on which they base their investment programmes on are of a better quality than Sadler is apparently suggesting.

One company that has, up to now, managed its investments in new tonnage rather well is Maersk. And the latest investment is about to slip into the water any day now. The first of the 18,000TEU Triple E ships is due to be delivered in the coming weeks.

Twin skegs, two 32MW MAN ultra-long stroke engines with an optimum speed of 19knots the Triple E ships will be a game changer. The economies of scale available to Maersk on the Asia/Europe trades will mean the Danes will not only reduce speed, but also fuel consumption.

In today's market that means cost savings and stealing a march on your competitors. Maersk, is not standing still, however, and perhaps the biggest savings the company will make will be through a deal for biofuels.

As Maersk's competitors have been evaluating the merits of sulphur scrubbers, LNG conversions to cut carbon and NOx emissions as well as reduce particulates, Maersk has been thinking big again.

Maersk has already been testing biofuels, particularly FAME, or Fatty Acid Methyl Esters to give it its full name, to see how the fuel reacts in bunker tanks and engines of *Maersk Kalmar*, formerly known as *P&O Nedlloyd Rotterdam*. About 5-7% biofuel is blended with distillate in the tanks.

However, with the company using upwards of nine million tonnes of bunker fuel and having made a unilateral commitment to cut its carbon emissions by 20% per container carried by 2017 there is clearly a need to achieve cut emissions radically by other means. And it appears that Maersk has again reacted quickest in looking to use lignin, a complex organic polymer and a by-product of paper manufacturing.

At the moment an MOU to buy 50,000tonnes could turn into more if the production of lignin can be scaled up significantly then Maersk may well find that it is again ahead of the game. *NA*

Biofuel

Maersk praying for biomass

Lignin could be the fuel that owners have been praying for. It is the carbon based element that makes trees and woody plants, such as wheat, brown and it may yet get the maritime industry out of the brown stuff.

Maersk signed an MoU in February with Progression Industry—a spin-off company of Eindhoven University of Technology—to develop a marine fuel from lignin. The agreement is for an initial 50,000tonnes of fuel.

Jacob Sterling, head of environment and corporate social responsibility at Maersk Line, told *The Naval Architect* that: "Over the lifetime of the fuel lignin is close carbon neutral because as part of a plant the lignin draws carbon from the atmosphere and returns almost the same amount when it is burnt. However, the impact through processing of lignin will mean that the fuel has a carbon cost."

It is not clear at this point in the fuel's development what the NOx emissions will be, but SOx is emissions are zero, added Sterling.

Maersk has engaged in the lignin project because they believe that by giving its support the development of the fuel it will be expedited. According to Sterling Maersk has looked at bunker fuel from rapeseed which produces a "lower grade" fuel from lignin and is based on feedstock. However, rapeseed is costly and it is unlikely that shipping would pay the price for the fuel, particularly as it would be competing for food production, explained Sterling.

An alternative to both rapeseed and lignin could be biofuel developed from Algae, which is a very high quality fuel, says Sterling. It has been tested by both the US Navy and Maersk, but this fuel currently costs 20 times more than HFO and would not be a cost effective alternative fuel.

That leaves the development of lignin as the most likely biofuel for the shipping industry, it is the most abundant material as it is found in all plants with a woody stem and can be produced as a by-product of food production, such as wheat.

Currently Maersk uses around nine million tonnes of bunkers per year, so the company is some way off producing a fuel in sufficient quantities to cover a significant amount of the demand from the group as a whole, but Maersk Line has made a voluntary commitment to reduce its carbon emissions by 25% per TEU on its 2007 emissions levels by 2020. The company says it achieved that goal in 2012; though this probably more to do with the economic crisis and slow steaming than more efficient vessels.

However, Maersk has increased its 2020 target to a 40% per TEU reduction of CO_2 emissions from its 2007 levels. "Maersk Line's focus on energy efficiency has made the company significantly more cost competitive," says the company.

Lignin is not yet considered to be a viable alternative fuel to HFO, but Maersk Line's target of reducing carbon emissions by 40% by 2020 may push the development of the fuel

Market Trends

Onwards and upwards

Lloyd's Register (LR) and its collaborators, Qinetiq and The University of Strathclyde, have produced a forward looking report that looks to clarify the immediate future of the maritime industry.

Global Marine Trends 2030 looks at three possible scenarios for the evolution of the global market and attempts to predict how the maritime industry will fare in each scenario.

A disclaimer suggests that the report does not "seek to predict the future, but instead provide a framework for thinking about possible futures and their implications".

Typically, LR CEO Richard Sadler claims the 144-page report is "all about sex". The essential tenet of GMT is that an increase in the global population to around eight billion people, particularly in India and China, there will be a rise in demand for consumer goods and a consequent increase in demand for shipping.

Inclusive in the general rise in numbers is an increase in the consumer class of these two massive nations ,which will require raw materials and finished goods to be shipped to meet that demand.

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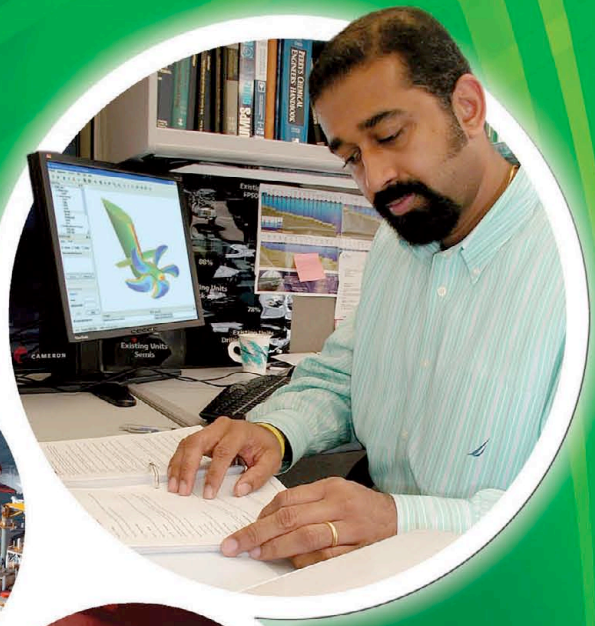

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Three possible scenarios for future development over the medium term are discussed, one labelled Status Quo, where the primary interest is social development, particularly living standards and employment. In this scenario governments seek short-term fixes to satisfy population needs.

In the Global Commons view of development there is concern over the limitations of resources and "environmental degradation". A sustainable vision of the future is accompanied by a fairer distribution of wealth. "Governments will act to forge agreements for the common good".

In the third scenario, Competing Nations the "state will act in the national interests, regardless of the people it represents. There will be little effort to achieve agreements with other nations for the common good. "This is self-interest in a zero-sum world". Protectionism and a slower economic growth are the inevitable result.

Sadler pointed out that one of the certainties about such forward looking reports is that they are always wrong. And in that vein the partners have attempted to cover all bases by outlining any possible spanners in the works. Sadler also reflected on the difficulties for owners who must decide now what the operating conditions will be like when their newbuildings are delivered and continue to operate for up to 30 years.

It is difficult enough for owners, but even the report suggests that there are plenty of unforeseen circumstances that could change the complexion of the future.

Included in this section is the rise and spread of Islamic states, Russia joining NATO, the dollar losing its reserve status, a technological game changer and a global economic collapse. Nevertheless, in the key report findings shipping does rather well with a growth in demand for shipping services matched by a demand in new ships in all sectors except the tanker sector.

Green shipping

Grieg hybrid cuts costs

Norwegian shipping company Grieg Star has announced that it has successfully tested a a battery operated hybrid ship crane project which it says has cut fuel costs by 30% and represents a payback time of less than one year.

Grieg conducted a joint industry project that was funded by the Norwegian Research Council that included DNV in the project. "Hybrid ships are similar to the better known hybrid cars, like the Toyota Prius, but have greater advantages. The payback time on additional investments is much less than the 10 years expected for a car," says Eirik Ovrum, a researcher in DNV Research & Innovation. "In our project, we have concluded that the payback time is less than a year and that fuel consumption will be reduced by nearly one third."

Research conducted by Grieg and DNV compared a crane operated on one of the shipowner's open hatch vessels driven by electricity generated from a diesel generator with a crane operated with power from a lithium-ion battery.

"The DNV simulation tool COSSMOS was used to model a conventional and a battery hybrid power production system on board the vessel. The simulation included four cranes using a conventional system of diesel generator sets to produce electric power while the hybrid system had a lithium-ion battery installed," says DNV.

According to the research results the battery powered hybrid ship would use 30% less fuel and this would aggregate to US$110,000 in annualised savings for the vessel.

Fatigue

Weld model improves ship durability

Research from Finland's Aalto University has developed a theoretical model that makes it possible to understand how weld fatigue attacks joints for a variety of welded steel materials.

According to the Aalto researcher Heikki Remes the model will allow designers to develop lighter structures that in turn will be more energy efficient.

"By utilising modern manufacturing technology and new materials, it is possible to achieve more efficient structures than the ones that currently exist. In addition, better physical models are needed to ensure structural strength," says Remes.

Currently fatigue measurements taken by class societies are based on the average weld quality and the same design guidelines are used for both traditional and advanced structures. "However, through the development of manufacturing technology, it is possible to achieve characteristics for welded joints that are significantly better than average. With the models that have been developed, it is possible to consider the difference between traditional and advanced structural joints and the impact on fatigue resistance," explains Remes.

Research results can be used to establish models for fatigue endurance for a variety of welded steel structures. "The goal is to predict fatigue endurance more accurately and to utilise material in the final product more efficiently," points out Remes.

The work is linked to a project at the Academy of Finland on fatigue in thin sandwich panel structures and to the EU's BESST project that aims to promote the competitiveness of the European shipbuilding industry.

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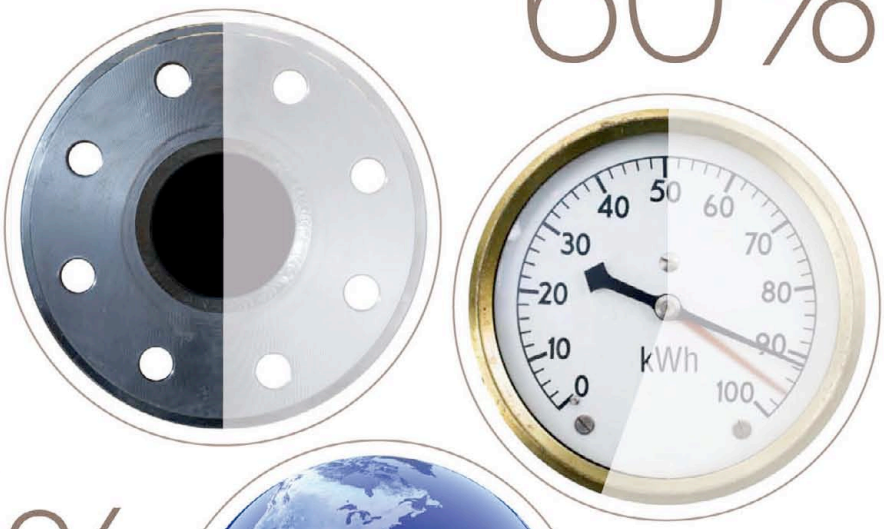

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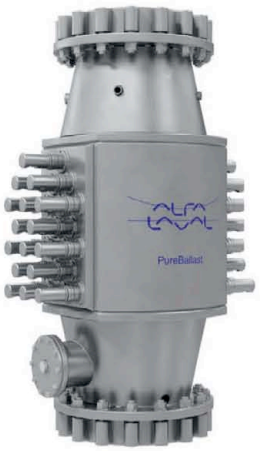

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Counting the cost of emissions regulations

While regulations to reduce emissions are certainly not going to go away, and the regime is likely to become tougher than ever, some measures taken to reduce them and to save costs may actually result in engine damage, *writes Sandra Speares*.

Insurers say they are already seeing a rise in claims for engine damage from cat fines as a result of burning law sulphur fuels and the use of slow steaming as a means of reducing fuel consumption has already been highlighted as a possible cause of engine damage.

As Bibby Ship Management, chief operating officer, Simon Barham pointed out recently, although new generation eco-friendly ships may solve some of the problems facing owners as far as fuel economy is concerned, as the fleet is relatively young, this is not a quick fix.

Current tactics like slow steaming to reduce costs bring with them their own problems notably that engines optimised for use at a certain speed are now being used at less than optimum levels, with possible consequences for performance or engine damage.

He also raised the issue of ships switching fuels when moving in and out of emission control areas.

"It must be said that switching on to low sulphur fuel is not a problem, but switching on to gas oil is and that will need some modifications to the vessel. The main engines themselves are not designed to burn light fuels. That will mean that changes will have to be made – pumps will have to be examined, even the design of some ships will have to be looked at because it is debateable whether some ships will actually have enough space to carry the additional bunker fuel tanks."

One way to deal with the shortage of bunker tanks is to undergo conversion work, with the inevitable costs that will result.

While LNG may be the fuel of the future, retrofitting is not really a financially viable alternative so hopes are centred on the new generation ships although these prototypes are proving expensive.

Wärtsilä, meanwhile, is on record as saying that using scrubbers to meet new sulphur requirements was a better way of dealing with the new rules than switching to MGO or LNG.

A recent report for the UK Chamber of Shipping painted a gloomy scenario about the likely effect of the introduction of the 0.1% sulphur cap for fuels in use in ECAs in 2015.

The report suggests that 2,000 jobs will be lost in the UK as a result of implementing the 2015 requirements, not to mention a move to road as opposed to seagoing transport, increased costs for ferry operators and other detrimental effects.

According to the Chamber use of low sulphur fuel would cost at least US$300 per tonne more than the current heavy fuel oil. Other estimates have put the figure closer to US$400.

The Chamber added that scrubbing technology was not yet sufficiently proven for shipowners to fit scrubbers with confidence before the 2015 deadline.

Using LNG, it added was feasible for newbuilds but not appropriate for most of the existing UK fleet.

John Stirling, quality manager for Norwegian-based World Fuel Services, has called on the industry to stop and think before going ahead with plans to use LNG as a fuel for ocean-going vessels.

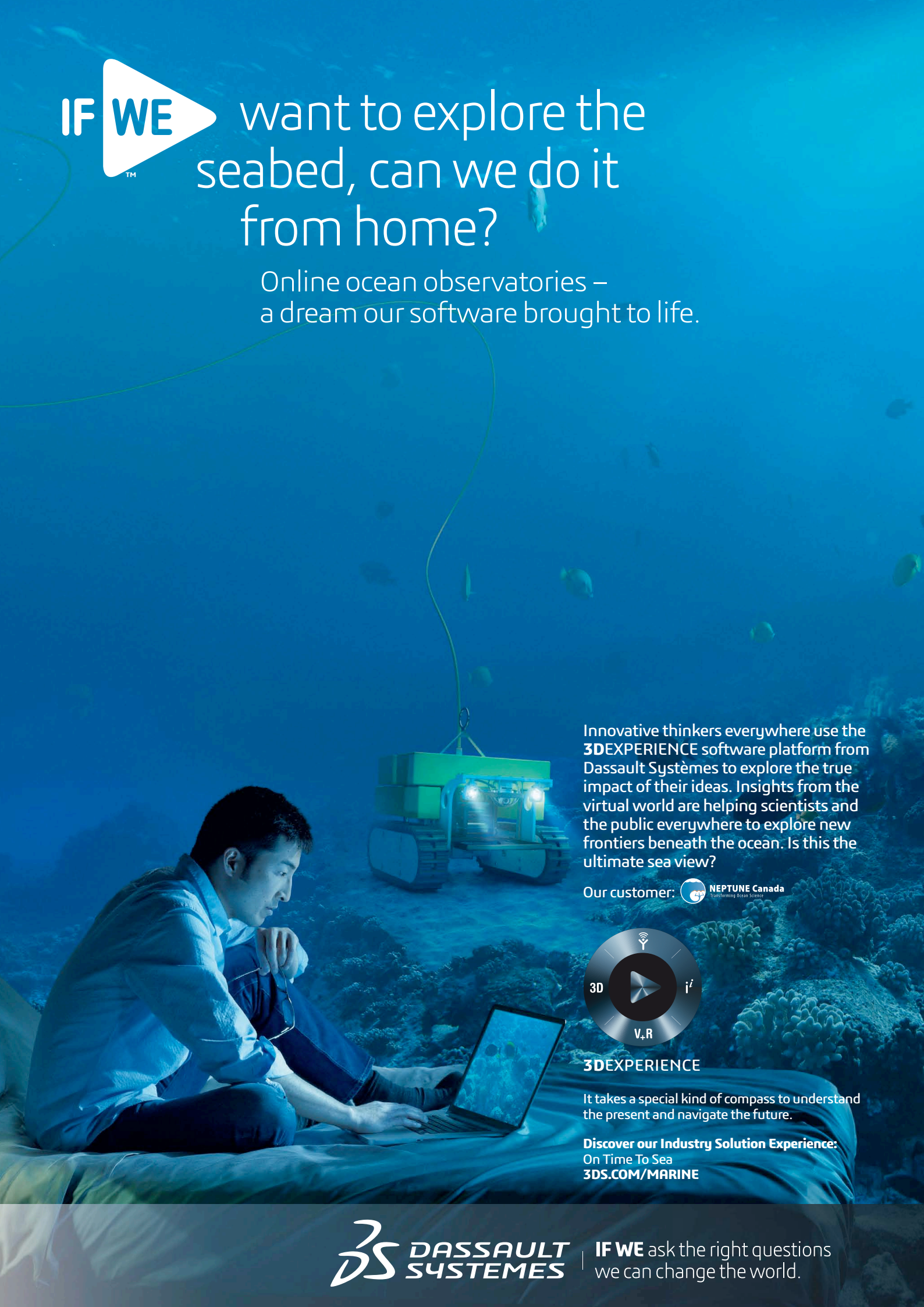
Speaking at the 8th International Fujairah Bunkering and Fuel Oil Forum, he pointed out that until about two years ago all the talk from the proponents of LNG was about coastal or shortsea shipping. He said that he thought that LNG was an excellent solution in many cases for vessels in such trades where bunkers could be taken from shoreside terminals.

More recently, however, LNG has been promoted as an option for the world fleet to replace HFO, but his feeling was that this would mean ship to ship transfers which he described as a "game changer".

If some deadlines for compliance with low sulphur regulations like the 2015 deadline of 0.1 sulphur in ECAs may be set in stone, there continues to be resistance in some quarters and concerns as to the availability of low sulphur supplies going forward. Another is whether yards will be able to meet the deadlines for retrofitting ships with scrubbers, should that route be chosen.

So far the supply issue does not seem to have come to the fore. However, questions remain as to what will happen when we move to a global sulphur cap, a situation that has resulted in the International Chamber of Shipping urging that a review of supplies should be brought forward from 2018.

Assuming an implementation date of 2020 for a global sulphur cap of 0.5%, that doesn't leave much time for investment if supplies are expected to fall short. Most people in the bunker industry appear to expect the deadline for the global sulphur cap to move to 2025, however. *NA*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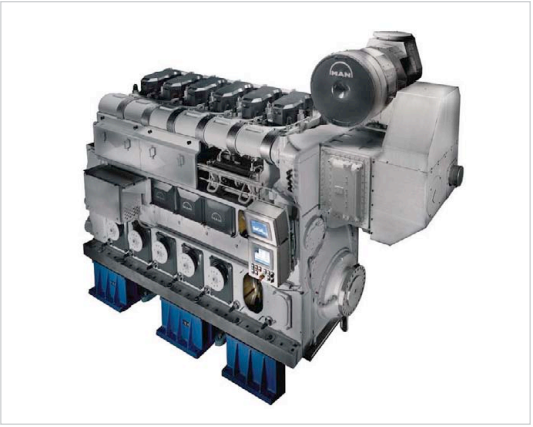
Engines

Visemar opts for MAN power

Italian Visemar has placed an order with the Cantiere Navale Visentini yard, near Venice, for a ro-ro ship. The vessel will be powered by a complete MAN propulsion package featuring two 9L32/44CR medium-speed engines.



MAN gets ro-ro order from Visemar

The 9L32/44CR engines each develop 5,040kW at 750rpm and are complemented by two Renk RSV 900C gearboxes and two Alpha CPP propellers. The engines fulfill IMO Tier II regulations and will be built at MAN Diesel & Turbo's Augsburg works in Germany from where they are scheduled for delivery in August 2013. The newbuilding is scheduled to follow in April 2014 and, having already been granted a 'green passport' and green star certification, will be one of the most efficient and environmentally friendly vessels in its class.
www.mandieselturbo.com

CAD/CAM

Dassault's V5-6R2013 adds more capabilities

Dassault Systèmes has announced the launch of the latest release of its Version 5 PLM applications.

The V5-6R2013 release now includes a composite fibre modelling technology (based on the recently acquired Simulayt), increased openness and standards support and enhanced high-end surface modelling capabilities. The latest release also includes additions to the V6-to-V5 multi-version compatibility announced last year, further enabling internal and external V6-V5 collaboration.

"Today's announced enhancements bring a new level of capability to our V5 install base. It is rich in features, functions, and new products. At the same time, we are thinking far beyond that," said Dominique Florack, senior executive vice president, products, R&D, Dassault Systèmes. "We are considering how our customers develop their products and their own customers' experiences, how they work with suppliers regardless of version, and how they adopt new software over time."
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Propulsion

Becker Marine receives order from STX

An order was placed by STX Marine on behalf of the owner STX Pan Ocean for the delivery of 10 Becker Mewis Ducts for the 57,000dwt open hatch bulk carrier newbuildings under construction at STX Offshore & Shipbuilding sites in China and Korea.

Becker Marine sees more orders for the bulk carrier market

These 10 Becker Mewis Ducts along with nine Becker Mewis Ducts, previously delivered add up to 19 identical Becker Mewis Ducts supplied to gain significant propulsion efficiency for these open hatch bulk carriers.
www.becker-marine-systems.com

Bridge & communications

Transas Marine gets tracking

Transas Marine has launched its remote worker tracking system (RWTS). The Transas RWTS has been developed to track personnel engaged in construction work on offshore structures such as wind and wave generators or any other offshore platform.


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Ancillary equipment

ABB acquires APS Technology Group

ABB has completed its acquisition of San Diego-based APS Technology Group (APS). The acquisition adds optical character recognition (OCR) and gate automation capabilities to further improve safety, productivity and efficiency of port operations as containerised shipping grows worldwide.

www.abb.com

Ancillary equipment

LESER releases the pressure

LESER has presented its solution for pressure relief valves for applications onboard FPSOs. The "API" product group of flanged safety valves has been designed for offshore oil and gas installations. The valves meet with all the requirements of API 526 such as standardised orifices and centre-to-face dimensions, but their robust construction with hardened or stellited discs and stellited seats allows them to be able to cope in areas of high pressures. Pilot operated safety valves from the "High Efficiency" product group can also be used in FPSO applications because of their smaller size and lower weight than traditional spring-loaded safety valves.

www.leser.com

Ancillary

MacGregor supplies cement handlers

Two 20,000dwt cement carriers on order in China will feature advanced MacGregor cement handling systems for autonomous, flexible, environmentally-friendly cargo operations at high handling rates. Equipment for the first vessel is scheduled to be delivered this summer with the second following later in the year; the order also includes an option for a third system.

MacGregor, part of Cargotec, has secured an order with Shanhaiguan New Shipbuilding Industry in China for advanced bulk-handling systems for a pair of 20,000dwt cement carriers on order for Singapore based Associated Bulk Carriers (ABC) which is a fully owned subsidiary of dry cargo shipowner Precious Shipping PCL, Thailand.

The identical sisterships will be equipped with MacGregor cement self-unloading/loading systems combining mechanical and pneumatic technologies to deliver a self-unloading rate of up to 1,000tonnes/h with pneumatic discharge systems or 2x250tonnes/h with discharging directly to on shore cement trucks and a self-loading rate up to 1000tonnes/h for both pneumatic and mechanical loading systems.

www.cargotec.com

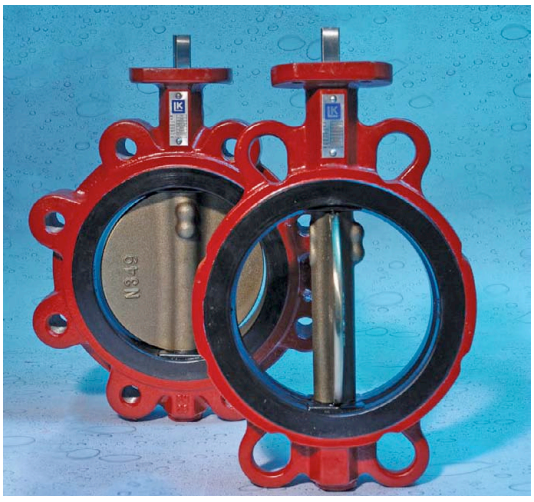
Ancillary equipment

LK Valves introduces butterfly valve

LK Valves has introduced its own vulcanised, soft seated butterfly valve. The latest valve, which has been designed, developed and produced in-house, has reduced torque and lower weight compared to equivalent products, the company highlights.

LK Valves rubber compound has been carefully specified for its purpose, high demands have been set for cleanliness in the production and the use of injection moulding is chosen to assure bonding strength and durability of the vulcanised rubber lining. Reduced torque and lower weight than similar valves on the market allows the customer

LK Valves expands it range with its butterfly valves



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to choose a smaller sized actuator for this butterfly valve, which gives a more cost-efficient solution, and makes it easier to handle, LK Valves added.
www.lkvalves.com

Ancillary equipment

PSM stays alert

PSM has produced a simple and cost effective complete package, based on proven and approved equipment that fully meets the International Marine Organisation (IMO) safety guidance for cargo tank overpressure protection, which comes into effect in July 2013.

PSM's ict 1000 pressure transmitters were designed to satisfy the safety stipulations of the SOLAS II regulations that originally came into force in July 1998. They also fully comply with IACS UI SC 140, effective from July 2013.

These updated IMO regulations require that a secondary means of allowing full flow of vapour, air or inert gas in the cargo tank is provided in the event that the primary pressure relief valve arrangement fails. This ensures that the tank is operated within its design limits and is not mechanically damaged by over or under pressure.

The PSM ict 1000 pressure transmitter is protected against positive or negative overloads and submersion. It is available with a choice of flanged or threaded fittings for installation directly to the tank top or piping into the venting system. They are type approved by many marine classification societies. They may also be used in hazardous areas when installed with appropriate PSM RFM safety barriers.

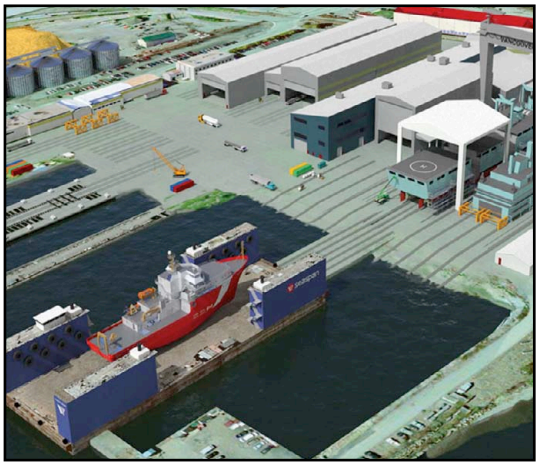
The PSM MTU display unit located in the Cargo Control Room provides a monitoring station which provides an indication of normal or alarm status for each tank, as well as the actual pressure.
www.psmmarine.com

CAM/CAD

PEMA modernises Vancouver Shipyards

Seaspan's Vancouver Shipyards is carrying out a US$200 million shipyard modernisation programme. As a part of modernisation project, Seaspan selected PEMA welding automation equipment for their panel production.

The contract includes a PEMA one-side welding station and stiffener mounting and welding stations equipped with hi-tech PEMA WeldControl 100 system. The line is also equipped with a covered conveyor solution to make working on the line safer and to transport welded panels smoothly. This new line will substantially increase the shipyard's productivity and its competitiveness in the market.



Seaspan Vancouver Shipyards updates it facilities with PEMA

Seaspan chose PEMA automation due to the strategic co-operation between Pemamek Oy Ltd. and Lincoln Electric Co. The PEMA welding automation lines use Lincoln PowerWave welding power sources. Lincoln and PEMA equipment together made the solution unique and suitable for shipyard's needs.
www.pemamek.com

CAD/CAM

SENER opens office in Brazil

Spanish CAD software manufacturer SENER has opened an office in São Paulo. SENER through this branch has established an operating and permanent division in Brazil, made up of about 300 Brazilian professionals specialised in engineering and construction that will carry out projects in the fields of power and process, civil engineering and architecture, aerospace and marine engineering. SENER's premises in Brazil also include an office in Rio de Janeiro. SENER's expects to make more contribution carrying out engineering projects and turnkey construction projects, especially those involving a technological challenge. In addition the company is applying for the license to bid on marine engineering tenders, a sector, in which it has an extensive experience. Heading this office is Guido Casanova, SENER's general manager in Brazil.
www.sener.com

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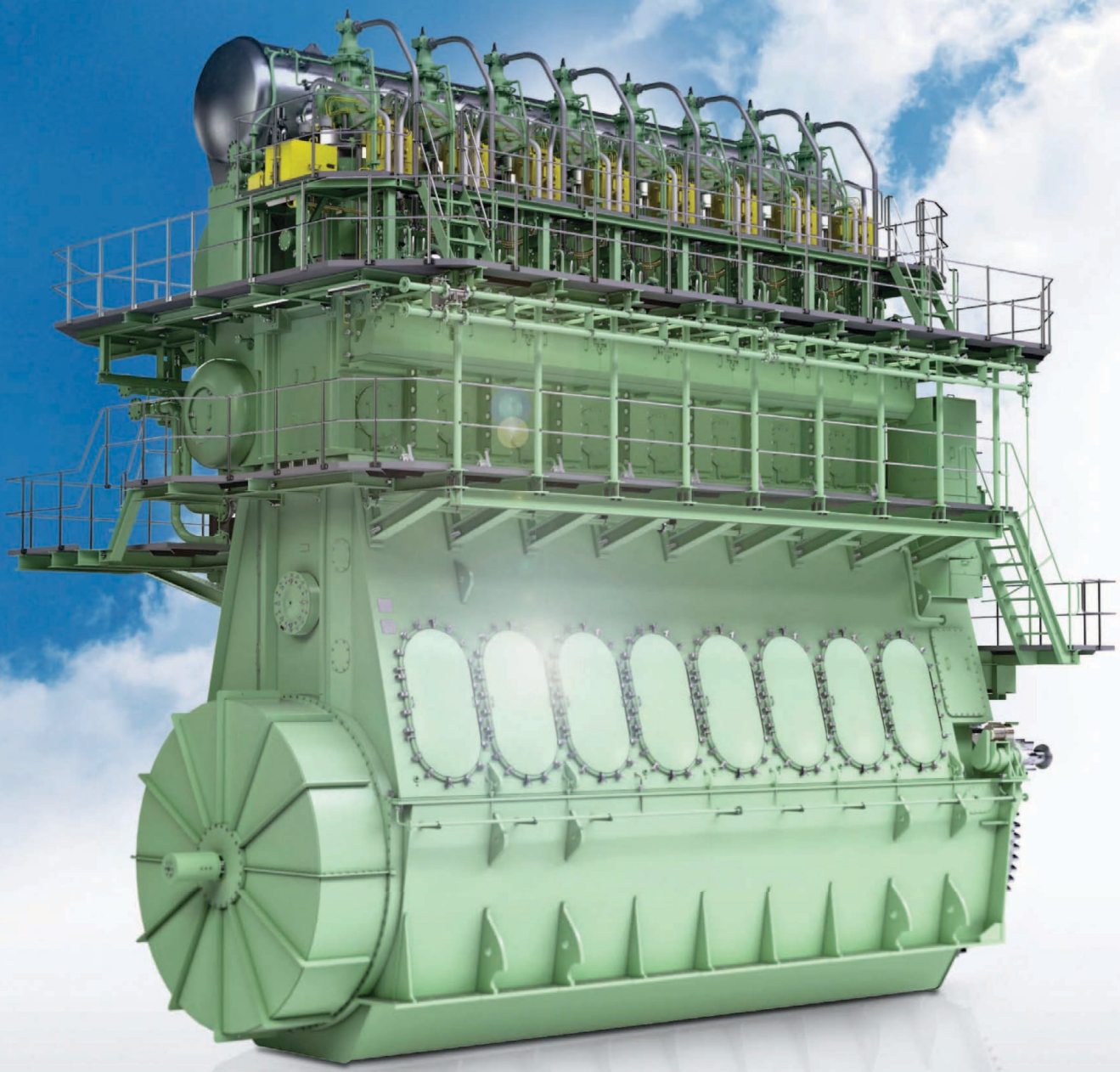

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Enter the Leviathan

Later this year Maersk Line will launch a series of vessels that will be the largest container vessels in the global fleet and the biggest ships in operation of any type. *The Naval Architect* met with some of the key personnel behind the technical aspects of the project at Maersk Maritime Technology's office in Singapore. Mike King reports

When the first Triple E vessel enters service next summer it will surpass CMA CGM's three 16,000TEU capacity ships, the first of which was launched late last year, as the largest container vessel in the global fleet. At some 400 meters long and with a beam of 59m, the vessels will offer a huge 18,000TEU of capacity.

Maersk's Triple E fleet of vessels, which are classed by ABS and being built by South Korea's Daewoo Shipbuilding and Marine Engineering (DSME) at a price of $US190 million each, will eventually total 20, all due for delivery over 2013-15. Options for 10 more ships were cancelled by Maersk in early 2012 in recognition of excess supply in the container market, particularly on the Asia-Europe trade where the ships will be deployed.

Construction of the Triple E vessels is taking place at DSME's Okpo yard

The 'Triple E' name is derived from the economies of scale, energy efficiency and environmental improvements Maersk claims the ships will offer. An expanded inside cavity and 'U' shape hull provides for 23 rows of containers across, up from 22 on the 'V' shaped hull of *Emma Maersk*. The navigation bridge and accommodation for up to 34 persons has also been moved forward and the engine room and casings back to create extra space without losing visibility.

Brian Ostergaard Sorensen, head of newbuilding and conversion at Maersk Maritime Technology's (MMT) Singapore office, said the rapid escalation of vessel sizes in the container sector had been possible over the last decade by a number of factors, one being advances in design computer analysis and finite element calculation techniques.

"We now have access to a lot more insight into where potential stresses are and how to overcome these high stress points," he explained. "It has been more of an evolution to the Triple-E from the *Emma Maersk* rather than a revolution.

"With the Triple-E we identified problem areas and then focused on gathering proven solutions and pushing the existing boundaries. Technically now we could go bigger but this is a risk-averse industry so I don't expect this to happen any time soon."

As well as representing a sizeable jump in capacity, the ship's design doffs its cap to the slow steaming strategies now deployed by most lines which cut fuel costs and soak up excess capacity. The top speed of the 'Triple E' vessels will be just 23knots, less than the 25knots top speeds common on the previous generation of container vessels. Maersk said the Triple-E would be approximately 20% more fuel efficient than the *Emma Maersk*, previously the company's largest ship. The new design will also consume 35% less fuel per container than the 13,100TEU vessels currently being delivered to other container shipping lines and offer 50% less CO_2 emissions than the industry average.

"Slow steaming was a driver of the design," said Sorensen. "A design of five or ten years ago was driven by speed, but now it's not so this created options on selection of hull form."

The main design innovation on the Triple-E according to Sorensen is the deployment of two slow running ultra-long stroke engines and two large

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propellers, a combination called 'twin skeg'. Maersk analysis found that using two of these slower running engines to turn two propellers resulted in energy savings of 4% compared to *Emma Maersk*'s one engine/one propeller design on.

Rens Groot, senior project manager for naval architecture at MMT, said even as DSME started building the vessels, the design process continued. "We locked in the main features, but we were making changes even during construction to refine features," he said.

"It was important for this construction that our input didn't end with the contract. We were able to carry on with changes so the contract was really an intermediary stage. Everyone had good ideas. Many people worked on this pre-contract and even more afterwards as we optimised it."

Groot said energy efficiency was the holy grail of the project. "This took in every part of the design, from how to optimise the seawater cooling system, to reducing harbour and maintenance time, to planning accommodation and the electrics and machinery.

"We took onboard the operational feedback and tried to implement that. "The 'U' shaped hull was developed for this ship to match the operational speed we needed. And we took the same approach to sourcing engines. The waste heat recovery system in the engine room also allows us to reuse heat from the exhaust instead of losing that energy. This increases power by nine percent and cuts fuel consumption by nine percent."

The size of the AP-Moller Maersk Group was also critical to enabling the company to set new design boundaries. With so many newbuildings under construction across the Group at any one point, Sorensen said the company had the management foresight and contractual clout with yards to push boundaries. "When we come up with ideas, we will discuss their feasibility with internal stakeholders such as Maersk Line. Then we jointly go to the yards to discuss how we can take this further to enhance our vessel designs.

"With the Triple-E vessels we have made a big technological leap that will have a significant impact on costs and environment through decreased fuel consumption and CO_2 emissions. *NA*

The evolution of container ship size and speed

The first ocean-going vessels to break the 400 meter length barrier were the super tankers constructed to ship crude oil in the 1970s when containerisation was still in its infancy. The driving factor behind increasing container ship sizes has been the desire to reduce the cost per unit transported as demand to move cargo in boxes has rapidly increased.

"Higher speeds called for larger engines which also meant that increasing the size of a ship would have to rationalise in the technical advances of diesel engines, machinery equipment and hull form design," said Konstantinos Chatzitolios, container ships manager at vessel classification society Bureau Veritas.

"In the last two decades, the increase in demand for containerised cargo and the technical innovation of 2-stroke engines, turbochargers, propellers and also optimisation in hull form design, provided both the will and the means to increase container ship sizes, while maintaining the necessary speeds in an efficient manner."

This saw the 1996 launch of Maersk's "R" Class with 6,000TEU capacity which superseded its predecessor, the "L" class of 1981, by more than 2,500TEU. Since then the speed of development has proceeded rapidly as naval architects have become more adept at overcoming structural challenges. This saw the 1997 launch of the "S" class with a nominal capacity of 8,000TEU, followed by the "E" class in 2006 with capacity of 12,500 TEU.

Container ships usually transfer high end consumer products which traditionally meant, pre- Triple-E at least, that design speeds of between 24knots to 26knots were common.

"Fuel consumption for a container ship is a function of size and speed and has an exponential mathematical function for typical hull forms," said Chatzitolios. "An 8,000TEU container ship will consume around 225tonnes of fuel per day at 24knots but only 150tonnes at 21knots."

The benefits of slow steaming are, therefore, not difficult to compute, especially when operational gains such as capacity absorption and high fuel prices are factored into the equation. "Normal slow steaming ranges from 18knots to 22knots and can be achieved by container ships of typical hull form design and typical propulsive system," said Chatzitolios.

"Super slow steaming (15knots to 18knots) can lead to significant fuel savings."

There is every chance that the super-size, super slow evolution of container ships will continue in future as lines look to further decrease per container slot costs and engineers find new ways to improve the efficiency of ships steaming at ever slower speeds.

"Whether or not container ships will continue to grow in size will be once more decided by demand," said Chatzitolios . "There is no reason to believe today that the new technical challenges that may await us above the 20,000TEU threshold will not be identified and appropriately addressed."

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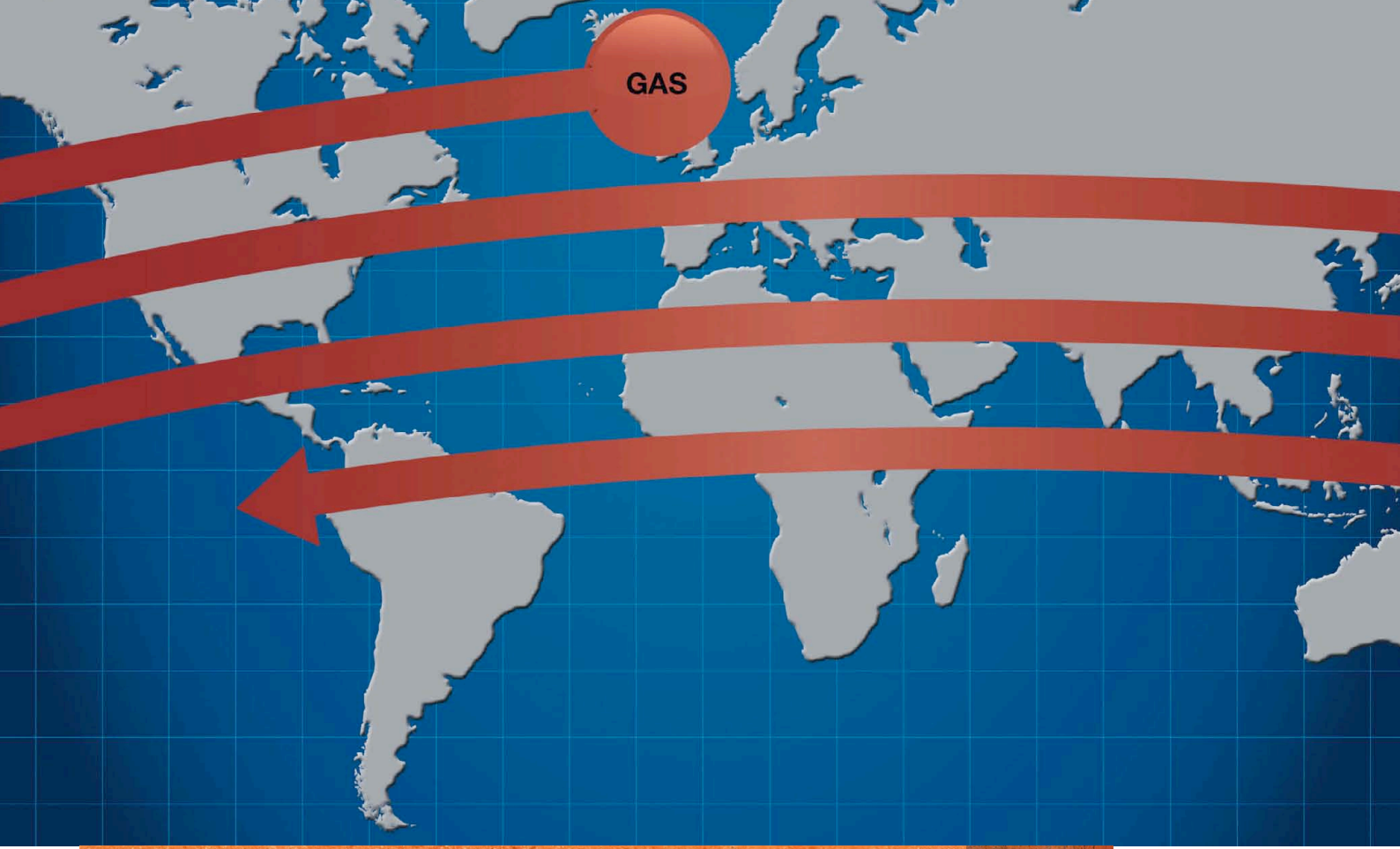

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CCS: Energy saving and emission reduction solutions for green ships

Since the 11th Five-year Plan period (2006-2010), China Classification Society (CCS) has launched a range of technical documents regarding the design, management, verification and evaluation of ship energy efficiency and green standards. Zhou Li Wei and Shu Hua of CCS report

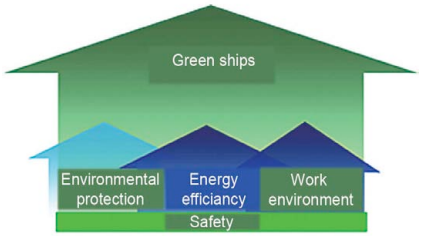
In response to the international and national trends in green shipping developments, CCS – as an important technical support institution for the country's shipping and shipbuilding sectors – has launched a variety of technical documents since the 11th Five-year Plan period.

CCS has also developed application software for ship energy efficiency management and operational management systems, as well as software for the calculation of ships' energy consumption distribution. The classification society has also started research on high energy efficient technologies, and has promoted trials of these technologies. All these initiatives have not only showcased CCS technical capability in green shipbuilding; but also helped build momentum for the sustainable development of China's shipping and shipbuilding industries.

Setting new standards

In 2011, CCS, based on goal-based standards (GBS), produced an integrated set of green ship survey and verification standards - "Rules for Green Ships" - which were claimed to be the world's first set of green ship standards and came into effect on 1 October, 2012.

Apart from the main body of the rules, the "Guidelines on Verification of Technical Requirements" and the "Common Green Technology Guidelines" also form parts of the rules. CCS, based on GBS, sets a definition for green ships green ships are vessels that, using relatively advanced technologies (green technologies), can economically fulfil their preset functions and performance in their life cycles; and at the same time can raise energy efficiency and reduce or eliminate pollution; and can offer good protection to their operators. Based on this definition, the Rules for Green Ships set requirements in four areas, namely safety, environmental protection, energy efficiency and work environment.



Green Shipping Model

The Rules for Green Ships cover the latest requirements of international conventions and the latest research results of the industry, and have set technical standards for the whole life cycle of ships. In terms of safety, the Rules require green ships to fulfill the criteria of international conventions, the regulations of the ships' flag states and the requirements of ship classification societies. In order to evaluate vessels' green performance thoroughly, system distinguishes the main factors from the sub-factors. Main factors include environmental protection, energy efficiency and work environment issues. The environmental protection factor covers sub-factors such as the prevention of oil pollution, sewage pollution, litter pollution, air pollution, ballast water pollution, and pollution from ship breaking etc. The energy efficiency factor covers two main sub-factors: ship design performance and ship operation performance. Environmental factor covers sub-factors such as automation, vibration and noise.

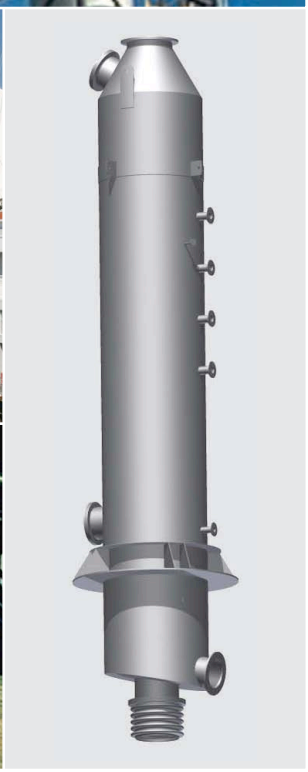
The Rules for Green Ships put forward the system of green ship labels to mark the integrated advancement of a ship in regards to environmental protection, energy efficiency and work environment. In order to promote the upgrading of industry structure for shipbuilding, peripheral manufacturing and shipping sectors, the rules set a three-level labelling system for green ships: Green Ship I/II/III; and set out the requirement of each level and the evaluation procedures.

Apart from marking the integrated green performance of ships, the rules also set up specialised green ship labels to encourage the application of green technologies, such as energy-saving propellers, heat reuse, drag reduction paint, shore power, wind power, solar power and fuel battery etc. The rules also set out specialised energy efficiency labels: EEDI (I/II/II) to mark the standard of energy efficiency of ship designs.

The rules for Green Ships provide technical directions for ship designs, construction, survey and operations etc. In order to meet the goals of the rules, the industry needs to achieve breakthroughs in the following aspects: upgrading existing ship models, raising the standard of peripheral services, application of green technologies and improving vibration reduction and noise reduction technologies etc.

On 20 September, 2012, the research on ships' energy consumption distribution and evaluation – one of the highlighted research projects of the G-VCBP – was approved by industry experts. The application of the software for the calculation and analysis of ships' energy consumption distribution has then started officially.

The "Guidelines on Ship Energy Consumption Distribution and Energy Saving" list out the energy consumption patterns and energy saving potentials of the three major ship types: oil tanker, bulk carrier and containership. The guidelines set baselines for ships' efficient energy consumption performance and provide sensitivity analyses of mainstream energy saving technologies. The guidelines also propose a set of comprehensive and scientific calculation methods of ships' energy consumption distribution. The guidelines provide important guidance to the research and development of ship energy saving and emission reduction, the design of new ships and conversion of existing vessels.



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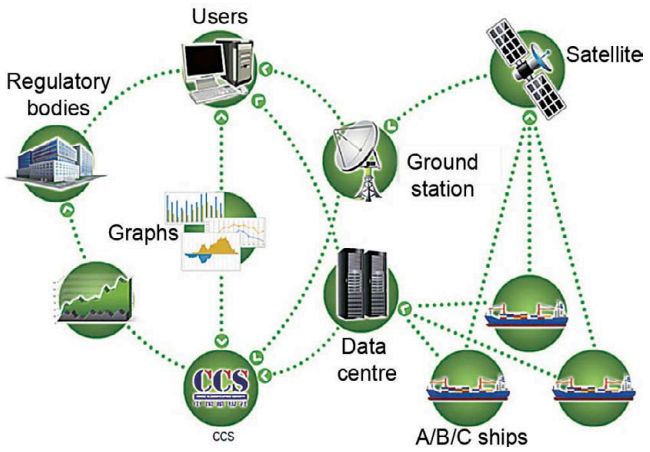

Operating Ships Energy Efficinecy Database & Applications

A 3,100 tonne LNG-fuelled bulk carrier

The software for the calculation and analysis of ships' energy consumption distribution was developed to help the users of the guidelines to calculate ships' energy consumption distribution. The software systematically displays the results of research on the calculation method of ships' energy consumption and energy consumption efficiency baselines. The software has seven major functions: ships' energy consumption distribution calculation, energy consumption distribution result analysis, energy consumption efficiency calculation, energy consumption efficiency analysis, green technology energy saving potential estimation, major ship types' energy consumption calculation statistics and national ships' energy consumption database (as shown in image. This software can fulfill the needs of different levels of users, including design institutes, shipping companies and regulatory bodies etc. The software has helped on the evaluation of 76 existing oil tankers and bulk carriers that belong to several companies since it was launched, and the results were well-received by clients.

The results help us to understand the situation of ships' energy consumption and consumption distribution, and to find out the weakest link and further energy saving potential, as well as pointing a clear direction to raise ships' energy efficiency. The software provides a reasonable method to calculate ships' energy consumption distribution, and technical support to grade the energy consumption levels of vessels and major equipment. It also supports the development of ship energy saving technology, heat reuse technology, multi-fuel integrated energy system, and even the country's energy saving and emission reduction policies for the shipbuilding and shipping sectors.

In 2012, a CCS's project on the development and application of operating ships' energy efficiency management and operation systems was awarded China Institute of Navigation's Science and Technology Award – Second Class Award. The project is a systematic study of energy efficiency management, procedure, survey and analysis that was done taking into account various IMO requirements regarding ship energy efficiency and sea carbon emission control; relevant regulations of the state department, ministry of transport and related industry organisations and the results of national and international research on ship carbon emissions.

The project has resulted in the publishing of: "Rules for Verification of Ship Energy Efficiency Management", ships' energy efficiency database and application system, "Best Practice Guidelines for Ship Energy Efficiency", and "Guidelines on Ship Energy Efficiency Management Planning and Survey". The project has fulfilled the needs of regulatory bodies on macro management and the development needs of companies and accomplished the ultimate goal of the project to improve management level of ship energy consumption.

The project has several technical initiatives. The first one is a new concept on energy efficiency management. It proposes to include energy efficiency management into the management system of shipping companies and highlights the best practice of energy efficiency management, and the energy efficiency survey and analysis systems. It helps to blend the energy efficiency improvement scheme of a single ship into the overall management system of a company. Second, the project proposes new ways to apply energy efficiency measures and has led to the compilation of the "Best Practice Guidelines for Ship Energy Efficiency" and "Guidelines on Ship Energy Efficiency Management Planning and Survey". Third, the project has initiated the use networking technology as management tools, and has developed multi-dimension, multi-level ship energy efficiency database and application system, and has set up an industry-wise energy efficiency network as a shared platform.

The results of the project have been widely adopted by many of China's large-scale state-owned and private shipping enterprises, and the project has achieved considerable economic and social benefits. According to statistics, since the implementation of the systematic management of energy efficiency, a sizeable oil tanker operator in China has saved 63,000tonnes of fuel a year; while two other large-scale container liners have saved 150,000

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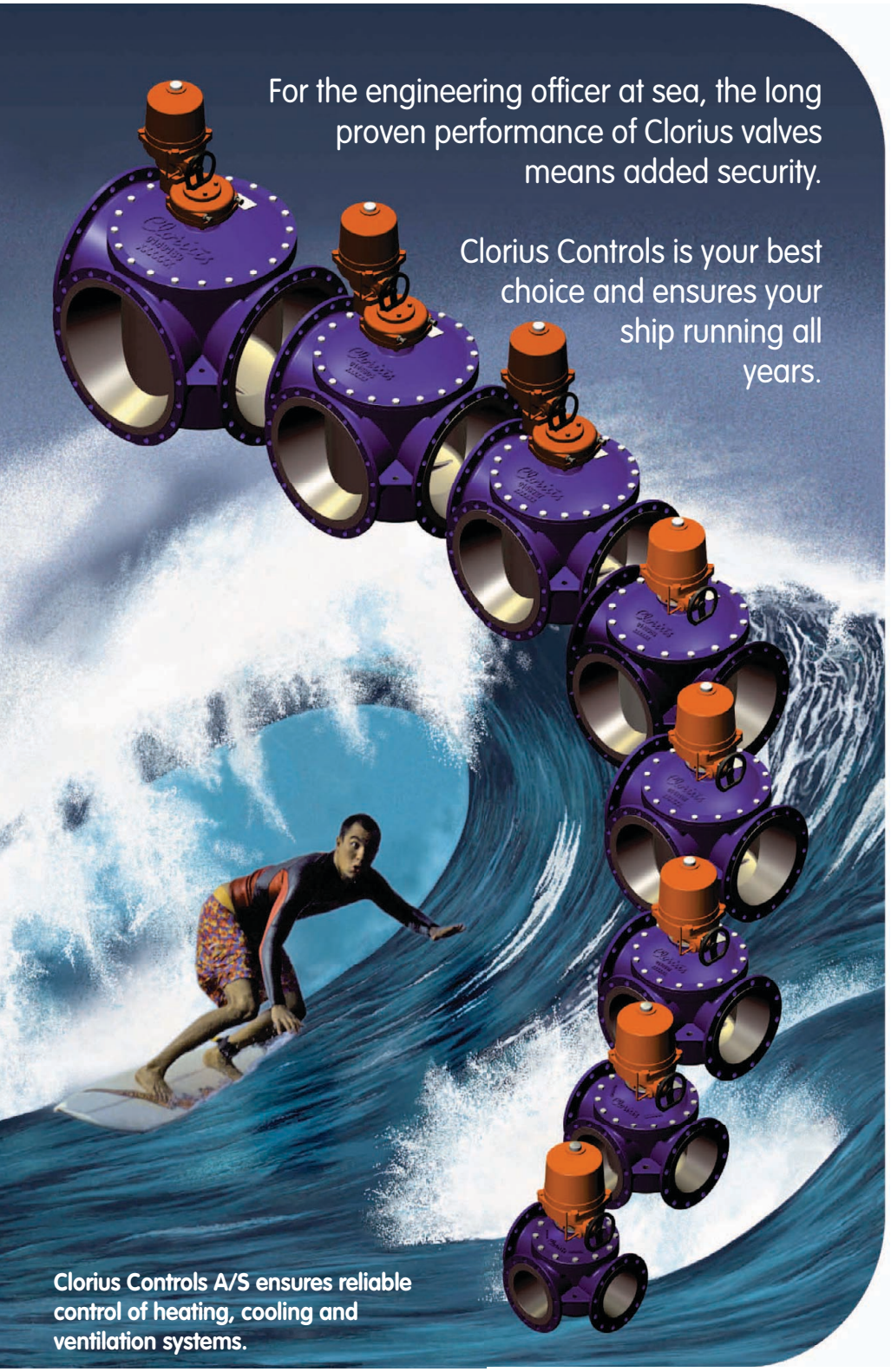

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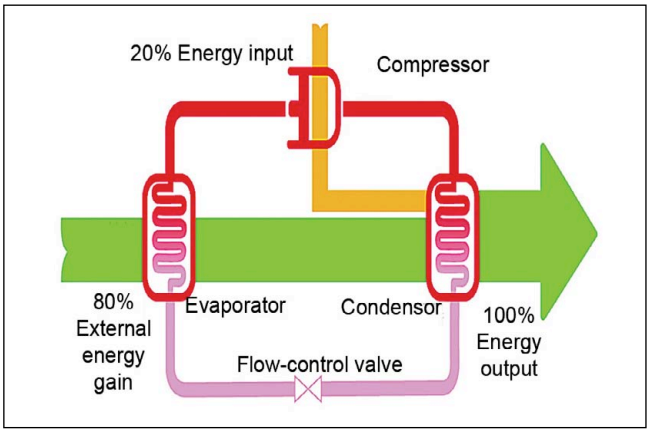

Heat Pump Technology

tonnes and 202,000tonnes of fuel respectively per year.

The implementation of the systematic management of energy efficiency can help improve companies' mode of energy efficiency management, and create healthier monitoring, servicing and management systems for energy saving in the industry. It also provides references to regulatory bodies when they are making decisions on the evaluation, planning and adjustment of energy saving and emission reduction policies. It helps on the optimisation of ship models' performance and capacity optimisation, and thus raises the level of energy efficiency of the whole industry. It also helps the industry to match international standard, and transform the market mechanism in China from administration-led to market-led and regulation-led mechanism.

Rules for green Inland Ships

On 29 March, 2012, the ministry of transport released the "Ship Type Standards for Inland Waterway Transport", which came into effect on 1 July, 2012. The standards specify the required main dimensions, energy efficiency levels and CO_2 emission levels of the standard ship types. Within a specific period of time in the future, standardised inland waterway transport ship types would mean vessels that fulfill the criteria specified in the standards.

CCS, as an institute that provides technical support to the standardisation of inland waterway ship types, is the main compiler of the standards. The standards mainly concern four aspects, namely safety, efficiency, green and advancement. In terms of safety and environmental protection, the standards were written based on existing shipbuilding regulations. In regards to efficiency, the standards has unified vessels' main dimensions so that ships can more easily adapt to port equipment such as ship gates and ship elevators, and has raised the energy performance of inland vessels by standardising level of energy strength. In the green aspect, the standards help achieve ship emission reduction target by establishing CO_2 emission level index. In regards to advancement, the standards encourage the use of new materials, new technologies, new methods, new equipment, new crafting technique and new energy on vessels, so as to achieve technical advancement. CCS has also drafted several set of guidelines for the implementation of the standards, they include "Ship Fuel Consumption Limits and Verification Methods", "Guidelines on Evaluation of the Energy Efficiency Design Index (EEDI) of Inland Ships" and "Guidelines on Inland Vessels Energy Efficiency Management Planning and Verifications". In the future, CCS will also help establish an inland river standard ship type database and a public information platform.

In order to promote the development of inland green shipping, CCS has combined its analyses on inland waterway vessels and inland shipping to set up a inland green ship standardization framework, which include one set of rules and three sets of guidelines: "Rules for Inland Green Ships", "Guidelines on Evaluation of the Energy Efficiency Design Index (*EEDI*) of Inland Ships", "Guidelines on Establishment of Inland Ship Energy Efficiency Management Plans (SEEMP)" and ""Guidelines on Control of Inland Ship Hazardous Materials". Rules for Inland Green Ships comprises of two parts. The first part contains technology requirements concerning energy efficiency, environmental protection and work environment. The second part contains technical requirements regarding green technologies applied on ships. The rules set a three-level labeling system for green ships: Green Ship I/II/III. Green technology can be used to satisfy the requirements of different green ship label levels in terms of energy efficiency, environmental protection and work environment. Guidelines on Evaluation of the Energy Efficiency Design Index (*EEDI*) of Inland Ships list out the technical requirements of the calculation, evaluation and verification of EEDI. Guidelines on Establishment of Inland Ship Energy Efficiency Management Plans (SEEMP) provide guidance to shipowners on how to set energy efficiency management measures for operating vessels. Guidelines on Control of Inland Ship Hazardous Materials provide guidance on how to draft a list of hazardous materials onboard a ship and the maintenance of the list.

Having consulted design institutes, shipyards, shipowners and equipment providers, CCS listed eight categories of energy saving technologies and 22 specific research directions, and has achieved initial results in the development of high efficient power system.

LNG dual-fuel power

As international oil prices remain high and energy saving and emission reduction requirements for ships tightened, LNG has become an important substitute power for future green ships. Using LNG as a fuel can help vessels to achieve emission and cost reduction targets.

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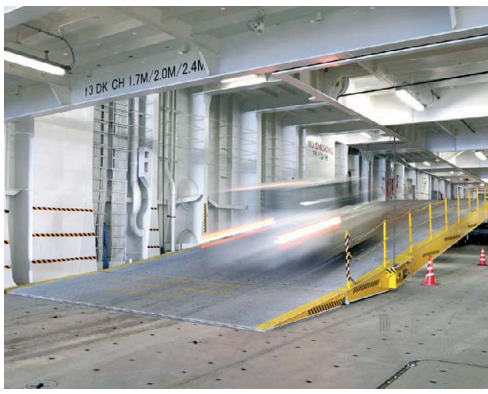

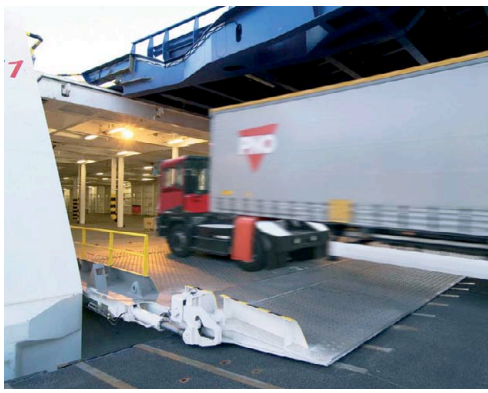

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In China, CCS has started research on standards for gas-fuelled vessels rather early, and has produced documents such as "Rules for Construction of LNG-Fuelled Ships", "Guidelines on Survey of Gas-fuelled Ships", "Guidelines on Design and Installation of Dual-Fuel Engine Power System", "Supplementary Rules for Survey of Gas-Fuelled Ships", "Principles of Evaluation of LNG Tanks for Ships" and "Technical Requirements for Trial of LNG/Diesel Dual-Fuelled Hybrid Ships", etc. Meanwhile, CCS has finished verifying the 8-type LNG engines from four manufacturers including WeiChai Power Company Limited, Zibo Diesel Engine Parent Company, Jinan Diesel Engine Company Limited and Guangzhou Diesel Engine Factory Company Limited. The classification society has completed the conversion of two LNG duel-fuelled hybrid bulk vessels, namely Wuhan Ferry Company's *Dulun302*, and China Changjiang National Shipping (Group) Corporation's *Changxun No.3*. CCS has also finished the survey of a new model of 3,100tonne LNG bulk vessel.

In January 2013, CCS and Wärtsilä Services (Shanghai) Company Limited signed a framework agreement for technical cooperation. Both sides will carry out comprehensive cooperation in areas such as LNG dual-fuelled ship power, ship design and development, verification of LNG dual-fuel engines and the standardisation of LNG dual-fuel engines. The cooperation with Wärtsilä will accelerate CCS progress in technologies, drawing review and surveying capability of LNG dual-fuel power.

Heat pump technology

Heat pump technology is an integrated energy utilisation system that can transport heat energy from low-temperature heat source to high-temperature heat source in order to realise the refrigerating and heat supply functions in a specific space. It is an energy saving technology. Heat pump is literally a "pump", which is not heat exchange equipment, but heats transfer equipment.

Currently, water-cooled chiller plants are commonly used to provide cooling in ships. Heating is supplied by steam from boiler. Cooling and heating should be provided by two separate systems. Water-cooled chiller plant is a special application of water-source heat pump technology, however, the water-source heat pump currently applied to ships can only support cooling function. CCS has commenced the research on application of water-source heat pump for the ministry of industry and information technology, and has developed inland passenger ferry water-source heat pump products and applied water-source heat pump technology onto large-scale inland cruise. The application of water-source heat pump technology is estimated to have reduced fuel cost by 2 million Yuan (US$323.509) for that vessel, and reduced CO_2 emission by nearly 1,000tonnes.

Best ship trim

Best ship trim adjustment practice means that if a ship is filled with a certain level of ballast water, when the trim is adjusted, the shape and volume of the underwater ship part will change accordingly, so will the waterline shape and length of the ship body, the location of buoyancy centre as well as the water flow pattern towards the bow and following the stern. These changes will affect the wave making resistance, frictional resistance and viscous pressure resistance of a ship. Adjustment of trim will also affect the performance of the propeller because of the change of water flow pattern at the stern area. According to research results in the past 20 years, there is always a best floating state to achieve the best ship trim for different types of ships under different ballast draft conditions and different speeds.

For example: a fully loaded 13,000 tonne cargo vessel sailing at 16knots, if adjusted to its best floating state, can save 296kW (around 6.5%) of its main engine power; if that vessel is half-loaded, the adjustment can save around 677kW (around 12.7%) of its main engine power; if that vessel is sailing in ballast, the adjustment can save around 63kW (around 1.5%) of its main engine power.

CCS is currently working with two big Chinese container liner companies to study the best ship trim adjustment practice for boxships. The results and the software currently being developed are expected to be applied onboard in 2013.

Solar power technology

Solar power technology is mainly divided into two types, including light-heat technology (solar heating)

and photovoltaic power generation. In recent years, with more stringent requirements of energy efficiency and emission reduction for ships, solar power has been applied onboard vessels. As early as 2000, an Australian-built hybrid catamaran has been installed with a photovoltaic power generation system.

In China, CCS has commenced the research on application of solar power on yachts, and has set related technology standards. The "Drawing Review Principles for Solar Power-fuelled Enhanced-Fibre Plastic Catamaran" formulated by CCS provides a verification standard for reviewing drawings of this type of ship. CCS has started the verification of flexible mono solar cell photovoltaic power generation parts and LiFePO4 battery, in order to assure core equipment and installations are up to standard. CCS is currently working on the verification of solar power-fuelled yachts built by a Chinese shipyard. That model of yacht is installed with two sets of solar energy lithium battery (with a separate set as reserve), with the batteries fully charged, the yacht can sail for eight consecutive hours using only power from the battery sets.

Shore power technology

Shore power means supplying electricity to ships using an onshore power source. Using onshore electricity to power ships' is an effective measure to save energy and reduce emissions when vessels are at berth. It is also more economical and can reduce vibration and improve the work environment onboard.

In recent years, CCS has set "Guidelines on Survey of High-Voltage Shore-to-Ship Power Supply System" and has participated in related system and product design, as well as the verification of relevant equipment onshore and onboard. On 24 September, 2011, CCS awarded the first classification certificate with shore-to-ship power supply system label (AMP) to Hebei Ocean Shipping Company Limited (HOSCO)'s *Glory China* in Lianyungang port. Meanwhile, shore-to-ship power supply system is applied in ports such as Lianyungang, Qingdao, Shanghai, Huanghua. *NA*

Improved SCR for marine applications

Mathias Magnusson, Erik Fridell and Hanna Härelind of Chalmers University in Sweden explain how selective catalytic reduction (SCRs) can help reduce emissions on ships of the future as part of a research project at the university

Increased environmental awareness considering emissions of nitrogen oxides (NOx is a generic term for mono-nitrogen oxides NO and NO_2 nitric oxide and nitrogen dioxide) and the related impact on the environment, e.g. eutrophication and acidification at land and sea [1], has contributed to the development of more stringent NOx regulations.

According to a report from the Swedish Maritime Administration [2] NOx emissions from ships in the Baltic Sea are approximately 370,000tonnes per year. This can be compared to the total amount of NOx emissions in Sweden during 2007, which corresponded to 165,000tonnes [2].

These high emission levels have meant that legislation to curb emissions from marine engines has been introduced. The most stringent international NOx legislation for ships can be found in IMO's Revised MARPOL (Marine Pollution) Annex VI [3]. Regulation 13 stipulates the international legislation for NOx, with Tier III from 2016 onwards with a reduction in the allowed NOx-emissions by about 80% compared to today's engines.

This will give rise to an increased demand for NOx abatement technology. It is possible to reduce the NOx emitted from marine engines with a number of techniques such as exhaust gas recirculation (EGR), water injection, SCR and engine modifications. Also a switch from marine bunker oil to for example LNG will reduce NOx emissions.

The most effective technique available today is SCR which can achieve about a 90% reduction in Nox emissions and can operate with high sulphur fuels and different engine types. There are, however, issues with low load (low temperature) applications and with catalyst deactivation. During the last 15-20 years extensive research has been conducted addressing the use of urea-SCRs for heavy duty vehicles, while investigations of SCR for marine applications remains limited. It is therefore important to further develop catalytic abatement systems specifically designed for the boundary conditions that apply for shipping.

In SCR, NOx reacts with ammonia over a base-metal catalyst to form nitrogen gas and water. The ammonia usually comes from urea that decomposes over the catalyst. The NOx reducing reaction/s that can take place over a SCR-catalyst are dependent on the composition of NOx in the gas feed. Previous studies have investigated these reactions [4, 5, 7-10], and in general the following reactions may occur:

Standard SCR:

$$4NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O \quad (1)$$

Fast SCR:

$$4NH_3 + 2NO + 2NO_2 \rightarrow 4N_2 + 6H_2O \quad (2)$$

Slow NO2 SCR:

$$4NH_3 + 2NO_2 \rightarrow 3.5N_2 + 6H_2O \quad (3)$$

In general, the reaction rates (r_x) of the different SCR reactions have been suggested by Tuenter et al. [10] to follow the order: rNO-NO2 >> rNO > rNO_2. It can be noted that the fastest SCR reaction (1) has equal amounts of NO and NO_2 as reactants. Thus, the reaction will be fast if NO and NO_2 are present in similar concentrations. In diesel exhaust over 90% of the NOx is in the form of NO [4-6], but the use of an oxidation catalyst could significantly increase the NO_2 fraction. However, several known oxidation catalyst, such as Platinum (Pt) and Palladium (Pd), become poised by sulphur and would require very low sulphur concentration in the exhaust to avoid deactivation.

The aim of this work is to investigate how various parameters, such as sulphur, water and varying NO/NO_2 concentrations affect the NOx reduction over a commercial urea-SCR catalyst for marine applications. This work takes a system approach where e.g. reaction temperature, gas flow and gas feed composition are considered.

An extended presentation of the experiments with pure NO can be found in a previous publication by Magnusson et al. [11]. However, the experiments and related results presented in this paper focus on the real and most challenging boundary conditions onboard ships, i.e. temperatures between 250 and 350°C, simultaneous addition of sulphur and water in the gas feed, and a future outlook with increased concentrations of NO_2 (50/50 fraction of NO/NO_2) in the gas feed.

Experimental methods

The catalyst samples used in this study was machined from a commercial wash-coated vanadium/tungsten (V_2O_5/WO_3)-based TiO_2 supported urea-SCR for marine applications (cell pitch 5x5mm). The catalyst was provided by DEC Marine AB [12].

The catalytic performance was evaluated in a flow reactor system consisting of a horizontal quartz tube with an outer diameter corresponding to 25mm, heated by a heating coil. The inlet gas concentrations were controlled by Bronkhorst mass flow controllers, and the outlet gas concentrations were measured by an MKS Multigas HS 2030 FTIR. Further details on the experimental setup can be found in a previous publication [11].

The inlet gas composition consisted of 0-500ppm NO, 0-500ppm NO_2, 500ppm NH_3, 8% O_2, with varying concentrations of SO_2 (0-750ppm) and H_2O (0-6%), balanced with Ar. The inlet gas temperature was varied between 250-350°C and the gas flow, measured as general hourly space velocities (GHSV = gas flow (m^3/h)/catalyst volume (m^3), between 6100-18300h^{-1} with the upper limit restricted by physical limitations in the lab. These parameters are chosen to represent the actual parameters found onboard ships; 1.0wt. % S in the marine fuel is approximately equal to 200ppm in the exhaust gas, and the gas flow is in the range of SV 15000-25000h^{-1}, respectively.

Results and discussion

Simultaneous addition of both SO_2(500ppm) and H_2O (4%) to the gas flow give stable NOx reduction performance at temperatures above 300°C and low space velocities (below

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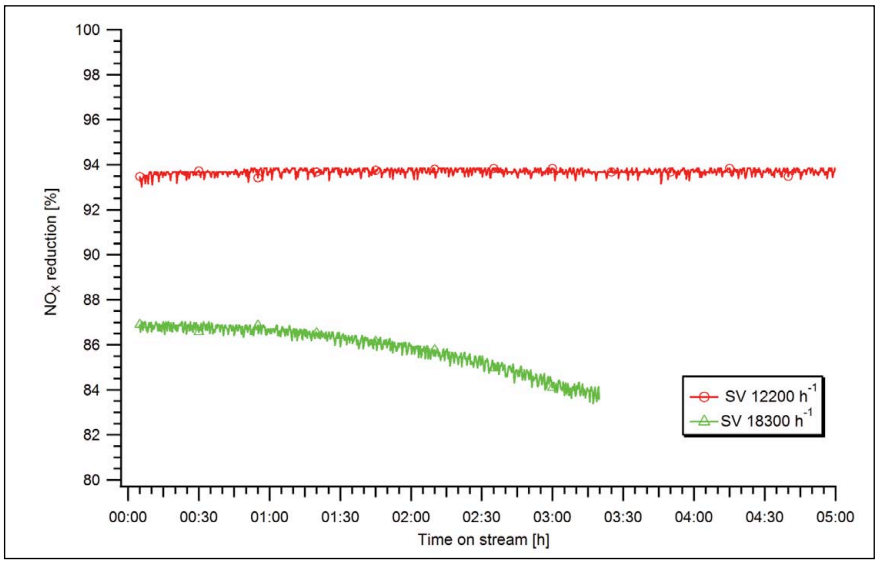


Figure 1: NOx reduction for 12200 (o) and 18300 h^{-1}(Δ). Feed gas composition: 500ppm NO, 500ppm NH_3, 8 % O_2, 500ppm SO_2 and 4% H_2O (300°C)

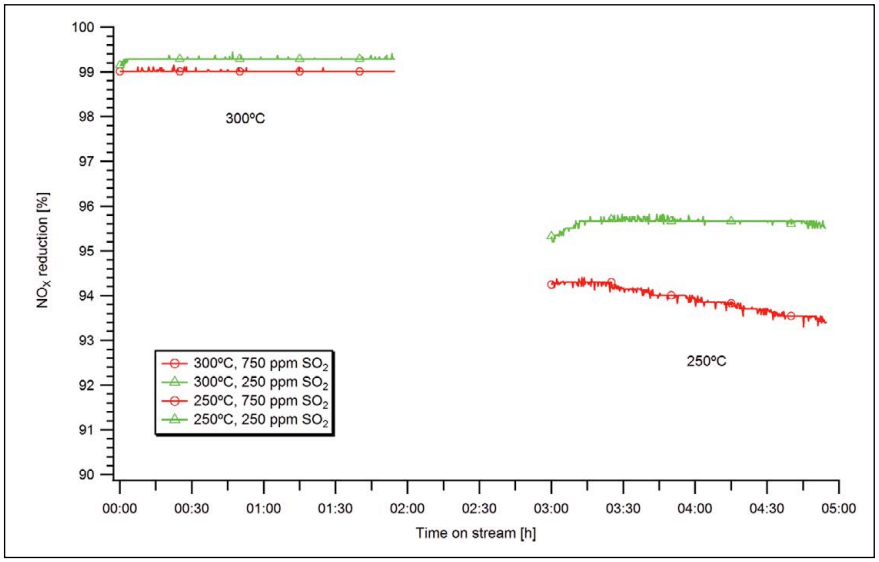
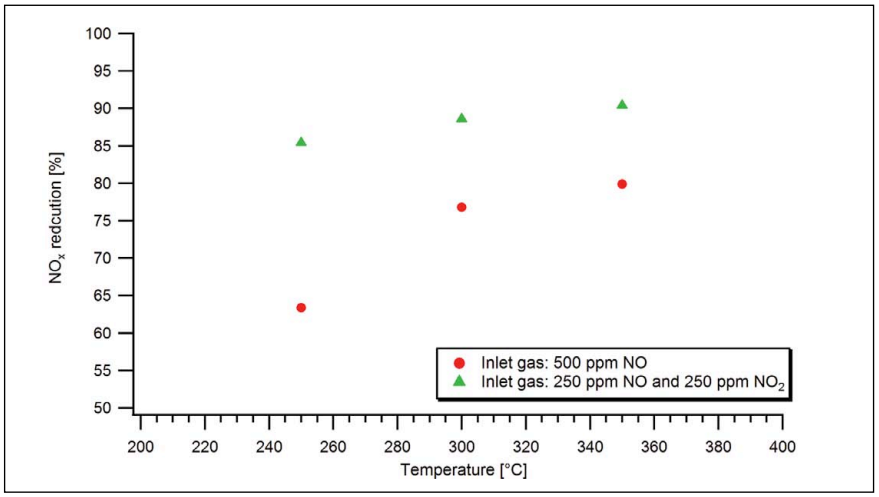


Figure 2: NOx reduction at 300 and 250°C at varying SO_2 concentrations and in the presence of H_2O. Feed gas composition: 250 (Δ) or 750ppm SO_2 (o), 500ppm NO, 500 ppm NH_3, 8 % O_2 and 4 % H_2O (SV 6100 h^{-1})



12200h-1). At lower temperatures and higher SO_2 concentrations there is increased deposition of ammonium sulphates which results in deactivation likely by pore plunging. The influence of space velocity on the NOx reduction is illustrated in Figure 1, and the combined influence of the temperature and SO_2 concentration on the catalytic activity is illustrated in Figure 2.

Furthermore, experiments with varying concentrations of NO and NO_2 in the feed gas at 250, 300 and 350°C indicate that the highest reduction rates are achieved at an equimolar mixtures of NO and NO_2 for all three temperatures. It can be noted that a significantly increased catalytic activity at reduced temperatures may be achieved by an increased NO_2 fraction. This may prove future opportunities for improved NOx reduction during low load operation of the engines. The results are presented in Figure 3.

Additionally, the addition of water (4%) at 250-350°C, in the absence of SO_2, at pure NO in the feed gas shows an inhibiting effect on the NOx reduction (minus 4-12%), with the strongest inhibiting effect at 250°C. However, the inhibiting effect of water is significantly reduced at an equimolar ratio of NO/NO_2, with a maximum reduction of about 2%.

Further, the addition of sulphur (500ppm) at 250-350°C, in the absence of water, at an equimolar ratio of NO/NO_2 indicates no significant effect on the NOx reduction.

Concluding remarks

In the presence of both SO_2 and water, the activity for NOx reduction decreases, in particular at high concentrations of SO_2, low temperatures and high space velocities. This may be explained by the formation of ammonium sulphate salts at low temperatures. In conclusion, these problems can be avoided by keeping the temperature high enough (i.e. above 300°C) and the space velocity and the SO_2 concentration low enough (i.e. below 12200h^{-1} and 500ppm respectively).

Additionally, the highest NOx reduction is achieved at an equimolar ratio (50/50) of NO/NO_2 and is significantly increased at all temperatures (250-350°C) and may prove

Figure 3: NOx reduction at 250, 300 and 350°C at varying NO/NO_2 ratios. Feed gas composition: 0-500ppm NO, 0-250ppm NO_2, 500ppm NH_3, 8 % O_2 (SV 12200 h^{-1})

future opportunities for improved SCR systems for marine applications. *NA*

Acknowledgment

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IMO set to decide on ro-ro EEDI fix

A decision on the mechanism that will offer a realistic Energy Efficiency Design Index (EEDI) value for all ro-ro vessels, including passenger and cargo ships is expected at MEPC 65 this month. *The Naval Architect* reviews the two opposing views for a ro-ro correction factor

Debate over the nature of the correction factor necessary to offer a realistic EEDI value for all the different types of ro-ro vessels is expected to reach its conclusion this month when two opposing views are discussed at MEPC 65 at the IMO in London.

At MEPC 64 in October 2012 it was decided that proposals put forward by the Danish, Japanese and Norwegians (which will be referred to as the Danish proposals for brevity) were effectively put on hold while the Swedish/German proposals, supported by Community of European Shipyard Associations (CESA) and latterly the ferry operators association Interferry (referred to as the Swedish proposal) will be further debated with the view for finalisation at MEPC 65.

Central to the discussions at MEPC 65 will be the use of the Froude number in the Swedish proposal which is considered perverse by the Danish contingent. According to the Danes by using the Froude number ship designs will be able to increase or decrease power without having an effect on the EEDI value for the vessel.

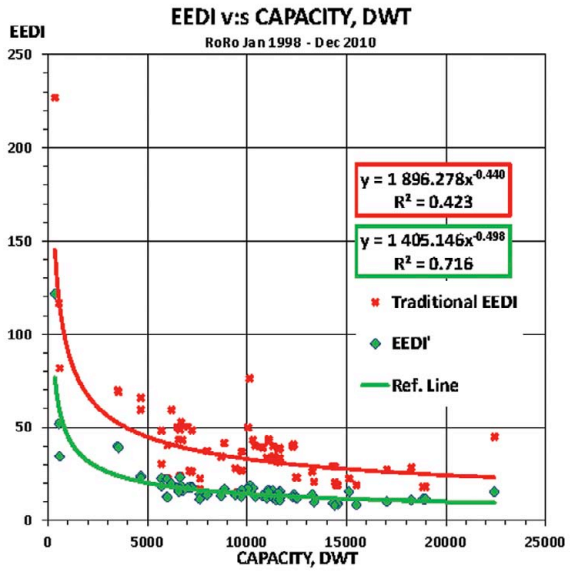
"This will be the key debate at MEPC 65, even though the Danes have shown some of the calculations [regarding the use of the Froude Number] it remains unclear whether their interpretation is correct," explained Lloyd's Register's lead environmental specialist Paul McStay.

As a result the Danes have asked for their proposals to be reconsidered at MEPC 65 and the proposals put forward, which use a cubic capacity correction factor, along similar line to the correction factor used for chemical tankers, will also be debated.

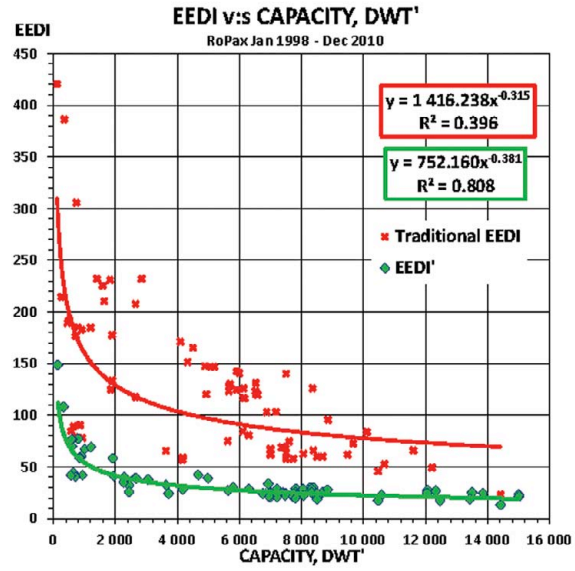
On the other hand, in the Swedish led view the relationship between GT (or DWT/GT) and ship performance "is not sufficiently robust" as these parameters have no influence on hydrodynamic properties and hence energy consumption. Accordingly for the vehicle carriers a DWT/GT-correction method was considered inappropriate during the MEPC 64 deliberations.

All sides of the debate recognise that the EEDI for ro-ro ships needs to be adjusted as the formula, which calculates the "CO_2-burden" over 'benefit to society', works for standard

EEDI reference line-ro-ro cargo ships - original EEDI and normalised EEDI



EEDI reference line-ro-ro passenger ships - original EEDI and normalised EEDI



vessels, but ro-ro ships do not fit neatly into the EEDI formula. In effect the debate at MEPC 65 will centre on ro-ro cargo ships and ro-pax vessels and will exclude for the moment ro-ro vehicle carriers. Any decisions taken at MEPC 65 will not be approved until MEPC 66 in the spring of 2014 and would not be an enforceable regulation until 16 months after that.

Effectively ro-ro ships will be penalised for carrying heavy cargo within a large space while passenger ferries may also carry cars and trailers and will have a far lighter cargo also in a relatively large area. In addition some ferries have cabins and the passengers will mean that the auxiliary engines will have a heavier load and would also need to be taken into consideration.

Ferries also operate to tight schedules and, in order to compete with other forms of transport most notably lorries, they must maintain their schedules. It is for these reasons that ro-ro ships require a correction factor that will allow them to remain competitive, maintain the services that these ships offer while still reducing the amount of CO_2 that the vessels emit.

Precedents for a correction factor have already been set with the development of formulae for chemical tankers when IMO realised that the tanker standard worked against parcel tankers which ordinarily carry cargoes with significantly less density than crude oil tankers, reducing the 'benefit to society' in terms of the weight of cargo carried for the tonne of CO_2 emitted. In addition IMO acknowledged that there was a necessity for a correction factor for "ship specific design elements".

The Danish correction factor uses the ratio between the deadweight and gross tonnage of the vessel. In the submission to the IMO the paper MEPC 64/4/9 the authors of this submission argue: "The principle of establishing a relationship between the DWT and the displacement or LW [light weight] is used to solve the problems in establishing a suitable reference line for ro-ro cargo and ro-ro passenger ships."

However, data for the light weight can be difficult to find and so the ration between dead weight and gross tonnage can be used as an alternative.

"Ships having a high GT and a low DWT will have a relatively high lightweight and thus a relatively high displacement compared to the DWT," says the MEPC/64/4/9 submission.

"The EEDI formula anticipates that the benefit a ship provides to society is proportional to its maximum deadweight multiplied by its speed. This assumption is of course a disadvantage eg for tankers designed to carry liquids with a low density when a common reference for all tankers is established. To compensate for this, MEPC 62 included a so-called cubic correction factor for chemical carriers designed to carry cargo with a lower density."

Similarly, there are proposals to establish cubic correction factors that would be applied to the various types of ro-ro ships.

However, while the Swedish and the Danish led groups believe their own proposals for a ro-ro correction factor are correct, MEPC 64 held the Danish proposals in abeyance while MEPC 65 hopes to finalise the Swedish led proposals this month.

And the Swedes have introduced a number of refinements to the original proposal discussed at MEPC 64. Changes that will be discussed this month include a lowering of the size of vessel that the EEDI will apply to, to 2,000dwt and over for ro-ro cargo ships and 4,000gt and over for ro-pax vessels.

In addition EEDI reduction rates have been brought into line with the Danish proposals and with other ship types, with phase 1 starting at 5% in 2015-2019, phase 2 reductions of 20 from 2020 and 30% by 2025.

Auxiliary power calculations in the Swedish model have also been brought into line with the original Danish proposal, says MeStay .

Ship hull design and the "energy burden" are functions of the operational conditions and the hull geometry and thereby the EEDI for each vessel. So the Swedish group devised the Ship Design Variable (SDV) which includes the following: the ship's reference speed; vessel length and breadth; draught and volumetric displacement at summer load line.

Furthermore, for ro-ro ships "wave-making resistance" is a significant element of the total resistance. The Swedish group adds: "Due to the diversity in operational conditions and geometrical constraints the range in Froude's Number is noticeably wide for these ship types. Hence a robust and fair basis for comparison must be founded on the Froude's Number; any comparison at absolute service speed is meaningless and results in undesired consequences."

The relationship between power and speed follows a 'power law' with an exponent of between 2.5 and 5.0 depending on the vessel type. For ro-ro cargo ships the exponent can be set at 3.0 in vicinity of the design point, which "correlates rather well" with the collective data for these ships, but passenger ro-ro's which must have a high reserve power, including spare power capacity to cover safe return to port regulations, the exponent must be set higher at 3.5.

$$SDV = Fn_L^{\alpha} \times \left(\frac{L_{pp}}{B_S}\right)^{\beta} \times \left(\frac{B_S}{d_S}\right)^{\gamma} \times \left(\frac{L_{pp}}{\nabla^{1/3}}\right)^{\delta}$$

The Ship Design Variable, is now defined as the product of the Fn_L and the non-dimensional ratios, the respective relevance of which are set by applying power law exponents β, γ, δ, in order to provide in the best representation of the fleet average performance

Accordingly the SDV will include length to beam ratio, beam to draught ratio, and a slenderness ratio and the applied power law exponents to give the formula:

$$\text{Estimated Index Value} = \frac{3.1144 \times (f_{jRoRo} \times 190 \times \sum P_{MEi} + 215 \times P_{AE})}{Cap \times V_{ref}}$$

For ro-ro cargo ships, the estimated index value for each individual ship is calculated as above

In the final version of the Swedish calculations the formula for both passenger and cargo ro-ro vessels, and including the adjustments for auxiliary power, are as follows:

$$\text{Estimated Index Value} = \frac{3.1144 \times (f_{jRoRo} \times 190 \times \sum P_{MEi} + 215 \times P_{AE})}{f_{cRoPax} \times Cap \times V_{ref}}$$

For ro-ro passenger ships, the estimated index value for each individual ship is calculated as above

For ro-ro cargo ships, the estimated index value for each individual ship is calculated as follows:

For ro-ro passenger ships, the estimated index value for each individual ship is calculated as follows:

It is these proposals that are now being backed by a number of flag states and non-governmental organisations, however, the Danish and Japanese representatives believe that the Swedish model is flawed.

"By introducing the ship's speed in a correction factor as proposed, the influence of the propulsion power is eliminated and there will be no incentive to reduce the power and thus the CO_2 burden of the ships. In several cases, the EEDI value will be lowered when the power is increased – which will not reduce CO_2 emissions from this segment of ships," says the latest submission, MEPC 65/4/18.

According to the Danish led group these proposals will not meet the nine fundamental principles on greenhouse gas emissions agreed at MEPC 57 and will not be reduce emissions.

"Put in more technical terms, the proposal introduces a correction factor which includes the "Froude number" – and thus the ship speed – in the power of 2.0 or 2.5 for cargo or passenger ships, respectively. When correcting the EEDI value by this factor, the EEDI of a ship is kept approximately unchanged when the speed and the installed power – and thus the CO_2 emission – is increased or decreased."

The Danes argue that any changes to the propulsive power will be negated by the application of the correction factor and this will benefit ro-ro ships enormously when compared to other ship types, but will not reduce the carbon footprint of the vessels.

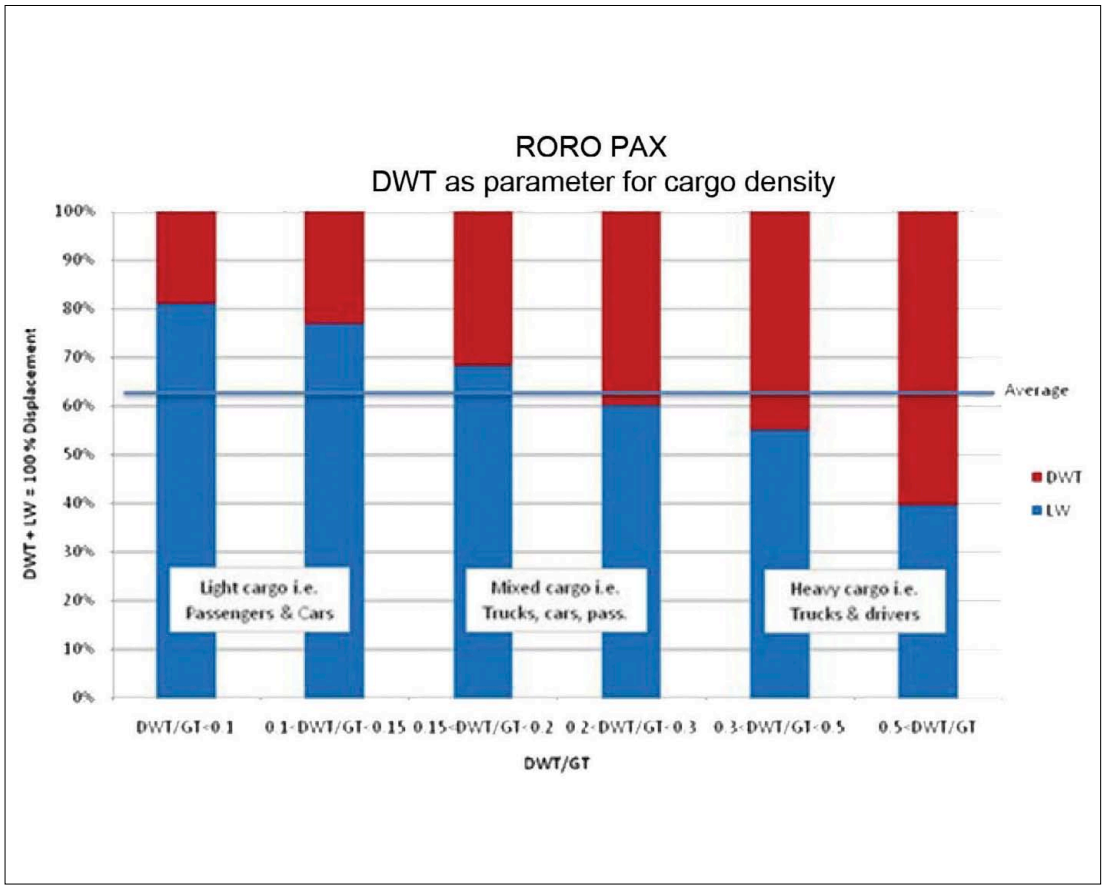
As a response to criticisms from the Danish led contingent the Swedish Transport Authority asked the Technical University of Hamburg-Harburg (TUHH) to evaluate the Danish concerns.

However, in response to the Danish criticism the Swedes state: "When applying a cubic speed-power performance relation, (α = 2.0) the normalised EEDI for speed values in the vicinity of the design point will for energy efficient ships be close to linear, but for increasing speed the gradient will increase and the EEDI expressed as a function of speed will intersect the normalized EEDI reference line.

Since the methodology is founded on the gradient of the speed-power curve, it directly addresses the "propulsive" energy efficiency. Consequently, a "Good Design" will exhibit a lesser speed-power gradient and consequently require less power for the same transport work than fleet average, whereas a "Bad Design" will not be found compliant."

A further concern for the Danes is that under the Swedish/German proposals a reduction in speed will increase the EEDI value. According to the Swedish response this is due to the auxiliary power remaining constant. The proposal to keep auxiliary power constant was originally made by the Danish contingent according to the Swedish/German group and this has now been adopted for both submissions.

Accordingly the Danish and Japanese contingent is calling for MEPC to reconsider the Swedish/German proposals and the group's own proposals based on the DWT/GT ratio. *NA*



Ships that have a high GT and a low DWT will have a relatively high lightweight and thus a relatively high displacement compared to the DWT according to the Danish led submission

MEPC debates technology transfer rules

Within IMO's MARPOL Annex VI Chapter 4 energy efficiency regulations, agreement on Regulation 23 has been reached allowing the technology transfer that will help developing countries meet new regulations. Dr Zabi Bazari, managing director at Energy and Emissions Solutions reports

As the discussion within the IMO moves from technical and operational measures to Measurement, Reporting and Verification (MRV) and Market Based Measures (MBM), the issue of technology transfer is expected to take centre stage. Any new deal on the control of GHG emissions from international shipping, beyond technical and operational measures, may become conditional to agreeing concrete measures for the transfer of technology within the spirit of the UNFCCC (United Nation Framework Convention on Climate Change) agreements.

Although the industry players are in favour of including technology transfer clauses that may be used to secure some sort of support for developing nations, there has not yet been much debate on how this complex issue will be tackled practically in order to ensure a meaningful and substantive technology transfer on the one hand and significant reduction in international shipping GHG emissions on the other.

This article aims to introduce the subject with the primary objective of promoting further debate in this area. It discusses aspects of technology transfer fundamentals and then moves to discuss the case for international shipping.

Technology transfer and its barriers

In the context of climate change, technology transfer is defined by IPCC as "a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, non-governmental organisations (NGOs) and research/education institutions".

Meeting the technology needs of developing countries must be done through a proper IMO framework says Dr Zabi Bazari Managing Director Energy and Emissions Solutions

This description explicitly mentions "processes" and "flows of know-how, experience and equipment" as the core of technology transfer. These processes intend to lead to certain goals such as the implementation of specific energy saving projects, new technology developments or new working arrangements. Of course, in any technology transfer, some elements of novelty need to be present with respect to current status of the technology recipients.

Management of the "flows of know-how, experience and equipment" in the form of planning, implementation, monitoring and reviews provides practical ways to define methods for technology transfer and ensuring its success. This could be discussed further under the theme of "technology management" that would be one of the technology transfer processes.

In technology transfer, as the above definition shows, a number of organisations will be involved including technology owners, technology recipients, possibly a number of technology transfer agents plus other stakeholders. In general, technology transfer is a multi-layer and multi-organisational series of activities that requires a medium to long-term perspective for it to be a success. This makes technology transfer a very complex process with a significant number of major barriers as shown in the diagram below. A clear understanding of barriers and push and pull factors are essential for a successful technology transfer activity.

What to transfer?

As part of technology transfer, one or more of the below may take place:

Transfer of knowledge: For technology transfer, access to knowledge and information is essential. With the advent of ICT (Information and Communication Technologies), this to a large extent has already happened. However, there are significant levels of proprietary information for which access requires resources. Provision of such information could be part of the overall technology transfer plan.

Transfer of know-how: This is to do with skills and competencies that can be acquired mainly through practice and by doing. A collaborative working relationship is key to a successful transfer of know-how. This element of technology transfer will involve organisational networking and multi-lateral engagements that would lead to effective institutional and human capacity building. Activities that could lead to further engagement by recipients in technology development could take a variety of forms e.g. collaborative activities, pilot projects, work and project assignments, on the job training and so on.

Transfer of software: Software here is defined in its more generic form and refers to processes, procedures and relevant tools; both technical and management. This may include working practices, design and development tools, management and

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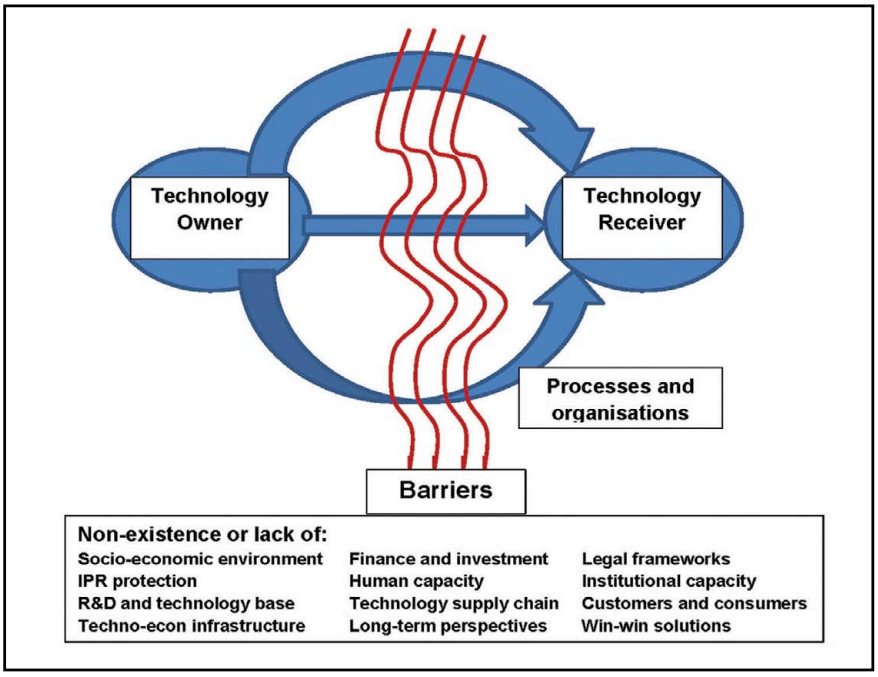

organisational processes, etc. Transfer of relevant software and related training could be decided as part of planning.

Transfer of hardware: Traditionally, technology transfer has been considered as the transfer of hardware. In the context of this article, however, the transfer of hardware is only one element of technology transfer; although it could be an important element depending on the requirements. Transfer of hardware in the context of technology transfer will go beyond a simple sale of equipment, but more of a long term collaborative working relationship on either use or development of relevant hardware.

To plan for the technology transfer, the first step is normally to perform a recipient's "*Technology Need Assessment (TNA)*". This is part of the initial gap analysis performed in the recipient country/institution in order to establish the recipient's requirements for knowledge, know-how, software or hardware.

Capacity building

Capacity building in general refers to activities that lead to preparation of the recipient's country/institution to absorb the new technology. Capacity building could involve a number of areas including improvements in human capacity, institutional capacity, infrastructure, socio-economic environment, etc. In its simplest form, capacity building is normally used for promoting human and institutional capacities.

To plan for capacity building, the first step is normally to perform a recipient's "*Capacity Needs Assessment (CNA)*". This is part of the initial gap analysis performed in order to establish the recipient's requirement for human and institutional developments. The gap analysis would include all aspects of capacity building as outlined above.

As part of a capacity building assessment, it is important that the institutional stakeholders' map for the recipient country / organisation is identified together with each institution's requirements and needs. This will not only provide the institutional gaps, but also the capacity gaps within each institution that will subsequently be the subject of capacity building within the context of technology transfer activities.

Technology transfer requirements

Prior to the actual start of the technology transfer there are certain requirements that need to be in place to make the process effective and efficient. These are highlighted here.

In the initial phase the identification of recipient technology needs involves the definition of technology transfer scope and requirements for the recipient via the analysis of TNAs and CNAs as indicated above. This activity is best led by the recipient country based on the analysis of its national strategies, policies and programmes. The identification of needs may eventually appear as a technology transfer roadmap in a specific area. To enable the provision of leadership by the recipient country, some level of initial capacity building activities in this area will normally be required.

The creation of the enabling environment is another important requirement; meaning that the recipient country needs to develop its own internal systems, institutions, infrastructure and socio-economic environment to prepare the groundwork for receiving the required technologies. Without vital pre-preparations, no technology transfer will be successful. Preparations may include aspects of institutional and human capacity building, infrastructure development, information systems, IPR (Intellectual Property Rights) aspects, educational and R&D institutions and so on.

To carry out specific technology transfer projects, there is a need for planning, programme and project developments to properly organise the technology transfer. This will involve aspects such as a top-down view of requirements, bottom up collection of needs and existing capacities and road mapping. As a result, a set of national initiatives will be identified. This macro-plan then needs to be converted into programmes and projects; for subsequent development, financing and implementation.

For financing of the projects, there are a variety of financial models that may be used. It is important that financial models provide a certain level of flexibility and market-oriented approaches to ensure long term viability. Models could be competition-based, incentive-based, joint ventures, foreign direct investment and so on. The selected financial model should ensure win-win situations for recipients, investors and the technology owner in order to assure the minimum

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requirements for a successful technology transfer activity.

As discussed before, technology transfer involves a large number of organisations as well as the transfer of know-how and IPR. This should be properly organised via creating a genuine collaborative environment based on win-win scenarios and safeguards for IPR. An extensive level of discussions, networking and relationship building is required as part of the whole process of needs assessment, planning, programme and project development and implementation.

Technology transfer in shipping

As part of the new Chapter 4 of MARPOL Annex VI on ship energy efficiency, IMO is advocating capacity-building, technical assistance, technical co-operation and transfer of technology to developing countries for compliance purposes. This is embodied in Regulation 23 entitled "promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships".

Regulation 23 in simple terms specifies that:

1. The Administrations shall provide support to States, especially developing States that request technical assistance.
2. A Party shall co-operate actively with other Parties, subject to its national laws, regulations and policies, to promote the development and transfer of technology and exchange of information to States which request technical assistance, particularly developing states, in respect of the implementation of measures to fulfil the requirements of chapter 4 of MARPOL Annex VI.

The above means that the scope of assistance will specifically be (1) the development and transfer of technology; and (2) the exchange of information. Additionally, the objective is to enable the recipient to fulfil the requirements of Chapter 4 Regulations, i.e. EEDI compliance.

Regulation 23 can, therefore, be interpreted as having a limited scope of technical assistance, i.e. Compliance to EEDI. Although Chapter 4 came into force on 1 January 2013, the work on Regulation 23 and how it should be implemented is at its early stages of discussion. IMO MEPC (Marine Environmental Protection Committee) is expected to deal with this issue in its future sessions.

Technology transfer for EEDI compliance

As stated above, in Regulation 23 reference to "development and transfer of technology" is primarily to support compliance to EEDI regulations. For compliance purposes, a number of activities may need to be undertaken such as:

- Capacity building
- The exchange of information and technical co-operation
- Collaborative R&D on Energy Efficient Technologies (EETs)
- Collaborative activities on ship design improvements.

To implement Regulation 23, it is likely that the existing IMO Technical Cooperation Programme framework would be a sufficient mechanism for short to medium term compliance purposes. This is based on the assumption that, for short to medium term (e.g. up to 2020), compliance to EEDI regulations could be achieved with minimal technology transfer. It will be mainly from Phase 2 (i.e. beyond 2020) or more likely phase 3 (beyond 2025) of EEDI implementation that compliance will become difficult and may require substantive technology transfer activities.

Technology transfer beyond compliance

A different perspective to technology transfer could be seen in the wider context of removing barriers for a significant mitigation of international shipping's GHG emissions. This view of technology transfer will go beyond compliance to EEDI and possibly will be linked to future targets within a marine MBM framework. Also, this view comes closer to concepts that are covered under UNFCCC and related decisions by COPs (Conference of the Parties) on targets, mitigation and adaptation and corresponding support for none-Annex I countries; that results from the principal of UNFCCC's Common But Differentiated Responsibilities (CBDR).

Energy efficient technologies (EETs)

It is well known that there are a number of ship technologies that may be used to improve ships' energy efficiency. A lot has been said by experts, NGOs and Administrations on this subject; indicating more or less a unanimous view of EETs' effectiveness as a way to mitigate shipping's GHG emissions. Also, it is well known that there are serious barriers to the uptake of these technologies; in the author's view, these barriers have not been profoundly discussed or appreciated yet.

In the context of technology transfer for energy efficiency, there are those who favour the "promotion of EETs" as the main method for shipping CO_2 mitigation and ship fuel cost reduction. Based on this paradigm, it is advocated for IMO to take a more central role to:

- Help to identify and assess EETs that currently exist or are being developed
- Play a role in promoting the development and uptake of EETs
- Assist states in identifying their needs with respect to EETs
- Help identify opportunities for technology cooperation among states with respect to EETs.

Within the same context there is a proposal at IMO level to establish:

- A Forum to improve the understanding of the extent and nature of the uptake of EETs and how to promote their uptake in shipping
- An Experts Group to assess EETs potential GHG reductions and their cost-effectiveness.

Within this context, technology transfer will to a large extent concentrate on promoting the use of

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EETs. The above Forum and Expert Group will provide the vehicle for removing the barriers to use of such technologies.

Towards a comprehensive approach

Technology transfer in the maritime sector should concentrate on ensuring the mitigation of CO_2 emissions via removing the main barriers to shipping energy efficiency. Maritime transport needs to adopt an approach that is compatible with its international nature. On shipbuilding, technology transfer should aim to ensure that developing maritime nations are not disadvantaged due to the future complexity of ships or future higher ships, fuel or CO_2 prices that may result from energy efficiency regulations or market instruments. Additionally, in view of the very large number of ships in operation, technology transfer should go beyond EEDI compliance and should include fuel efficient ship operations.

The maritime sector has so far identified the barriers; it is time to concentrate on how to resolve them rather than stay at generic levels. A holistic approach / framework is needed in finding solutions to some major barriers. Some examples of aspects that need to be part of the framework are described below:

- *Private sector financing*: Shipping is mainly an industry that is driven by the private sector in both developed and developing countries. Involvement of the private sector in particular in financing of energy efficient initiatives is essential. Barriers to private sector engagement in ship's energy efficiency need to be identified and removed.
- *Split incentives and innovative financing schemes*: A major barrier in the maritime sector is split incentives; meaning that various players in ship operations have different incentives that prevent their full contribution to energy saving. This needs to be resolved in order to ensure that all parties are incentivised for this purpose. Since the structure of the industry that has developed over time cannot be changed, the main tool for this would include innovative financing schemes and legal frameworks that need to be developed and supported by the international community within a GHG abatement framework.
- *Use of economies of scale*: Energy management and CO_2 reduction will benefit from economies of scale, meaning that the larger the number of ships under energy management schemes, the higher the benefit. In this case, arrangements to develop multi-national and multi-corporation joint initiatives need to be encouraged. Alliance building of the type seen in the aviation industry, where airlines entice customers by offering a better service and fully loading aeroplanes (thereby reducing unit cost to the benefit of passengers and airlines), can be tried in the maritime industry. International technical cooperation between various countries/organisations could support this process. Consortiums or alliances in support of various technical activities and the operational management of fleets will help smaller fleet owners to benefit from this interaction. This scheme needs to be based on a sound business case to ensure positive outcomes for all.
- *Concentrate on major energy saving measures*: Large numbers of energy saving measures are advocated by various experts and authorities. However, few of these measures provide most of the energy saving potentials with the others having less impact. The former can be referred to as Major Energy Efficiency Measures (MEEMs). It is proposed to concentrate on MEEMs in the first place and include them in forthcoming maritime GHG international cooperation. Discussions should move away from generic lists of measures to specific items. For example, for ships in operation, areas with most energy saving potential could be selected as slow steaming, just-in-time (virtual arrival), hull and propeller conditions, etc. IMO or various international bodies and associations could concentrate on these and try to provide solutions for action within a technology transfer framework.
- *Promotion of EETs*: The promotion of EETs could be carried out as part of an international cooperation and via the use of private sector financing. Apart from activities that assure that energy saving claims are verifiable (e.g. certification of claims, design and pilot studies), financing of such projects for developing nations needs to be supported. This forms a specific area of support that could be implemented with due consideration for other items that are described above.
- *MRV (Measurement, Reporting and Verification) and other management systems*: There have been some debates on MRV and this will be followed further in due course. A proper MRV system will require additional hardware and software if the reported numbers are going to be relied upon. The implementation of the MRV plus other GHG/fuel management systems could also be included as part of the maritime technology transfer cooperation.

The above list is not exhaustive but shows areas that we need to concentrate on with priority, if the reduction of carbon from shipping is going to be realised. If this general approach and framework is accepted, the next step is to go deeper on issues raised herein and aim for an integrated solution with technology transfer scheme for developing countries as part of a wider framework for GHG emissions mitigation from ships.

IMO could play a significant role on the above fronts to encourage the definition of the framework, prepare the ground work and encourage various parties to develop processes in support of technology transfer and international cooperation for shipping CO_2 abatement. IMO could primarily concentrate on removing the barriers to technology transfer as well as to help identify and secure resources for project financing in support of developing countries and in particular the least developed countries.

At the national levels and, since technology transfer for energy efficiency goes beyond the conventional Maritime Administration functions, the establishment of new entities may be required in order to deal with this specialised task of maritime GHG emissions control. How these new institutions should be organised could be the subject of national debates in countries that aim to actively take part in international cooperation on shipping GHG emissions mitigation. *NA*

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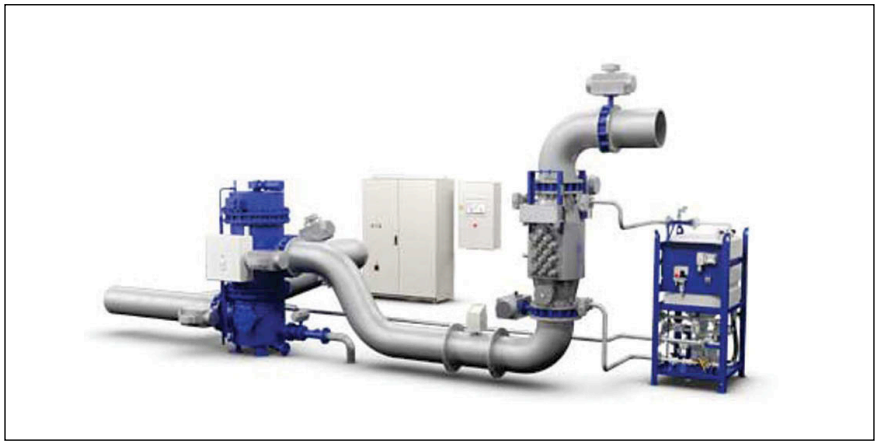
Less is more for Alfa Laval's latest BWTS

A reduction in size has seen the optimisation of Alfa Laval's ballast water treatment system with the introduction of its Pure Ballast 3.0

Alfa Laval has announced the launch of its third generation of ballast water treatment system (BWTS), the Pure Ballast 3.0, which will be smaller than previous systems, have a higher cubic capacity and is able to achieve 60% energy savings, it claimed.

To achieve this Alfa Laval has taken stock of its previous systems and made some changes to its design. The maximum power of the system has been reduced by 30%, with an additional dimming function, which allows the system to automatically reduce the power used if the ballast water is of better quality. Fewer components have also been used, which has also allowed the system to reduce its foot print.



Alfa Laval launches its Pure Ballast 3.0

Jonas Alván, product development manager for PureBallast, points out that this was really a new start for the system. "The original construction had been streamlined as much as was possible, which meant we were forced to think in new ways to move forward," he says.

The advanced oxidisation technology (AOT) reactor has been redesigned and now comes in two capacities 1,000m^3/h and 300m^3/h. The power consumption of the 1,000m^3/h unit has been reduced by 30% from 130kW from its predecessors to 100kW, highlights Alfa Laval. Adding to this the reactor has been optimised to give better flow and mixing through CFD studies carried out on the unit. As a result Pure Ballast 3.0 uses only one AOT unit instead of four.

"One of the things we were looking for was greater mixing, which would, both increase the effect of the AOT and help to compensate for low UV transmittance," Alván says, referring to the distance UV light travels in water. "With more fluid mixing, the chance of an organism passing close to the UV lamps increases –thereby the biological efficiency increases."

Furthermore, Alfa Laval has highlighted that it is important that the UV dosing needs to be optimised for the flow rate to get the correct dosage. Adding stronger UV lamps or increasing the lamp number can increase biological efficiency, but only at the expense of energy efficiency. This left two main reactor parameters that could be adjusted: flow patterns and lamp placement.

Through the CFD modelling the new model, light sources were introduced into the equation, making it possible to see the UV dose for each of 50,000 theoretical particles (organisms) passing through the reactor.

"In our visualisations, we assigned each particle a colour according to the UV dose incurred," Alván explains. "By optimising the reactor design for a uniform colour among exiting paths, we could ensure the most even UV dose possible. And that gave us the reactor design with the least possible energy consumption. The end result is startling."

Alfa Laval says that the 1,000m^3/h units will cater for the VLCC market, but further developments are on the way for intermediate and smaller size vessels and also the offshore market. High-alloy austenitic stainless steel SMO 25L has been used for the treatment unit, as the company found that 360L could not cope with warm sea water.

The system is not yet type approved and is currently under-going sea-tests on the vessel *Turandot*. The company has noted that it is looking to receive type approval shortly, with the first of the systems coming on to the market later in the year. *NA*

Alfa Laval receives order for Maersk Triple E's

Alfa Laval has received an order to equip all 20 Triple E vessels with its Pure Ballast 3.0 treatment system, with the first vessel scheduled for delivery later this year.

The order will see Alfa Laval supply its 1,000m^3/h systems for the vessels with each vessel being fitted with two systems to cater for the ballast capacity. However, Alfa Laval has noted that due to the impending type approval of the Pure Ballast 3.0 the first two vessels will be initially fitted with Pure Ballast 2.0 and later retrofitted with the 3.0.

The Triple E vessels will be the largest container vessels on the market, at 18,000TEU, that will be 400m long, 59m wide and 73m high. The focus of these vessels is not just the size but in being more energy efficient and better for the environment. For this the vessels will also have other green technology such as waste heat recovery systems fitted.

Fjord 1 takes green transport further

Multi Maritime has in close cooperation with the ferry operator Fjord1 launched a green ferry concept the "MM 110 FE" with LNG hybrid and Flettner rotors

The latest ferry concept is a LNG hybrid that also has facilities for cold ironing, which incorporates several features to reduce the ferry's environmental footprint. The concept has been developed as a part of Fjord1's bid for operating the Lavik-Oppedal ferry link in western Norway. The ferry's design has the capacity for 125 cars and would be 110m long and 17m wide.

The most significant feature of the vessel is the two Flettner rotors which will act as sails for the vessel. "The fjords have a lot of wind which, can be utilised for a lot of the year and can mean that we can use Flettner rotors", says Alvid Holsen, technical director, Multi Maritime.

For the Lavik-Oppedal link where the ferry would operate it has been calculated that the rotors will contribute a minimum 12% of the ferry's total energy consumption. The theoretical potential is significantly bigger says the company.

"From the wind you get force from the longitudinal, which is more effective with the Flettner rotors. The Flettner rotor would need to be positioned 90degs to the wind for optimal operation. We predict that that the vessel will be able to cross the fjords on wind power alone", says Holsen.

Fjord's 1 latest eco-design in the green ship market

Multi Maritime says that due to this advantage the only time that extra power will be needed is when coming in and out of port. The vessel would be powered by an LNG hybrid engine, Holsen highlights that the vessel has the possibility to run on just LNG or battery power. Further optimisation of the hull form has been made to the shape and the wet surfaces with reduction of the wet surfaces.

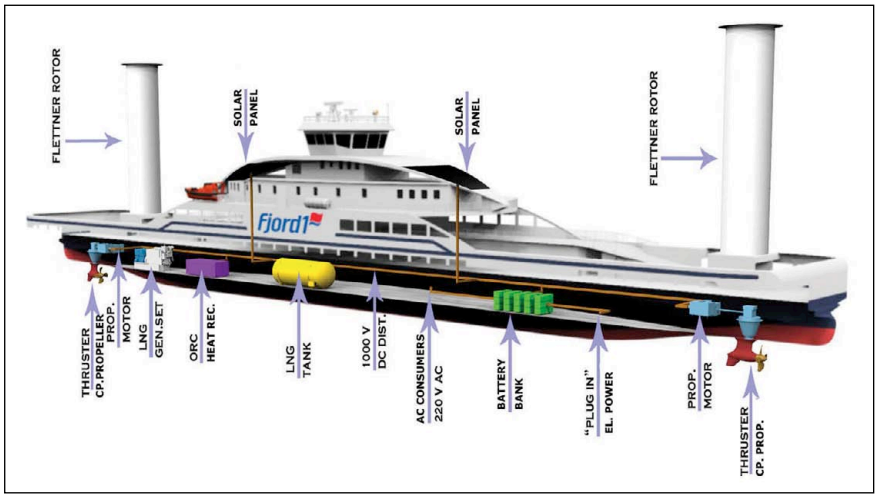
Normally on a double ended ferry both the forward and the aft propeller provides thrust. However, the forward propeller has been developed so that it is significantly less efficient than the aft. "We have developed a 'sailing' position on the forward propeller. It is an open propeller which allows the flow of water to pass freely. For this we have developed a different position for the blades", says Holsen.

The vessel concept has thrusters with controllable pitch propellers which can be feathered, the forward propeller is then feathered and the aft propeller provides all thrust during transit. This will significantly increase the ferry's propulsion efficiency. When docking and undocking both propellers may be used for optimal manoeuvrability.

Propulsion for the ferry will be provided by a highly efficient "lean burn" LNG driven engine. Part of the energy normally lost through the engine's exhaust is recovered as electricity with an organic rankine cycle (ORC) heat recovery system. The engine is a part of a hybrid system, which includes a battery bank. The battery bank can be sized to be charged with an arbitrary amount of shore power. The electricity is then distributed through a direct current (DC) distribution system, which reduces electrical losses compared to conventional systems.

Multi Maritime has been in talks with suppliers and three engine manufacturers and says that it feels confident that this concept will go forward to be constructed as a lot of work has gone into the design. *NA*

The ferry is expected to be able to sail across the fjords and reduce fuel consumption



Green pressure grows on cruise shipping

As pressure on the shipping industry grows to reduce its carbon footprint, and fuel prices continue to rise, the cruise industry is looking to maximise its energy saving measures, writes Sandra Speares

According to Boris Altmayer, Germanischer Lloyd's passenger ship expert, the classification society classes two big cruise ship projects at the moment, *Europa II* being built for Hapag Lloyd at STX France, which is due to be delivered at the end of April.

The new ship has been designed in accordance with the new stability regulations and safe return to port principles. GL is also involved in the latest newbuilding project with *AIDA* which involves the only cruise ship to be built in the Far East at Mitsubishi Heavy Industries in Japan. Aside from complying with the new stability regulations and safe return to port principles, one innovation of the project is to coat some sections in non-combustible material which will not liquefy in the event of a fire.

The first of two energy related topics that GL has been working closely on include the Energy Efficiency Design Index (EEDI), which requires a minimum energy efficiency level per tonne mile and sets CO_2 emissions for different types and sizes of ship.

At the moment EEDI is not relevant for cruise ships although a system is under development, Altmayer says. The problem with adapting the system to cruise ships is that the biggest part of energy requirements relates to the hotel side of the ship and not from the propulsion. One option being considered at the moment, he says is an energy balance table.

For cruise ships, energy requirements vary throughout the year, with different energy requirements in summer or in winter for example. There also needs to be an indication of the time a specific item is working. For example the air conditioning would be used more in summer than in winter and this needs to factored in so, Altmayer says, the energy balance table is a "weak measurement" with poor indication of whether it is correct or not, at least during the design phase of a vessel.

As far as energy saving is concerned, hull designs are already optimised, Altmayer says. Cruise ships operate to tight schedules and have to operate at required speeds to reach the next port in time.

Boris Altmayer, Germanischer Lloyd, says that with the biggest energy demand coming from the hotel side of cruise ships rather than propulsion the IMO's EEDI is not currently relevant to the cruise industry

Further opportunities do exist for optimisation in the hotel side of operations, he says. One example would be to improve insulation in order to reduce energy consumption, and another to use energy saving bulbs. Using lifts of a lighter construction, or reducing the weight of the superstructure could also be ways to improve energy efficiency. Other developments include reducing the resistance of the ship through the water by creating a cushion of air under the ship's hull. This concept will be included on the new *AIDA* ship under construction at MHI's yard. GL estimates that using this method friction will be reduced by 8-12% although yard tests are continuing.

Aside from carbon dioxide reduction, cruise companies have to consider the new sulphur rules and operation of ships in emission control areas. The trend he sees at the moment is towards complete exhaust gas treatment on the vessel. The new *AIDA* vessel also has a gas turbine to produce power when the ship is in port.

Electricity supplied from on shore is also an option in some ports. "The problem is that these vessels have very high required loads going up to 16MW and this cannot be provided solely from the shore". Other alternatives on the table include supplies of gas pumped from ashore, although this needs further development. Use of low sulphur fuels is an expensive proposition.

Exhaust gas treatment plant for newbuildings can be installed easily, he says, but retrofitting scrubbers brings with it its own problems because the equipment needs to be installed at the top of the vessel and weight is an issue and could interfere with the stability of the ship.

The third alternative is using gas as fuel while at sea, but at the moment there are infrastructure issues to be considered in order to support vessels. Vessels on fixed routes might be able to source supplies, but for cruise vessels it is more difficult because itineraries change, Altmayer explains. The question remains whether investment is made first in infrastructure or converting ships to gas power. "One party waits for the other".

Watertight doors were one of the issues raised last year at the Maritime Safety Committee when the Italian delegation presented an interim report on *Costa Concordia* accident. "When a ship is going to be built according to a specific damage stability requirement the basis for this calculation is the watertight subdivision. Within that subdivision are watertight doors and as soon as you open those doors you no longer comply with damage stability requirements". It is very important that the crew are aware of this, he adds. Sometimes it is possible to get an exemption to have a watertight door open but this has to be granted by the flag state administration for a specific door. Altmayer explains that the basis for allowing the exemption is based on a very detailed investigation based on

additional damage stability calculations and the level of risk.

Papers put in at MSC suggested that revisiting the damage stability and safe return to port requirements might be needed. According to Altmayer under the up-to-date damage stability requirements and probabilisitic requirements in accordance with SOLAS 2009 the idea was to have a harmonised damage stability calculation which means in general that safety levels should not be higher than according to the former prescriptive approach.

Subsequently it was decided to raise safety levels more for larger ships and this has been done. In 2010 the safe return to port rules were implemented, with the idea being that the ship is its own best lifeboat. A number of delegations at IMO advocated considering safety levels in SOLAS in combination with the safe return to port principle and standards should be raised. Altmayer believes that stability should play a greater role in safe return to port considerations. At the moment, he says, safe return to port deals with fire and flooding of one compartment, but it does not take into consideration anything to do with stability. This issue needs to be addressed, he says.

At the moment there is a requirement for shore-based support in the case of an emergency, meaning an emergency response team, like the one GL, like most class societies, has which can make direct calculations related to damage, stability and strength and provide advice. *NA*

Technological advances key to cruise shipping's future

Innovation is key to the future success of the cruise industry, as Enrico Buschi, chief operating officer at Fincantieri pointed out at the Cruise Shipping Miami conference and trade fair in March. By Sandra Speares

Shipyards needed to be able to design and build new ships compliant with the requirements of their customers and including up-to-date technical solutions, while maritime authorities had to be ready to improve the regulatory framework in terms of safety and environmental standards, Buschi told delegates at the conference.

"The request for aggressively-priced quality vessels is justified by the searching for margin improvements, struggling with financial constraints and managing costs increase," he said. From 2008 to 2012, fuel costs more than doubled and revenues per passenger days slightly declined, as a consequence the return on invested capital of the cruise lines declined. "In order to face this challenging scenario, it is necessary to offer innovative, aggressively-priced quality vessels."

On the technological side "shipyards have to face additional product complexity linked to new rules like safe return to port and probabilistic damage stability as well as to challenging targets in terms of fuel efficiency and reduction of their environmental footprint."

The price threshold by shipbuilders has to combine the trade-off between the acceptable spending target of the client and the intrinsic higher value of the innovative prototype. "A really hard task," he explained.

According to Raoul Jack, principal consultant at PFJ Maritime though Asia has an enviable reputation for merchant ships, expertise in cruise ship newbuilding is very scarce in the region and very few "core" contractors are located within the Asian region necessitating a reliance on European contractors for a significant proportion of vessel outfit. This, he said, could lead to "shipyards being held to ransom".

He told delegates he expected Japan to continue to develop its expertise in the area of cruise shipbuilding; while China has also indicated that it is interested entering the market.

While the majority of technical spares for cruise ships have come from Europe due to the main builders' locations there is a move towards spares coming from Asia due to pricing, but also vessel location. Major

European manufacturers are now producing in Asia, "This will lead to improved supplier options for newbuilds", he said.

According to Fredrik Johannson, partner and senior architect at Tillberg Design, there is now a strong trend in the cruise industry towards refits in refurbishments, as operators do not want to sell their ships. "Historically, a cruise company would consider selling a 15-year old vessel when it needed upgraded bathrooms and cabins. Today, the common strategy is to refurbish,

And after just over a decade, most ships are dragged into drydock for a major refit project," he told the Miami conference.

The other trend sweeping through the industry is about the design of a vessel, he said. Not that long ago it was highly skilled engineers that both designed and managed the projects. They produced technically beautiful vessels, and then it was up to the operational and marketing groups actually sell and use the ship.

"Today, we see a much stronger focus on optimising operations, marketing possibilities and revenue. The customer experience - or the 'wow factor' if you will - is very much in the driving seat. The whole process is therefore much more design-driven, and the technician has almost become almost secondary - he or she has to make things work for the operational group."

Cruise Shipping Miami offers a showcase for some of the latest innovations in the passenger shipping segment with a number of presentations focusing on improved efficiency and energy saving.

For example Rolls-Royce's integrated propeller rudder system Promas offers increased propulsive efficiency without any loss in manoeuvrability, the company says. The propeller and the rudder are considered as one propulsion unit and are designed together for optimum propulsive efficiency.

The rudder design is adapted to the particular propeller design and is optimised to regain losses from the propeller slipstream, whilst the propeller design utilises the presence of the rudder bulb and hubcap to recover losses behind the propeller hub. Promas comprises of a twisted full-spade rudder with bulb that is connected to the propeller hub by a hubcap, and is adapted and optimised to the propeller design.

A well-designed twist adapts the rudder to the rotation of the propeller slipstream and reduces the local angle of attack on the rudders leading edge.

This gives a more efficient rudder with lower drag and better recovery of rotational energy from the propeller slipstream, the company says. Rolls-Royce also outlined the benefits of its new generation Mermaid propulsion system in a presentation by Oskar Levander, vice president of innovation, engineering and technology marine, which has been installed on Hapag-Lloyd's *Europa II*.

Other innovations included the launch of Jotun's SeaLion Resilient, a high performance marine coating based on epoxy-polysiloxane technology.

"Following extensive research and testing, Jotun has introduced the industry's first anti-fouling coating that includes epoxy-polysiloxane, a compound of resins and hardeners that provides highly resilient hull protection. When combined with Jotun's proven Fouling Release Coatings technology, the epoxy-polysiloxane in SeaLion Resilient prevents settling of organisms on the hull and produces a glossy, smooth surface optimised for owners seeking to reduce costs related to dry-docking and maintenance," the company said in a statement.

SeaLion Resilient has been specifically formulated for owners and managers seeking improved maintenance and docking efficiency. The properties of SeaLion Resilient significantly reduce the risk of mechanical damage and maintain hull condition throughout the service period, the company says. It added that in addition to the strong coating features reducing mechanical damage, SeaLion Resilient resists fouling and provides a smooth surface that decreases drag and reducing carbon emissions by savings in fuel consumption.

According to product manager Jorunn Saetnoe: "We are confident that cruise ship owners will recognise the value of using a product that combines a glossy appearance with anti-abrasive qualities that effectively prevent most types of mechanical damage," she says. "For owners operating Caribbean cruises, where warm and shallow waters contribute to rapid fouling, Sea Lion Resilient helps reduce costs related to underwater cleaning and cuts the risk of transferring of invasive species to highly regulated areas."

Meanwhile Blue Ocean Solutions (BOS) has announced the introduction of the next generation emulsifier that replaces the older designs like the homogeniser, cavitation and ultrasonic type emulsifiers.

The BOS emulsifier is designed from dimensional charts established the company's research and development team to ensure that correct emulsions are consistently produced at the required rate for best fuel savings which BOS says will be a minimum of 3%. *NA*

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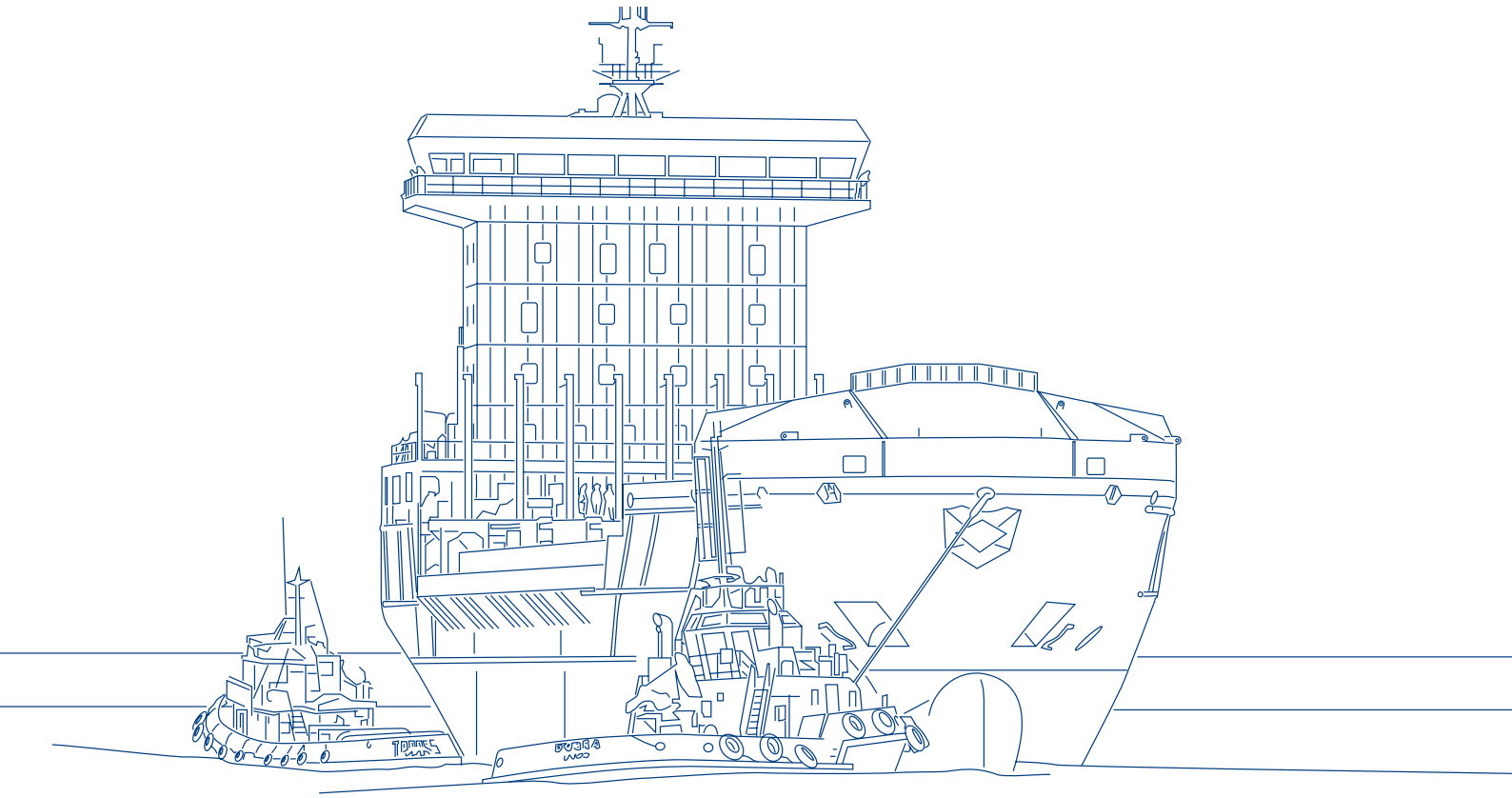

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Cruising costs set to soar

Regulations already in force to reduce sulphur content in fuels and those forthcoming in the coming years are expected to have a serious impact on the cost of fuel, reports Sandra Speares

Andrea Cogliolo, head of innovation at class society RINA estimates that low sulphur fuels could cost as much as US$300 more per tonne than the current prices.

So how can money and fuel be saved, while protecting the environment? RINA is offering services in this respect to all the marine industry, but especially the cruise industry, he explains. One service is providing audits onboard ships in order to understand how fuel is used onboard and to identify measures needed to reduce fuel consumption.

The energy audit is based on an analysis of the way the ship is performing. The audit is normally undertaken during a two to three day cruise, but putting together the information could take about one month, he says.

The next issue to be considered is the complexity of the energy consumption on the vessel. Another service RINA provides is support for the owner in preparing the Ship Energy Efficiency Management Plan (SEEMP), which is required under MARPOL Annex VI and came into force on 1 January this year and should be prepared within the next two years.

The time frame means the performance of the ship can be assessed, also its consumption and whether there is an improvement. Measurements can be made of the consumption of power onboard vessel, both for propulsion and hotel services, and optimising the trim.

RINA offers a system that is capable of collecting the data including the most important users of power on the ship, including air conditioning, galley lighting and propulsion. The aim is to identify the most economic solution to introduce on the ship in order to make good savings. He gives as an example ships that have been designed for a certain speed but are not utilised at that speed, for example as far as optimising the use of the propeller is concerned. In some cases propellers have been redesigned so they are optimised for use at the relevant speed.

Other efficiencies could be the use of hull paints that improve the performance of the ship through the water so that less power is used to reach the same speed.

Similarly, when a large ship is in port it will use approximately 8-10MW of power Cogliolo says for hotel services onboard and this use of power can be assessed to see if savings can be made. Use of low consumption LED lighting is one obvious example which could produce savings of the order of 700kW, he adds.

Voyage planning is another area that could result in savings and good communications with the ports to be visited means calculations factoring in weather conditions can be used to establish the best speed to arrive in the port just in time. If it is possible to use a slower speed in order to arrive at the right time, the amount of fuel saved can be maximised.

Crew training is also an important issue and RINA provides training to improve crew awareness of energy saving issues. "You can have the most eco-friendly ship but if you don't use it correctly you will not have the result you expect".

For this reason, he says awareness by the crew, who is managing environmental aspects of the ship "is one of the most important things". RINA offers training courses which are customised for individual companies and ship types. For passenger ships, he says "there is a lot of work to do. There are many things that can be done in order to reach a good performance".

Other issues Cogliano points to include how to reduce pollutants in exhaust emissions and ballast water treatment systems. While there are a lot of potential solutions, RINA works with owners to establish which is the best solution for them, he says.

Use of LNG onboard ships is a hot issue as is the transfer of data from ship to shore using electronic means, a topic which is becoming increasingly important with the European directive planned for 2015 which will require electronic data to be exchanged between the ship and the port authority. All the information that will be supplied could also be used as an indicator of efficiency, Cogliano says.

RINA has recently announced that it has grouped all its experts on cruise vessels under a new Cruise Ships Centre of Excellence. The aim is to deliver improved services to operators, designers and builders of cruise vessels, and to foster innovation in new services internally.

According to Paolo Moretti, general manager, Business Line Marine at RINA: "We have a lot of expertise around the group which can benefit cruise ship owners. Our recent internal reorganisation has given us the chance to harness that expertise more effectively. We have created a Cruise Ship Excellence Centre which brings together a group of leading experts in passenger ship safety, environmental issues and operational aspects. The centre has a footprint in Italy, the USA and Asia so that we can serve clients in both mature and emerging markets."

The Cruise Ship Centre of Excellence will provide a one-stop point of contact for the cruise industry to deliver assistance with classification and design review, environmental services, risk assessment, trouble-shooting and management and software tools.

According to Moretti: "We currently class forty cruise vessels and we get diverse approaches about technical issues such as Safe Return to Port, environmental issues and energy efficiency, and above all at present about operational efficiency. Cruise companies really know that their big risks, and big operational gains, come from improving the skills of their people and helping them to work smarter. We want to help the cruise lines with the software, their people, as well as their hardware. That is why we are delivering specialised behavioural training, risk-assessment and trouble-shooting services, health, sanitation and hotel services management, monitoring and certification and managerial software, including maintenance activity, purchase cycle and cost control. People matter." *NA*

WARSHIP 2013: Minor Warships

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Minor warships are a category of naval vessel covering a wide range of roles, including mine counter measures, off-shore patrol and survey. These vessels may be deployed in a war role, within threat environments, but are usually small and of a specialised nature.

Traditionally, these roles have been achieved through the design of individual specialised classes of vessel. However, the emergence of new technologies, including the use of off-board, unmanned systems provides an opportunity to decrease the need for a highly specialised platforms and offers the potential of a single, re-configurable platform.

As with warships of all types, minor warships require to be affordable whilst meeting an often complex capability. Minor war vessels are often required to operate globally. The Conference icludes:

- Keynote Speech by Director Ships (MoD) Tony Graham
- THE EVOLUTION OF MINOR WARSHIPS IN THE LAST DECADE: GENERAL CONCEPTS AND PRACTICAL EXAMPLES, Serpagli S., Ferraris S., FINCANTIERI Naval Vessel Business Unit, Genoa, Italy
- HOW TO SQUARE THE CIRCLE FOR THE NEXT GENERATION OF PATROL SHIP DESIGNS, Andy Kimber, Jay Hart, BMT Defence Services, UK
- APPLICATION OF MECHANISED HANDLING SYSTEMS TO ENABLE MULTI-ROLE CAPABILITY ON MINOR WARSHIPS, Daniel Pettitt, Babcock, UK
- APPLICATION OF SLAM PRESSURE LOADS TO A QUASI-STATIC FINITE ELEMENT ANALYSIS OF A PATROL BOAT, Teresa Magoga, Seref Aksu, Terry Turner, Jenny Mathew and Stephen Kennett, Defence Science and Technology Organisation, Australia.
- LARGE UNMANNED VEHICLES AND THE MINOR WAR VESSEL, Rachel Pawling & David Andrews, Design Research Centre, UCL, UK

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New generation con-ro's raise the bar

Giving first form to a new generation of multipurpose cargo vessels designed to achieve higher-than-ever standards of energy efficiency in the scheduled liner trade, the 31,000dwt *Shansi* was delivered during April to the China Navigation Company (CNCo), the deepsea shipping arm of the Swire group, David Tinsley reports

Eight con-ro newbuilds were contracted to Zhejiang Ouhua Shipbuilding, on China's Zhoushan Island, under a US$300 million contract placed at the end of 2010.

Constituting the S31-class, the entire series will be brought to bear on Swire Shipping's extensive and multi-faceted liner service network linking North, East and South East Asia with Australia, New Zealand and the island nations of the South Pacific. With the commissioning programme now under way, to yield one ship every month, the eighth and final vessel, *Szechuen*, is due for handover in November 2013.

Shansi, the first of eight con-ro vessels to be delivered by China's Zhejiang Ouhua Shipbuilding is set to raise the standards in the Oceania trades

TECHNICAL PARTICULARS
SHANSI

Length, oa	199.90m
Length, bp	190.00m
Breadth	28.20m
Depth	15.50m
Draught, design	9.50m
Draught, scantling	10.50m
Deadweight, design	26,000t
Deadweight, scantling	31,000t
Holds	5(3 cellular; 2 flush-sided/tweendecked)
Hold capacity	44,000m^3
Nominal container capacity	2,118TEU (916TEU in holds + 1,202TEU on deck)
Bulk cargo, maximum @0.616t/m3	28,035t
Steel coil cargo, maximum	28,285t
Cranes	4 x 60t @26m (50t @28m; 40t @36m)
Maximum tandem lift	120t
Main engine	Wartsila 6RT-flex58T-D
Main engine power (MCR)	13,560kW @105rpm
Speed @8,136kW (60% MCR), on scantling draught(10.5m), 18% sea margin	15.5knots
Consumption, main engine @15.5knots, maximum(10.5m) draught	29tonnes/day
Consumption, generator (at sea)	2.5tonnes /day
Cruising range	15,000nm
Class	LR

Applying the multipurpose concept to cargo liner schedules, *Shansi* opens a new chapter in the long history of trade and fleet development fostered by the China Navigation Company (CNCo). The innovative S31-class ships are intended to provide Swire Shipping's customers with additional capacity and increased cargo carrying flexibility in Asia/Australasia/Oceania service, while meeting the owner's goals as regards long-term operating competitiveness and 'sustainability' through substantive advances in energy efficiency and environmental standards.

The vessels have been conceived to offer ground-breaking fuel efficiency, high-speed cargo handling, and the versatility to transport a wide range of cargo types, including containers, steel and forest products, heavy-lift plant, machinery and equipment and project cargo, as well as agricultural commodities and minor bulk parcels.

Every aspect of the design, layout and engineering has been considered in the context of energy usage across the complete operating profile, in a drive for the lowest fuel consumption per tonne-mile possible, and the attendant environmental benefits.

The meticulously drafted hull form is the product of computer-based investigations, covering anticipated speed and load conditions in the many different spheres of operation encompassed by the Asia Pacific and South Pacific route network. Hydrodynamic efficiency also springs from the nature of the rudder and propeller used, and the adoption of a flow improvement device and low-resistance antifouling. A conscious effort to minimise fuel consumption, while also enhancing operational characteristics has been made through the choice of main engine, boiler, pumps and other equipment, including the specification of fully-electric deck cranes and mooring winches.

The 31,000dwt *Shansi* was commissioned in early April, and is scheduled to be followed out of Zhejiang Ouhua Shipyard at approximately monthly intervals by sisterships *Shantung, Shaoshing, Shengking, Shuntien, Siangtan,*

Soochow and *Szechuen*. The builder has a track record in multipurpose vessels, and the CNCo series denotes a new milestone for both the yard and the owner as a truly state-of-the-art design in the context of 'polyvalent' liner service tonnage.

The cargo section is configured with five holds plumbed by high-stooled, centreline deck cranes. The shipowner's requirements and experience on scheduled liner trades, with close regard to the evolving nature of the traffic and the economies served provided the foundation for Cargotec's development of a purpose-built cargo access system combining lift-away, folding and tweendeck folding hatch covers complemented by cell guides and fixed container fittings.

Three of the holds (Nos 1, 2 and 5) incorporate cell guides for 40ft containers. Through the expedient of swing around container stoppers at the level of the top of a second tier of boxes, breakbulk cargo and steel coils can be loaded on the tank top, with containers carried above. The weatherdeck hatchcovers to the three cellular holds are lift-away pontoons handled non-sequentially by crane.

The two other and largest holds, Nos 3 and 4, are designed as flush-sided, multipurpose cargo spaces, with a centreline girder and a tweendeck. They are conducive to block-stowed containers and bale goods, breakbulk shipments, including heavy cargoes such as steel products, as well as to agricultural bulks and other dry bulk consignments. The two holds' weatherdeck hatchways are closed by high-stowing, folding-type covers. The folding pairs, one at each end, are actuated by external hydraulic cylinders and manually cleated.

Holds 3 and 4 give added scope to the ship's cargo carrying options and permutations by virtue of a tailored design of tweendeck covers, of the high-stowing Foldtite-type. Tank top strengthening to 24tonnes/m^2 has been applied in holds 2, 3, 4 and 5, while No 1 has been specified for 14tonnes/m^2. The tweendecks are rated for 5tonnes/m^2.

The modulling and fitting of the ship for containerised cargo is such that the vessel has a nominal capacity for 2,118TEU, whereby 916TEU can be loaded in the holds and 1,202TEU can be taken above deck. Scope for temperature-controlled goods is expressed in provision for 147 40ft (FEU) reefer containers on deck. Stack weights on both the pontoon and folding hatch covers serving the four largest holds are 75tonnes for 20ft units and 90tonnes for 40ft boxes, reduced to 60tonnes and 75tonnes respectively for No1 hatch panels. The hatch covers have recessed container fittings, rendering a flush surface conducive to deck- stowed project cargo, timber or other goods as well as boxes.

Interposed between each hatchway are high-mounted deck cranes, ensuring complete self-reliance in handling the gamut of cargoes, including heavy freight consignments, and serving manifold ports and locations with limited dockside equipment. The four electrically-driven MacGregor GLE cranes can each lift 60tonnes on the hook at 26m outreach, and up to 40tonnes at 36m, and can work in pairs to provide tandem lifts of 120tonnes. The maximum safe working load with a grab

attachment is 37tonnes. A clearkeeper facility ensures that two cranes can be deployed for one hold without colliding.

As an element of the company's strategy of embracing more efficient, environmentally-advantageous systems and equipment, CNCo had evaluated a MacGregor variable-frequency drive deck crane in normal service, fitting the unit in 2007 as a replacement for one of the electro-hydraulic cranes on a D-class 41,500dwt multipurpose cargo ship. This led to the nomination of the fully electric GLE deck crane outfit for the S-class vessels, and subsequently also for the company's W-class 39,500dwt bulker newbuilds at Chengxi Shipyard.

Efficiency savings offered by the MacGregor cranes embodying variable frequency drive technology are mainly attributable to faster and more accurate positioning, which reduces port turnaround time, along with a 30% reduction in power consumption than electro-hydraulic closed loop cranes. The power control arrangements allow all four cranes to be operated in port with a single generator running, instead of two, saving fuel at a rate of about 1.5tonnes to 2tonnes per day during cargo handling. The GLE6028 models specified for Shansi and her sisters have added efficiency merits through a system whereby energy is fed back to the generator when lowering.

The GLE cranes encapsulate fewer moving parts than their electro-hydraulic predecessors, and the all-electric outfit obviates the hydraulic oil seepage common to electro-hydraulic equipment. Fully-electric mooring winches have also been installed.

The electronically-controlled Wartsila 6RT-flex58T two-stroke main engine has been optimised for maximum fuel efficiency at 60% maximum continuous rating (MCR), and utilises low load tuning and high efficiency turbocharging with a controllable exhaust gas waste gate. The nominal MCR of 13,560kW ensures power availability for making around 19knots in laden condition and for recovering schedules. However, the focal point has been in providing for a design speed of 15.5knots at 60% MCR power, equating to 8,136kW, on the scantling draught of 10.5m, with a realistic sea margin of 18%. Main engine consumption under these conditions is expected to be about 29tonnes/day.

In mind of environmental legislation and controls influencing fuel usage, the S31 ships are laid out with triple service and settling tanks, facilitating switching between HFO, regular MDO and ultra-low sulphur fuel.

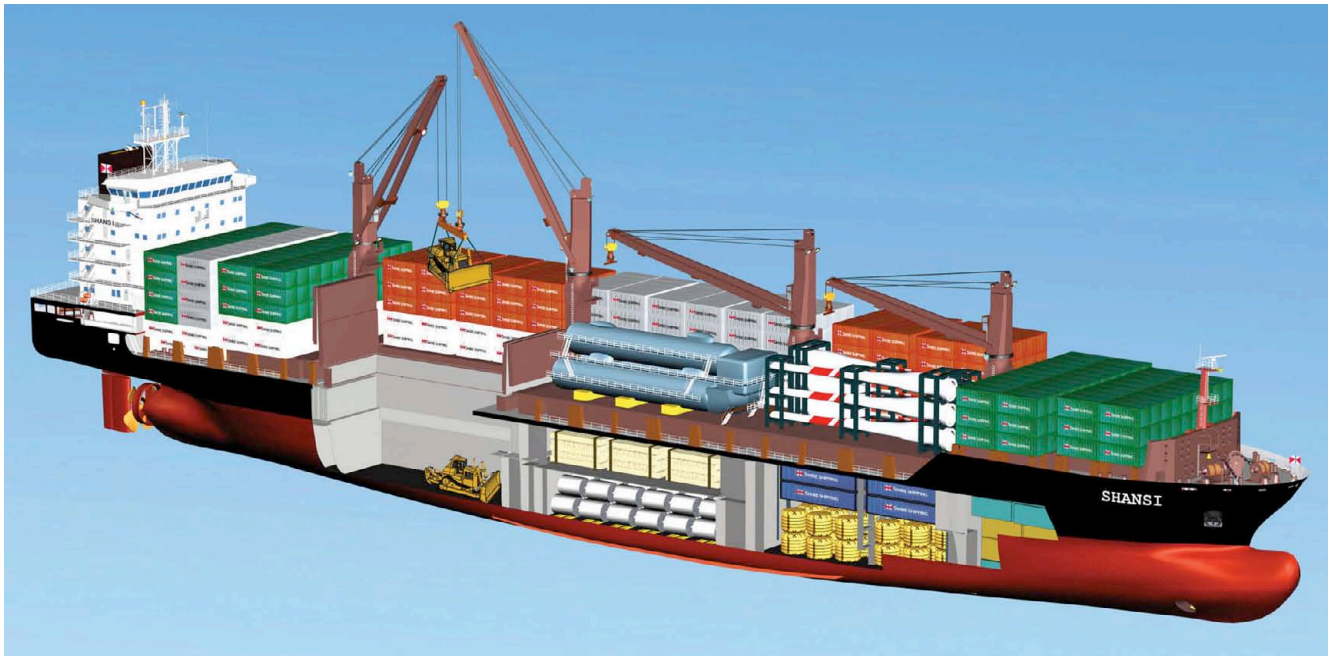
The refined hull form encapsulated by the S31-class is the product of a design optimisation process that saw 20,000 computer iterations conducted by the GL subsidiary FutureShip, covering a range of draught and speed combinations, and contributing to the efficient ratios achieved in terms of fuel consumption and emissions per cargo tonne-mile. FutureShip also designed the high-efficiency propeller to match the optimised hull form.

A Mewis duct, a well-proven device to enhance water flow into the propeller, has been adopted in the new ships, and is said to have the effect of reducing the power requirement by 4% across the operating range. The flap rudder and 45degs steering gear also yield efficiency gains, in providing side thrust when manoeuvring and improved course stability in a seaway. Ship handling in confined waters and at tight berths is assisted by a 1,200kW Nakashima bow thruster.

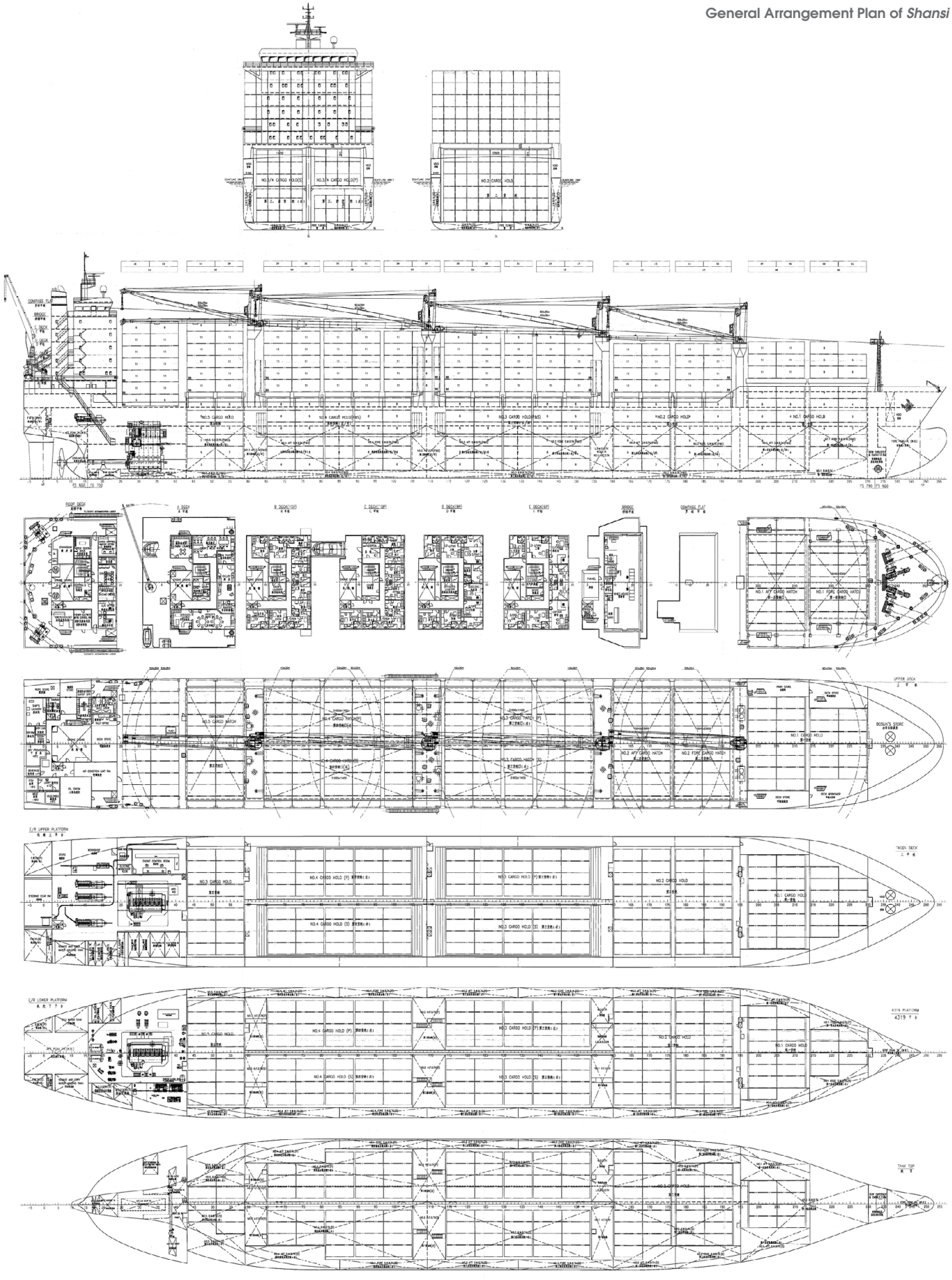
Supplied to CNCo's specific requirements, the Aalborg composite boiler produces heat from both main engine and auxiliary machinery exhaust streams. Other examples of the bid to reduce fuel usage are the nomination of variable-speed cooling pumps, low wattage lighting and improved thermal insulation.

Founded in 1872, CNCo shifted its head office from Hong Kong to Singapore at the end of 2009. In March this year, the company augmented its newbuild programme at Zhejiang Ouhua by ordering four 22,000dwt multipurpose vessels. Dubbed the Chief class, and destined for the trade between Australia and Papua New Guinea, the ships will incorporate many of the features employed in the S31 Shansi generation. *NA*

A cut out image of *Shansi* showing a typical cargo mix



General Arrangement Plan of *Shansi*



Norwegians raise concerns over BWMC

As ratification of the Ballast Water Management Convention (BWMC) approaches shipowners are still being slow to react to the new regulation, due to continuing concerns over the convention

Time is running out for shipowners to install ballast water treatment systems on their ships, as it stands the BWMC from January this year has been ratified by 36 countries, representing 29.07% of the world merchant fleet tonnage recorded. Even so there is still doubt among some that the convention will be ratified this year.

Many shipowners are being slow to adopt and invest in the technologies that are on the market as there are still questions that need to be answered for both the convention and for the products that are on the market. Tor Christian Sletner, head of section in The Department of Safety, Environment and Innovation at the Norwegian Shipowners Association says: "Norwegians care about the environment and strongly support the convention. We have a mission to reduce harmful emissions, as long as it is equal to all."

Sletner also points out the current status of the convention which has seen countries mainly with little tonnage signing up to it and that it only needs a couple more of the large port state countries for the convention to be ratified, but even so doubts whether the industry will see it ratified this year.

However, time is a factor that is following closely behind for most shipowners. "The world fleet has been waiting for new technology and has been sitting on its hands. The question is will there be adjustments to the G8 timeline. The final date is 2018 for all vessels to be fitted with a system. This equates to some 40,000 vessels that have to have systems fitted by the end of 2017. Will the capacity of the equipment and installation facilities be able to cope", asks Sletner?

Tor Christian Sletner highlights current problems with BWMC

Many shipowners agree that there is a surfeit of choice as far as the variety of ballast water treatment systems (BWTS) on the market at present, but owners are still weighing up costs and efficacy while waiting for the convention to be ratified.

"There are still lots of questions out there because this is a big investment. There is technology out there that works differently from each other, but there is still uncertainty about the equipment. Some technologies have pulled out and that has caused doubt for shipowners, which has also been an eye opener", says Sletner. "The equipment only has to have 95% certainty that it will comply with the regulations. We need more tailor made solutions and the IMO to say something more precise." Sletner highlights that in the G8 test procedures for ballast water management systems (BWMS) the technology does not have to cover all water types, but only needs to work in two out of three types of water.

Concern over the sampling process is also high on the agenda for shipowners, due to the lack of certainty about how it will be carried out and also the implications should a BWTS be found to be ineffective.

"There is doubt about lab testing. For instance there are different sized tanks and volumes, where will the test be taken from (eg. which part of the tank), how do you make it equal and make certain it works in all types of water?" asks Sletner.

A more precise set of guidance rules and sampling methods will need to be put in place for shipowners to fully back the convention. Until then, with these questions still outstanding shipowners are hanging back until the very last moment. *NA*

Pulling power from Lilaas

Lilaas says its latest LO4 joystick brings more functionality and ergonomic design to the user

Lilaas has launched its latest LO4 multifunctional joystick, which can be supplied with one, two or three axes. Designed for electronic control, the handle can move 48deg in the x- and y- directions and turn 180deg in the z-direction without the need for the push button.

A key feature of the LO4 design is that it has touch-free magnetic sensors, and no potentiometers, which reduce the amount of space required under the mounting plate and make movement extremely smooth.

"The need to achieve even greater control sensitivity has underpinned the development of the new LO4 joystick and this is the reason we have gone for magnetic sensors on this design," Terje Akerholt, sales & marketing manager, Maritime Division, Lilaas says. "The use of touch-free magnetic sensors makes the movement of the joystick smoother and makes it both very user-friendly and accurate to operate."

The standard LO4 unit includes adjustable brake and a zero return. All axes are useable simultaneously and the unit is delivered with a ball-shaped transition between handle and panel plate. Options include built-in switches, a spring-loaded return to neutral, a pushbutton with or without a light, and different shafts and panel plates.

The magnetic sensor is physically smaller than a traditional potentiometer, and this has given Lilaas the opportunity to produce a more compact joystick with fewer parts. The form of the handle itself is also distinctive. It is not circular, as is often the case with this type of joystick, and has been designed to fit well in the hand. Furthermore, the shape of the handle points out the direction of the rotatable z-axis.

Lilaas has also secured a number of key classification approvals for the LO4, including DNV, GL, ABS, BV, KR, LR, NK, RINA and CRS. The lever also conforms to EN/IEC 60945 standards (IP for L04 = 56).

According to Lilaas the design approach that links the LO1 and LO4 units is the series' flexibility, which gives customers a great deal of choice within the overall all-electronic design platform. "If a customer wants a system with a potentiometer they can have one. But, if they want to go the next step with a magnetic sensor, they can go that way too," Akerholt says.

Lilaas appeals to all with its ergonomically designed levers

Both the levers and joysticks can be modified to meet the different needs of individual operators and the requirements of varying ship types, so that within the basic design platform, the end result can be very different. "With the various different interfaces available, you can change how the levers and joysticks are used within an integrated system. They can in effect be more, or less integrated within the integrated control system," Akerholt says.

The functions that can be controlled by the lever and joystick can also be varied. "For example if an operator wants to control pumps or the lighting system from the lever that can be arranged," he adds.

The all-electronic LO1-class range of levers and LO4 joysticks offer operators a new-found level of control across the full range of vessel sizes, according to Norwegian supplier Lilaas.

"We do not see it as over-ambitious that the aim for our new all-electronic product range includes the entire shipping market," says Akerholt. "The LO1 levers and LO4 joysticks can be used in small vessels like fishing boats, yachts and offshore support vessels, but they are equally suitable for the largest cruise ships, bulk carriers, container vessels and tankers. The fact is their enhanced functionality makes them advantageous for all types of ship."

The LO1 is a compact, rugged, multifunctional control lever for azimuth, thruster or propulsion controls, which brings together the functions of multiple joysticks or levers into a single unit. It is programmable so that individual customer requirements can be met relatively easily.

The high software content integral to the levers represents a major step forward and this will offer owners and operators of small and large vessels significant benefits. "All-electronic levers like the LO1 are the future for the whole shipping industry," Akerholt says. "Everything a customer needs can be pre-installed within the lever structure and only a very shallow cut-out beneath the unit is required."

One of the key features of the LO1 is the built-in 2.4in TFT LCD digital display. This shows the operator all information he needs including the position of the lever, and can be supplied with the option for feeding back data from the vessel's operating systems. Lilaas believes the fact that the display is an integral part of the lever structure will make the LO1 series easier to use as all the information required by the operator is available in a user friendly way in one location.

Various models are available for azimuth, thruster or propulsion control, with a range of further options to facilitate customisation. System integrators and end users can elect not to have a display, for example, while other options include a 4-20ma current loop, relay outputs, display graphics, a USB interface, el- motors, potentiometers, force feedback and the possibility of having either CAN bus (standard), Profibus or Ethernet interfaces. The unit can also be supplied in different colours to suit customer preferences.

During the development stage, Lilaas invested in a unique software programme, CREO/Pro Engineers, to allow the

company to meet customer requests to tailor systems and equipment to specific needs. This software enables the engineers to 'talk' directly to the machinery, in 3D, so that no drawing is required and it enables Lilaas to customise the design, producing components of the type required in a very short space of time.

Safety has been another key priority for Lilaas in designing these levers. The lever range offers a high degree of redundancy in case of any technical problems. The LO1 lever features redundant capacity touch switches, with up to four for an azimuth or single controller and up to eight for a double controller, while the switch text has been engraved on the lever as an added safety feature in case of electrical failure. Lilaas only requires one of the switches for its menu settings, with the rest of the switches available for individual customer settings. The L01 will be available in two versions; the first, with display and electronics will be equipped with magnetic touch free sensors (0-5V); the second simplified version, without display and electronics, will be equipped with standard potentiometers.

To meet future requirements for functionality and price Lilaas has been developing a completely new technology for the motorised, force feedback and the L-shaft versions. These versions will be available at the end of the second quarter of 2013.

The lever runs on 24vDC power supply and has a panel plate and housing manufactured from coated aluminium while the handle is manufactured from aluminium and moulded Arnitel. Lilaas worked with Oslo-based Hareide Design to produce the distinct, bold aesthetics of the LO1 unit, which gives the lever a very 'modern' look.

The standard sensor within the LO1 design is a 0-5V magnetic unit, and the LO1 has two types of analogue sensor output. One is an isolated analogue output based on filtered PWM, with an output 10-90% of the reference voltage. The alternative is an isolated output directly from the sensor. This has an output that is between 5% and 95% of the voltage supplied.

Both the LO1 and LO4 are now in production at the Lilaas factory outside Oslo. An initial order for the LO1 lever, for a Platform Support vessel under construction at a Norwegian yard, has been confirmed and the company expects to ship the first new generation joysticks in the next few months.

In addition, several well-known maritime suppliers of propulsion, thrust control, azimuth control and DP systems have ordered samples of L01 and L04 for test purposes. *NA*

Oceansaver cuts a deal

The latest offering from Oceansaver will give customers an alternative way of paying and preparing for ballast water treatment systems

For just 10% of the cost of its ballast water treatment system (BWTS), Oceansaver has said that it will configure newbuild vessels for easy installation of a unit at a later date, fitting base components to allow its system to be 'plugged-in' when required.

Oceansaver's 10% deal, which will see essential piping and power supply installed, alongside other key base parts such as system bed plates and connections will give owners and operators peace of mind, without the need for substantial financial outlay in an increasingly cost conscious sector, says the company.

"Owners pay 10% and sign a fixed contract with the shipowner then the other 90% is paid at the first drydocking when the system is fitted", says Tor Atle Eiken, senior vice president sales and marketing, Oceansaver. "Customers know that they will be getting a ballast water system and that they are first in the queue and that there will be no price surprises when it comes to the installation", he adds.

Oceansaver's latest offering gives shipowners more options

If the convention is ratified later this year or early next year, systems can be fitted quickly, minimising downtime of ships that can command day rates of tens of thousands of dollars. The huge demand for BWTS, upon ratification, will also drive drydocking prices up, meaning lengthy and costly drydockings for owners. The 'plug-in' system will save shipowners time and cost, claims Eiken.

"A normal retrofit installation is 21 days, with the type of installation that we are offering a normal drydocking period will be roughly 10 days for a 1st drydocking. This means that in the year that you are drydocking you have 10 extra days of being in service", says Eiken.

The system can be fitted whilst in service but, Eiken notes that it is better to do this whilst the vessel is in dock, so that the operation can be carried more easily due to the facilities at the yard. Eiken also says that by offering this deal to its customers that they will be prepared for any eventuality that the convention may throw up. "If the convention is ratified the system can be quickly fitted, but if not then the shipowner has only paid a fraction of the price of the complete installation", he says.

But, what happens should the shipowner should change his mind at a later date or the system fails to meet with the standards. Eiken says that in an instance like this, apart from the terms and conditions of the contract, a shipowner would need to opt for a ballast water treatment system that would operate and have a similar set up to that of Oceansaver's. *NA*

Maris moves into the Turkish market

Maris has received an order for 30 of its ECDIS900 systems for Turkish shipowners

The Turkish order will see Maris supply marine electronics distribution to service specialist STT International, who will deliver the Maris systems to shipowners and yards.

The first three ships that the systems will be fitted to are general cargo ships under outfitting at Maramara Shipyard that are due to be delivered at the end of 2013. A further 10 systems have been allocated to newbuilds, which are a mix of general cargo and bulk carriers. Other systems have yet to be formally allocated.

"Securing this contract is a timely reward for the work Maris and our distribution partner STT International have been putting into the shipbuilding business in Turkey," says Ralph Pluch, Maris director sales Europe. "As mandatory ECDIS is phased in, we are especially delighted to have secured an order with our partner that signals our strength in both newbuilding and retrofit in this key regional market for owners and yards."

Maris' ECDIS900 is being continuously updated and is now on its Mk10 version. The Maris ECDIS900 Mk10 is an IMO approved electronic chart system, designed to make ships navigation easier and safer. It is offered with a wide choice of installation options and can be installed in any retrofit. An all-in-one 19 inch display with integrated PC, the system is compact and can be installed on a short pedestal on the chart table, long pedestal or console-mounted. It is fully integrated with the UK Hydrographic Office "e-Navigator" planning and chart update service. All systems are delivered with computer based training with follow on user training courses also available. *NA*

Touch screen remote control

Norway's Kongsberg Maritime is introducing a more contemporary way of working with the launch of a new touch screen propulsion control system. Aage Førrisdal, product manager, Autochief Propulsion control system, Kongsberg explains further

In marine engineering circles, the release of a new AutoChief system from Kongsberg is a significant development. Over 8,000 vessels have had Kongsberg Maritime propulsion control systems installed since AutoChief I, the first remote control system for low speed propulsion plants, which was released in 1967. Close cooperation with the main engine manufacturers over five decades has led to six new AutoChief (AC) systems being developed. The AC – C20 provided in 2004 a holistic approach with inclusion of an LCD screen. The AutoChief 600 takes this even further by the implementation of touch screen operation.

Kongsberg's latest offering will allow crew to operate propulsion systems in a simplified way

This, in part, is made possible by the company's on-going research into creating a uniform, common, human machine interface (HMI) across its various systems. In development for several years, Kongsberg Maritime has already rolled out its latest HMI across various different technologies, including the K-Master aft bridge system, the K-Chief 600 Automation and Control system, and its Dynamic Positioning systems.

Technically, the HMI introduces a number of tangible changes, designed to enhance the user experience. The modernised graphical interface improves usability in general, by introducing more logical, intuitive navigation, for instance. This will reduce training time for novices, as well as enable more efficient use by experienced and advanced users. With several different HMIs all vying for attention on the bridge, it's clear that a more uniform look and operation across different systems will support more efficient and safer operations.

In addition to applying more user friendliness, Kongsberg Maritime has also considered the use of new hardware technology when designing the HMI. For navigation and automation systems, the general screen layout is suitable for wide screen displays, as multiple and larger displays are becoming quite common in control rooms. Touch screen has also been a key consideration, with the HMI's suitability for it being demonstrated successfully on the K-Master system, which puts two touch screens within arm's reach of a seated operator.

The HMI concept has been applied to the AC 600, which will be available Q2 2013, simplifies the presentation of information to the operators, whilst also meeting the NAUT OS / OSV requirements for handling Command Control when adapted as a multi plant engine and thruster control system. The AC 600 supports being adapted to all makers of thrusters control, Azimuth control and Rudder Control, giving a 'full picture' remote control system for all types of vessels. The system has been adapted to famous vessels, such as the Royal yacht in Norway to, OSVs, PSVs, oil tankers and the world's largest container vessels.

Utilising the possibility of having one platform displaying critical engine and thruster data, the system is designed to also handle the transfer of control in a uniform way. On a vessel with different vendors supplying their own control systems, there will of course be as many ways of doing this as there are vendors. There will also be a problem with space in the consoles as all suppliers need space for their equipment. With a single system though, installation and operations are much more efficient.

Another important aspect of using a touch screen instead of hardware buttons for the latest propulsion control system is that of reliability. Any hardware switch on a bridge or automation system may need up to six separate wires, so should there be an issue, troubleshooting can be challenging, especially considering multiple components. Dimming will also be an issue when having hardware switches, in regards to the importance of illumination on the bridge.

AC 600 is delivered as a Redundant Bus based system (CAN). All User interfaces are on CAN; instrumentation, levers, displays etc. The time for mounting and connecting the system is significantly reduced as there is no internal wiring between the units. Everything is on the redundant CAN bus. If there is a problem with a unit in the AC 600 system, an alarm will sound, alerting the operator to the exact problem, whilst hardware back up and Command Control handover ensures full control of the vessels propulsion.

The considerably short time it has taken for touch screens to permeate almost every aspect of our lives is astonishing. The conservative nature of the shipping industry means that this technology won't be so easily adopted at sea, but officers and engineers could trust such a well-known name as AutoChief to show them that, whilst in no way perfect for all bridge operations, touch screen really is the way forward for propulsion control. *NA*

Basic Dry Dock Training Course

20th - 23rd May 2013, London, UK

DM Consulting's Basic Dry Dock Training is a 4-day course that covers the fundamentals and calculations of dry docking.

The course begins with the basics and safety concerns, and progresses through all phases of dry docking: preparation, docking, lay period, and undocking. The course ends with a discussion of Accidents and Incidents.

It's designed to be relevant to Dock Masters, Docking Officers, Engineers, Naval Architects, Port Engineers and others involved in the dry docking of ships and vessels. The course is presented through classroom lectures, student participation in projects and practical application exercises. The course addresses the deck plate level of practical operation needed by the dock operator and the universally accepted mathematical calculations required to carry out operations in accordance with established sound engineering practices.

www.rina.org.uk/basic-drydock-2013.html

Integrating ship management

Keeping the world moving safely, efficiently and profitably is the shipping community's ticket to trade. But, it also requires an industry transformation: the unification of marine navigation and operational management. Paul S. Elgar, OEM strategic business manager, Jeppesen explains further

Safely bringing a vessel and cargo to a destination on time is no longer enough. It must be done in an environmentally sensitive and fuel-efficient way that returns a profit. However, with ship and fleet operating efficiencies becoming increasingly complex and interdependent, the relative impact of each improvement strategy is difficult to evaluate.

To succeed in their quest for optimal safety, efficiency and improved operating margins, shipowners, operators and charterers need to fully and intelligently integrate navigational information with operational data. This is essential in order to enhance safety and fuel efficiency while reducing the mariner's workload and providing effective fleet management tools. Armed with these powerful analytics, mariners and shipping companies will be able to improve their strategic decision-making.

Jeppesen calls this "i3", integrated, intelligent information. To move from data to intelligence, the industry is embracing the e-Navigation vision and an integrated approach. To that end, Jeppesen is working on the next generation of maritime solutions, a full suite of tools designed to offer the end user not only a seamless experience, but a constant connection to the most up-to-date information needed to make changes and decisions at a moment's notice. This integrated solution is expected to bring together several important components.

Chart management

Mariners need a cost-effective, flexible and easy-to-use method for licensing and using electronic navigation charts (ENCs) and nautical charts if the mandated use of electronic chart display & information system (ECDIS) is to live up to its true potential for improving safety and navigation. Ship operators want global ENC coverage without the headache of comparing subscription models and costs.

Paul Elgar, OEM strategic business manager, Jeppesen

Whether shore side or bridge side, static "one-fits-all" chart data provides little extra benefit compared to paper charts. The intelligent solution is electronic charts that can be combined with dynamic data.

These charts put critical navigational and operational information, such as tidal information, piracy alerts and weather forecasting, in the hands of mariners and ship operators alike. They can also be rapidly ordered and installed, and updated via e-mail or Internet, with licenses tailored to specific vessel routing plans.

Voyage optimisation

The safest way from port to port — and the simplest way to save fuel — is to route a ship optimally. But, that's no easy task; increased demands from authorities and charterers have combined with new navigational hazards to add layers of complexity to routing.

The answer, and a logical step in increasing marine transportation safety, efficiency and environmental protection, is to replace traditional weather routing with state-of-the-art voyage optimisation software.

Voyage optimisation unites bridge crews with shore-side routing centres in the task of optimising each route for on-time arrival while minimising fuel consumption, maintaining sea keeping limits and avoiding heavy weather.

Fleet management

Shore side operations, cargo planners, technical staff, commercial managers and ship officers are facing the challenge of increasing the fleet's operational efficiency and performance. To succeed they need to extract the knowledge hidden in operational data from sources as diverse as fuel consumption monitors and ship loading sensors. A common frustration is how to derive actionable intelligent data from systems supplied by different vendors, which can seldom exchange information.

The solution is two-fold: data integration and system integration. A comprehensive fleet management tool can provide insight on fleet status and performance by transforming vessel and voyage data into vital information. However, this is only possible if the fleet management tool is able to integrate with other systems to ensure they share data in an intelligent way.

Together with our clients, Jeppesen continues to develop solutions to equip companies with the critical tools needed to navigate an industry that is becoming increasingly complex and interdependent. These solutions will turn a new tide in the commercial shipping industry by empowering maritime mangers to combine the best information available with their wealth of seafaring experience to revolutionise how business is done on the seas. *NA*

Author

Paul S. Elgar, OEM strategic business manager, Jeppesen.

Paul Elgar has been employed at Jeppesen since 1996 and has worked exclusively in the marine business from the Norway office. Elgar is responsible for managing the Jeppesen OEM partners that develop systems that utiliase Jeppersen products.

Driving a new perspective

Professor Zygmunt Paszota, faculty of ocean engineering and ship technology, Gdansk University of Technology, Poland, explains a new approach to the Sankey Diagram for drive motors

It is necessary to replace the traditional, commonly accepted but erroneous, Sankey diagram of power decrease in the direction of power flow to one where the power increases in the direction opposite to the direction of power flow. This proposed view of losses and energy efficiency should be applied to all types of drive motors and drive systems. The presented proposals open a new perspective for research into drive motors and systems.

Losses and energy efficiency of every drive motor must be presented as functions of physical quantities independent of losses in the motor. Such quantities are the speed and load required by the machine or device driven by the motor, changing in the drive operating field. The speed and load of the motor decide instantaneously the useful power of the motor and also in a differentiated way the kinds and values of losses occurring in the motor.

However, losses and energy efficiency of the drive motors and systems are evaluated by researchers and manufacturers as functions of parameters depending on the losses. An example of the wrong interpretation may be presentation of energy efficiencies of the hydrostatic rotational displacement motors as dependent on the flow intensity of the motor feeding liquid and on the pressure decrease of the motor.

The energy efficiency of turbines is presented in a similar way. A cause of such a situation is the traditional, commonly accepted but erroneous, view of the power flow in the drive motors and systems represented by the Sankey diagram of power decrease in the direction of power flow.

It is necessary to replace the Sankey diagram by the proposed diagram of increase of power in the motor and in the drive system in the direction opposite to the direction of power flow, [1-9].

The proposed view of losses and energy efficiency should be applied to all types of motor and drive systems, for instance:

- internal combustion motors
- turbines
- electric motors
- hydrostatic displacement motors
- ship screw propellers.

"losses and energy efficiency of the drive motors and systems are evaluated by researchers and manufacturers as functions of parameters depending on the losses"

The aim of this paper is to show the resulting problems of the above theories, exemplified by the operation of a rotational displacement motor in a hydrostatic drive system.

In order to make possible an objective evaluation of the energy behaviour of different motor and system solutions and sizes, the losses and energy efficiency should be described and compared as dependent on the motor speed coefficient and load coefficient changing in the drive system operating field ($0 \le \overline{\omega}_M < \overline{\omega}_{M\,max}$, $0 \le \overline{M}_M < \overline{M}_{M\,max}$).

The presented proposals open a new perspective of unavoidable research of drive motors and systems, making it possible to compare objectively the energy efficiency of different types of motors and drive systems.

The motor operating field in a drive system Figure 1 presents the operating field of a rotational or linear displacement motor in a hydro-static drive system. The operating field is determined in the plane of motor mechanical pa-rameters, i.e. speed coefficient and load coefficient, independent of the motor and of the system.

The limit values $\overline{\omega}_{M\,max} = f(\overline{M}_M)$ or $\overline{M}_{M\,max} = f(\overline{\omega}_M)$ of the hydraulic motor operating field are determined by the maximum motor feed capability in the hydrostatic drive system. The values $\overline{\omega}_{M\,max}$ and $\overline{M}_{M\,max}$ are dependent on the motor and on the system losses.

Direction of power increase in a drive system

The Sankey diagram is the fundamental cause of the incorrect evaluation of losses in a drive system.

The Sankey diagram connected with a drive system suggests an evaluation defining the output power of the system as a difference between the system input power and sum of the powers of losses occurring in the system. Therefore the energy losses in the system are evaluated as a function of parameters describing the input power.

In accordance with the proposed diagram of power increase in a drive system opposite to the direction of power flow, the system input power is a sum of the system output power and powers of losses occurring in the system. The energy losses in the system are evaluated as a function of parameters describing the system output power.

The full picture of the energy losses in a drive system is a picture of the power of energy losses in the system elements. Shaft power of the hydrostatic system feeding pump is equal to the sum of hydraulic motor shaft (or piston rod) power and powers of individual losses in the power flowing from the pump shaft to the hydraulic motor shaft (or piston rod).

The quantity of power increases, in order to overcome the power of energy losses, in the opposite direction to the direction of power flow. Therefore, the image of power and energy losses in the system should be constructed in the direction from the hydraulic rotational motor shaft or from the linear motor piston rod towards the system feeding pump shaft.

Replacing the Sankey diagram

Figure 2 illustrates the diagram of power increase in a rotational hydraulic motor opposite to the direction of power flow, replacing the Sankey diagram of power decrease in the direction of power flow.

The power PMc consumed by the hydraulic motor is a sum of the motor shaft useful power PMu and the power of three different energy losses in the motor. The losses occur in series increasing power in the opposite direction to the direction of power flow. In effect, the power in the motor increases from the shaft useful power PMu to the working liquid power PMc consumed by the motor:

$$P_{Mc} = P_{Mu} + \Delta P_{Mm} + \Delta P_{Mv} + \Delta P_{Mp}.$$

Mechanical losses (and power ΔP_{Mm} of mechanical losses) occur in the"shaft - working chambers" assembly.

Volumetric losses (and power ΔP_{Mv} of volumetric losses) occur in the working chambers.

Pressure losses (and power ΔP_{Mp} of pressure losses) occur in the channels.

Mathematical models

The necessity of use of the energy loss mathematical models with the loss coefficients in displacement motor and in a hydrostatic drive systems are described below.

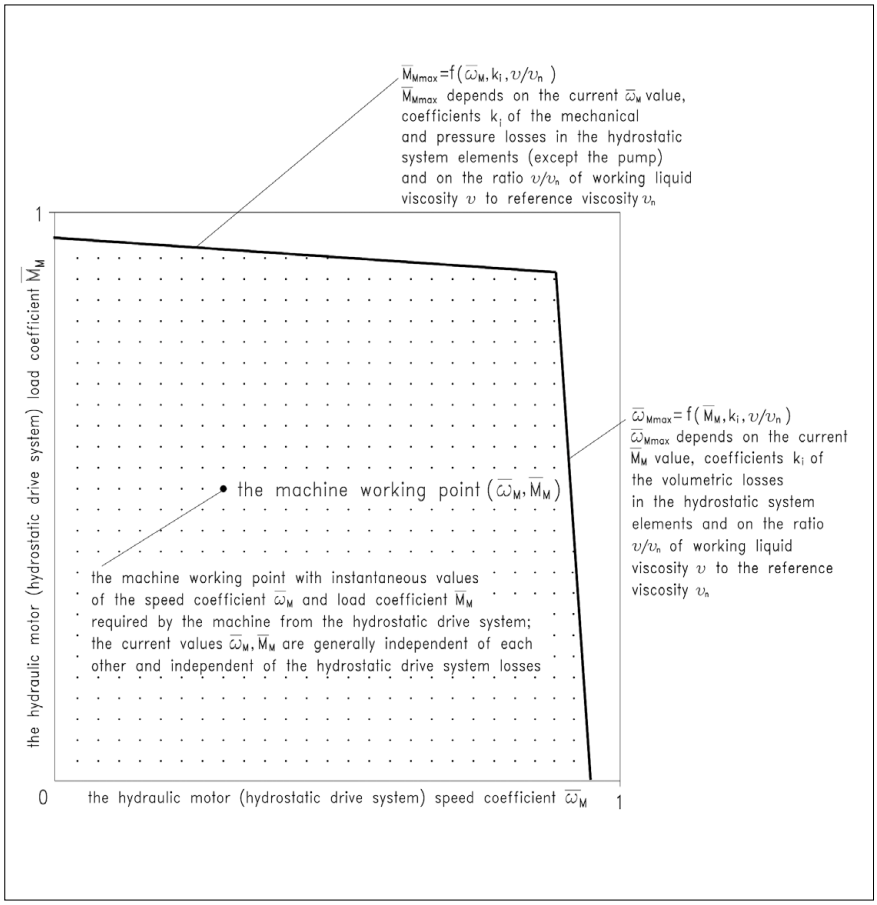


Figure 1: The range ($0 \le \overline{\omega}_M < \overline{\omega}_{M\,max}$, $0 \le \overline{M}_M < \overline{M}_{M\,max}$) of motor speed coefficient and $\overline{\omega}_M$ load coefficient $\overline{M}_M$ in a hydrostatic drive system

Evaluation of the hydraulic motor energy efficiency is performed together with evaluation of the efficiency of a hydrostatic drive system where the hydraulic motor is used (including also the energy efficiency of the pump, conduits and the hydraulic motor speed throttling control assembly (if it is used).

In the proposed method, based on the mathematical models of losses, each kind of energy losses is a function of parameters directly influencing the losses and independent of those losses.

The method is precise by definition and simple in use. It simplifies the laboratory investiga-tion of pumps, hydraulic motors and hydrostatic drive systems. It allows the search for energy saving solutions in pumps and hydraulic motors. It also allows for the evaluation of the overall energy efficiency of the drive and to find energy saving hydrostatic drive system structures. *NA*

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(1236kWm/750min^{-1})

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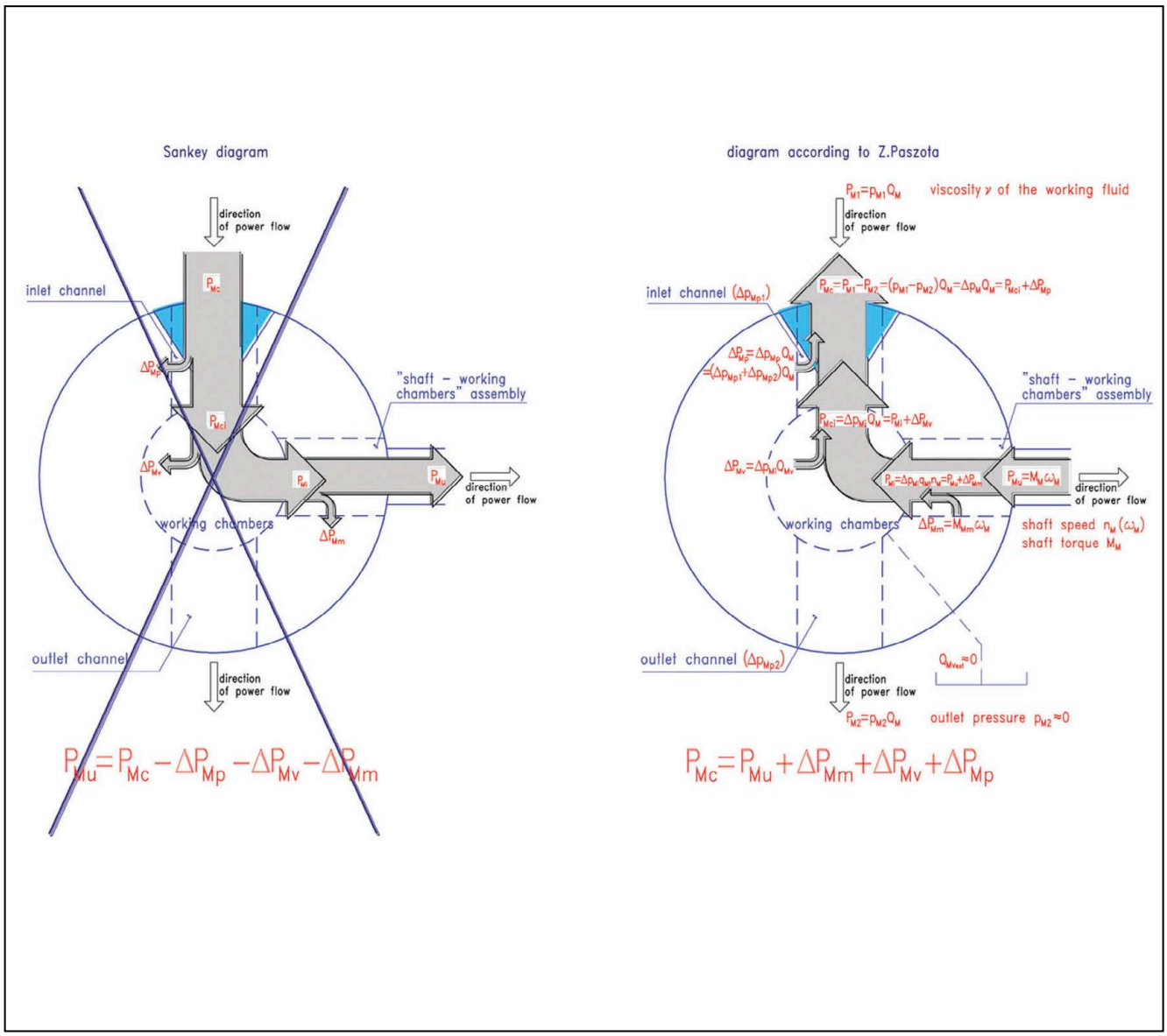
Figure 2: This is a diagram of the power increase in a rotational displacement hydraulic motor, opposite to the direction of power flow, replacing the Sankey diagram of power decrease in the direction of power flow (the example of a motor with theoretical (constant) capacity q_{Mt} (V_{Mt}) per one shaft revolution)



Latest Jumbo's set for heavy duty

Croatian shipyard Brodosplit gets an order for two heavy-lift vessels for Jumbo Shipping

The latest Jumbo designed K-Class vessels will incorporate the most modern technological advancements, which means this latest generation of vessels offer the possibility to build, lift, transport and install larger units than ever. The vessels have been designed to operate in the oil and gas and offshore markets. Jumbo shipping says that the heavy-lift vessels are multifunctional and will allow them to adjust to new demands in the market as they arise.

"The K-3000 has multiple developments and is a step up from the earlier J-Class before them. We saw that when we built the J-Class that there was demand, even then, for vessels with larger lifting capacities. The K-Class will fill a similar void as the J-Class did then", says Patrick van Eerten, director operations and offshore, Jumbo.

The design of the vessels incorporates Finnish-Swedish ice class 1A with each vessel prepared for DP2 installation which, when fitted, will provide multifunctional installation support in the offshore sector enabling large and heavy structures to be loaded, transported and installed by a single vessel optimising project scheduling, safety and efficiency. In order to increase stability during lifting operations, pontoon stabilisation of the vessel can be secured. "The vessels when launched will be DP2 prepared and then retrofitted at a later date if it's needed to be done", says van Eerten.

The latest K-Class will give Jumbo greater lifting capacities

Brodosplit shipyard has overcome a number of technological challenges during the building process as these vessels have proved to be an innovative project by way of hull structure, hatchcovers and tweendecks, which has required high precision in production as the building tolerances are very rigid, closer to ones used in mechanical engineering than in shipbuilding, according to the yard. Furthermore, anti-corrosive protection technology significantly differs from the one Brodosplit has been using in the past. That and many other implemented improvements in the shipbuilding process.

"The designs of these vessels are new, but are also a development from the J-Class that we did previously. We looked at the design and how we could make things bigger and more efficient. It is not a radical new design, but we have changed many things which are small and incremental", explains van Eerten.

Jumbo entrusted the building of the vessels to Brodosplit while Huisman in The Netherlands will supply and install the two mast cranes of 1,500tonnes each at 20m outreach (1,200tonnes capacity at max 37m outreach) enabling an in tandem operational lifting capacity of 3,000tonnes. The large deck, unobstructed hold and its speed give the K-Class a unique position in the heavy lift market.

"One of the main features of these vessels is that they will have the largest lifting capacities on the market. We have increased the capacity from 900 – 1,500tonnes", says van Eerten.

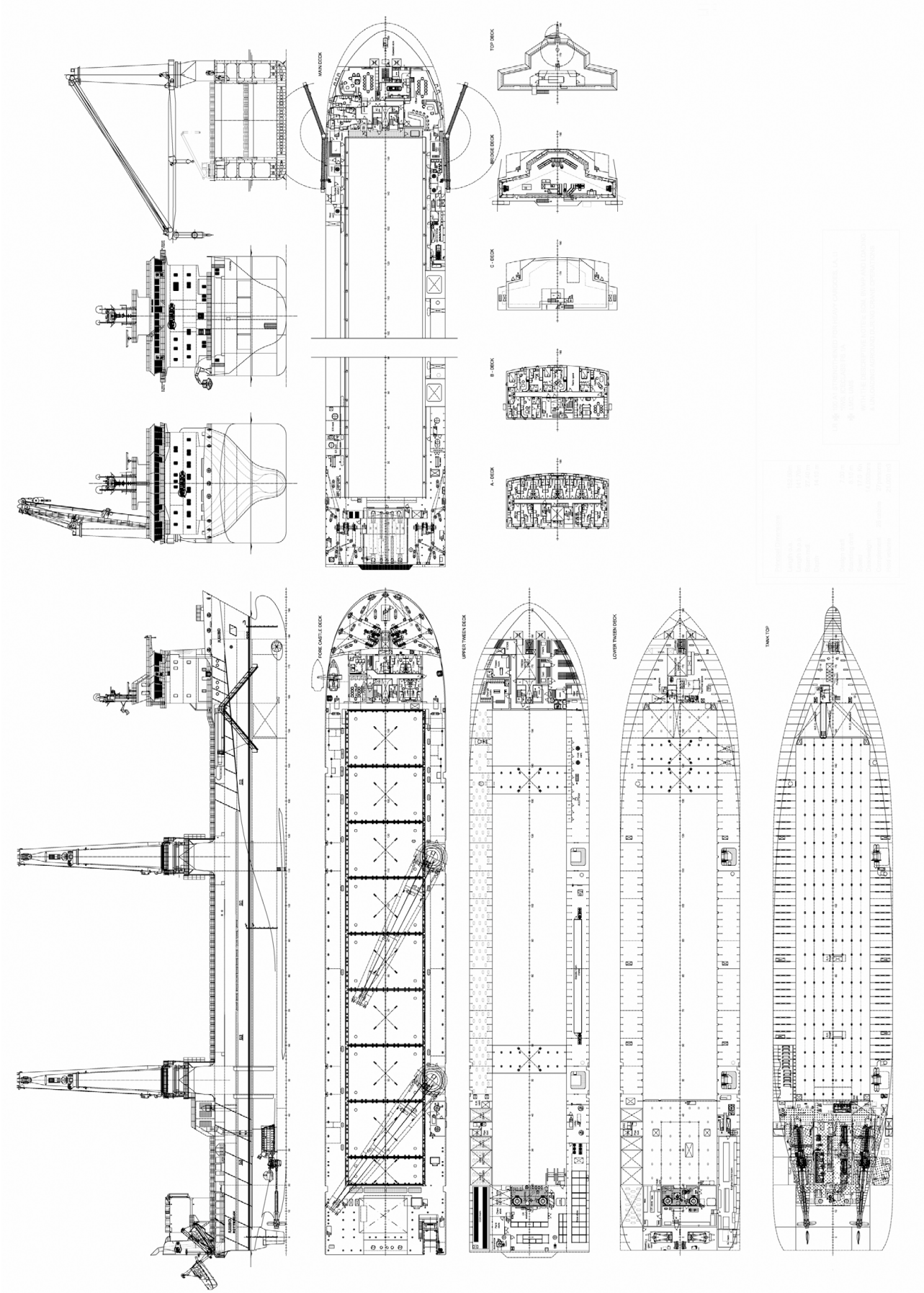
In July 2011 Brodosplit-Shipyard Ltd and Dutch shipping company Jumbo had contracted the construction of the first vessel *Jumbo Kinetic* (Brodosplit Hull 473), and in April, 2012 of the second heavy lift vessel *Fairmaster* (Brodosplit Hull 474). The keel for the first vessel was laid on 20 July 2012 with the second vessel's keel laid on 28 November 2012. Both are planned to be launched later this year with the deliveries scheduled for second half of 2013 and 1Q 2014. *NA*

TECHNICAL PARTICULARS

K-3000

Classification:	Lloyd's Register +100 A1 Strengthened for Heavy Cargoes, +LMC, UMS, CG, LI, IWS, IceClass FS 1A
Ice Class:	1A Finnish Swedish
Deadweight (summer) abt:	14,000dwt
Draft:	8.1m
LOA:	152.60m
Beam Moulded:	27.4m
Free Deck Space:	3,250m^2
Number of Holds / Hatches:	1
Bale Capacity (with twendecks fitted):	21,000m^3
Cargo Gear:	2Mastcranes of 1,500tonnes each
Lifting Capacity:	3,000tonnes at 20m outreach (1,200tonnes at max 37m)
Main Engines:	2 x Mak 9M32C (9,000kW) + 2 x CPP
Bowthruster:	1,500kW
Speed:	17knots

GA for K-class Jumbo vessels



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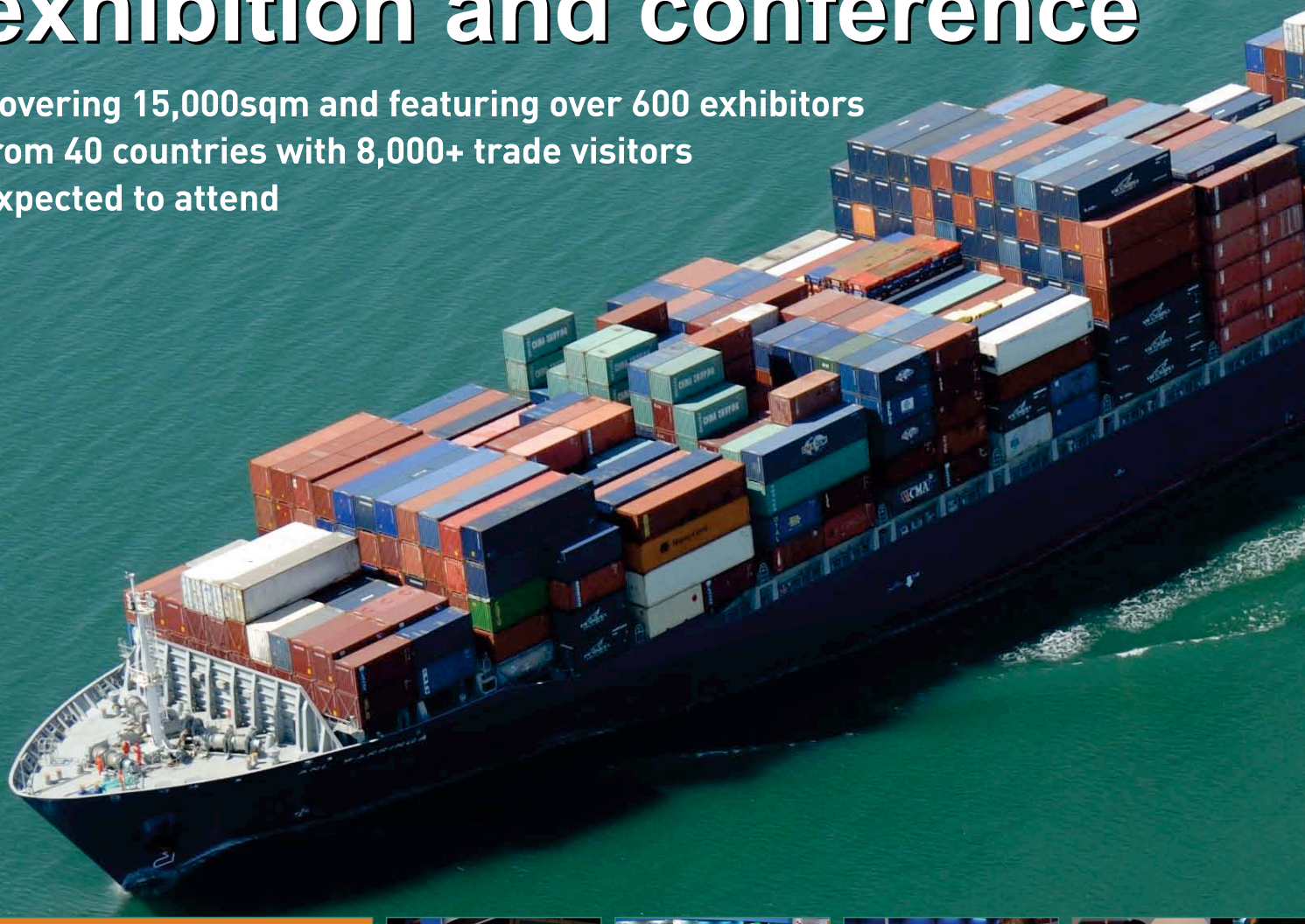

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