THE NAVAL ARCHITECT

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Denmark / Ro-ro ferry report /
CAD/CAM / Heavy-lift / **April 2011**

NUPAS CADMATIC

3D Ship Design Software

Ship model courtesy of Wärtsilä Ship Design Norway AS

VERSION 6

increases ease of use and efficiency

Nupas-Cadmatic latest software version, V6, is an extremely powerful tool for ship design and engineering. The most eye catching feature of V6 is the introduction of a new user interface that will further ease work and bring new efficiencies throughout the ship design process.

The new user interface combines a modern Office 2007 look and feel with enhancements welcomed by both novice and experienced users. It will change the way the software is used and allow for faster and more efficient work. In V6 it is available in Plant Modeller with other modules to follow in due course.

The software's easy-to-use 3D modelling tools can be used for early and basic design, detailed engineering, and the production of workshop drawings and generation of ready-to-use production data for production machinery.

With Nupas-Cadmatic you can successfully carry out the entire ship design project, right from the early start, up to the detailed engineering and final production phase. It improves engineering quality and shortens design and construction times. Nupas-Cadmatic seamlessly distributes engineering projects globally between different sites while ensuring effective communication between project partners.

Version 6 highlights

New GUI For the first time in history an Office 2007 style User Interface has been applied to 3D software, making it easier and faster to learn than comparable systems. Nupas-Cadmatic's intuitive and efficient User Interface speeds up design projects. **Distributed design** Nupas-Cadmatic's CoDesigner technology is the most advanced and easiest tool to use for distributed projects. It does not require massive hardware or very fast internet connections. **Easy administration** Administration of 3D software has never been so easy. Nupas-Cadmatic has the most modern tools for library and catalogue management. **Internet-based technology** Nupas-Cadmatic was the first developer to launch an Internet-based 3D model viewer and data query tool on the market in 2003. Today eBrowser is the most advanced software to visualize 3D models, to walk through, to query data and to communicate design details interactively with other users and project parties. The internet-based technology has unlimited scope for easy integrations.

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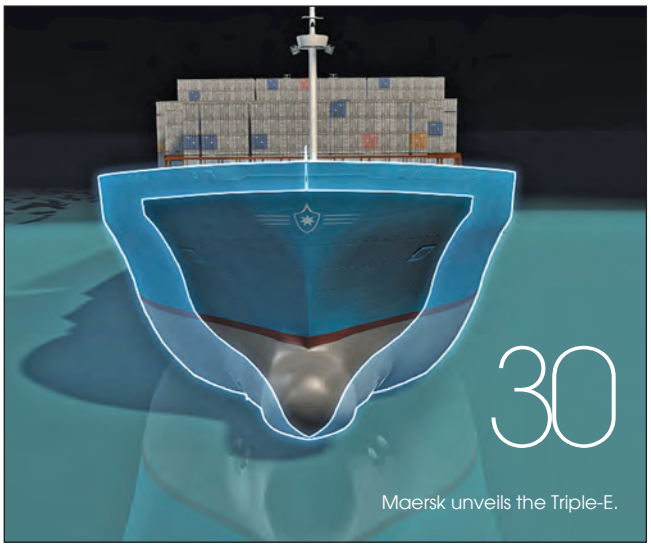

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30-70 Features

On-line Edition

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

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Second Announcement

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Following a highly successful conference in 2009, RINA is pleased to return to Genoa for the second edition of the super and mega yachts conference.

The luxuary yacht sector has not been unnaffected by the global financial situation, but it has survived in good form and is growing again. New regulations are being developed to deal with the increasing size of vessels and these are both helping and challenging designers and builders of the latest generation of yachts. This growth in size and complexity coupled with the new technologies becoming available bring new challenges requiring innovative solutions.

Today's owners are demanding ever greater levels of comfort and luxury, not only in terms of the vessel fittings and styling but also in the vessels behaviour whilst underway and at anchor. They are also increasingly aware of the impact of their vessels on the environment. Many vessels are now used for charter and this has implications for the way in which the vessel is designed and classed.

RINA invites papers on all aspects of large sail and motor yacht design, construction, and operation, from designers, researchers, manufacturers, operators, and regulators. Suggested topics include the following:

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Big is beautiful!

Maersk's great leap of faith as it is poised to make up to a total of US$17.1 billion for 30 Triple-E ships.

In developing the 18,000TEU Triple-E container vessel Maersk and Daewoo Shipbuilding and Marine Engineering (DSME) have taken the industry to the edge of what today's technology can do. If it is successful the ships will offer significant savings in fuel costs and in the environmental impact, reducing CO_2 emissions by 50% and NOx and particulate substantially too.

Two issues become immediately obvious after one has taken in the enormity of this announcement for the container industry. The initial impact is the realisation that these ships will have great economies of scale and Maersk and DSME believe they can save 26% on slot costs compared to a standard 13,100TEU ship. Secondly, on closer inspection you find there is little by way of savings in SOx emissions.

In fact on further questioning, Maersk has decided to leave a space where scrubber technology should be installed. It seems that these ultra-large container carriers will have to operate on more expensive distillate fuel in order to reduce SOx emissions. Like Cinderella the scrubber manufacturers were not invited to the Maersk ball.

Unfortunately this leads us to the question that must be coming to everyone's mind as they read this piece; 'Why were the scrubbers not invited to the party?' And for this I ask forgiveness. However, it seems that Maersk is not convinced that current scrubber technology is up to the task according to the company's head of sustainability, Søren Stig Nielsen.

The space in the design where the scrubber will go appears to indicate that Maersk has confidence that the technology will work, eventually, but that it will not buy it until it is proven. Given that the scrubber companies have invested some considerable capital into the design, manufacture and promotion of these pieces of equipment that they say will mean ship operators will be able to continue using the significantly cheaper heavy fuel oil this is a surprising move.

Conspicuous by their absence the scrubber companies must now, one assumes, be engaged in a race to prove to Maersk that their technology really does work. The winner of course will have much to crow about, not only providing the kit, but also being a part of what promises to be the highest profile launch, well, since Maersk built the Emma Class vessels.

Already the mainstream media has been alerted to the Triple-E and the US$5.7 billion initial investment for the first 10 ships will mean that Maersk will want to fill these ships. Promotion of them then will be important and though many shippers are apparently looking at the green credentials of their service providers, one suspects that the most eloquent persuasion will come in the cost savings that will be passed on to them as a result of the economies of scale and the fuel saving technology employed in the ships.

Triple-E ships have the potential, then, to act like cargo black holes, sucking in cargo from miles around as shippers want to be able to say that they have imported goods on the most environmentally friendly ships in the world and they can save a buck or two as well.

Handling 18,000TEU ships will be a complex process, however, and the thought of so many containers being handled on one ship would have the potential to cause a log jam in cargo processing at any one port. If this is the case then Maersk will need to step up its hub and spoke operations and develop the feeder operations that will be necessary for the efficient distribution of cargo.

In all probability that will mean feeding cargo to places like Hamburg and the UK from Rotterdam and perhaps the Western Mediterranean, the Eastern Mediterranean, to the Middle East and Subcontinent from Salalah in Omanand so on. In short shippers, who are generally averse to feeder shipping, will change the way they view the hub and spoke system.

There are risks in this strategy for Maersk, however. In the first place the company is very firmly banking on the price of fuel rising sharply and staying high. Next, it must see a growth in demand for trans-continental container shipping, a demand that has been in part fuelled by the gradual migration of cargoes from bulk to containerised transportation over the years. This process is due to come to an end with some experts saying that all the cargoes that can be containerised have been. This means that economic growth is essential and the trickle of factories that have returned to Europe from China must not become a flood. A return to the 15% growth rates in the Asia/Europe trades of the noughties is unlikely, but growth will be resumed, the question is at what level?

At this moment the Triple-E is looking like a great investment from a company that has the courage of its convictions. Whether these ships will become a great white elephant remains to be seen. *NA*

Newbuildings

Danes design Saudi con-ro's

The National Shipping Company of Saudi Arabia (NSCSA) and South Korea's Hyundai Mipo yard signed a contract for four container/ro-ro (con-ro) ships of 26,000dwt with options for a further two vessels.

Danish ship designer Knud E. Hansen said that it "carried out a very thorough project study including design and calculations" and assisted NSCSA in the contract phase of the deal by providing technical expertise and advice.

The ships are designed to allow flexibility in loading both ro-ro and container cargo and with a focus on low fuel consumption. In order to minimise turn around time in port the vessels are designed with good manoeuvrability and optimised cargo decks.

The NSCSA con-ro ship displaying the starboard rear ramp.

NSCSA wishes to expand its capacity within ro-ro, general and project cargo sectors, with a focus on service between the United States East Coast and the Middle East (Red Sea-Arabian Gulf) and the Indian Subcontinent.

The first vessels will replace NSCSA's aging con-ro fleet and are to be delivered from Hyundai Mipo in 2012-2013.

Container capacity on the ships will be 364TEU, with a further 24,000m^2 space for ro-ro cargo. The amin engine will have a maximum continuous rating of 12,500kW giving the ships a service speed of around 17knots. The ships will be 220m in length, have a beam of 32.3m and a maximum draught 9.5m.

Classification

BV and RS in sign LNG/FPU deal

France's Bureau Veritas (BV) and the Russian Maritime Register of Shipping (RS) have agreed to jointly develop guidelines for LNG carriers and Offshore Floating Production Units (FPUs) after signing a three-year co-operation agreement.

Common guidelines for LNG carriers based on the class societies' rules and GAP analyses carried out by the societies are expected to be published during the first three months of next year while work on producing common guidelines for FPU's is expected to begin in the second half of this year.

Pierre Besse, vice-president research and development for BV, said: "We will now be able to combine the particular strengths of the BV and RS rules, to produce definitive guidelines which draw on the experience and expertise of both organisations. In addition, the co-operation agreement enables us to exchange information from the results of recent research projects, including those relating – but by no means limited - to operations in Arctic conditions."

Engines

Wärtsilä Upgrades RT-flex68-D

The first upgraded Wärtsilä RT-flex68-D engine equipped with a variable turbine geometry (VTG) turbocharger was successfully tested at Doosan Engine Co Ltd in South Korea. It is fully compliant with the International Maritime Organization's (IMO) Tier II regulations.

Its slimmer outline of the RT-flex68-D makes it more suitable for installation on container ships and the company said the engine provides extended flexibility over a broader load range when equipped with a VTG turbocharger. The tested engine is the first of eight for installation on eight vessels being built by a Chinese shipyard for a Chinese owner. The engine has a contracted maximum continuous power of 21,910 kW at 95rpm.

The slimmer engine outline was achieved by introducing a simplified supply unit and a new design for the scavenge air receiver, as well as RT-flex components which offer improved engine maintenance due to the greater commonality of parts with other engine types which reduces both component costs and the spares inventory. Components were also made more manufacturing-friendly.

The RT-flex electronic control system, in combination with the VTG turbocharger, enables more efficient operation and a better brake specific fuel consumption (BSFC) over an extended load range allowing the engine to meet IMO Tier II emission regulations while maintaining a highly competitive fuel consumption.

"With this development, Wärtsilä is able to offer a technological solution for lowering emission levels

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from marine engines, while at the same time offering a cost effective product. This is in line with our efforts to enhance sustainable shipping and we see great demand for it in the current market," says Mr Anders Eklund, director, product engineering in product centre 2-stroke, Wärtsilä Industrial Operations.

Scrubbers

Wärtsilä delivers marine scrubber

Finland's Containerships Ltd Oy has earmarked its vessel *Containerships VII* to fit the Wärtsilä fresh water scrubber which reduces SOx emissions from ships' exhaust. Wärtsilä and Containerships signed an agreement last month covering the retrofitting of a fresh water scrubber to the vessel which is alsofitted with a Wärtsilä W7L64 main engine. Wärtsilä's said that the *Containerships VII* project was its first commercial marine scrubber project for a main engine. The scrubber will be delivered in August 2011. The conversion will enable the vessel to meet future sulphur oxides (SOx) emission requirements in Sulphur Emission Control Areas.

"The Wärtsilä fresh water scrubber technology will meet both environmental and commercial requirements for our operations. We see it as a clear advantage that Wärtsilä, with its long experience in emissions abatement technology, delivers the scrubber solution," said Sigurjon Markusson, Containerships' CEO.

Wärtsilä is the first manufacturer to have been awarded a marine scrubber certificate by the classification societies Det Norske Veritas and Germanischer Lloyd.

The Wärtsilä scrubber works with fresh water in a closed-loop system in which sulphur oxides are neutralised with caustic soda. A small amount of scrubbing water is extracted to remove contaminants in a treatment unit onboard, thereby fulfilling all the quality and monitoring requirements stipulated by the IMO. In so-called zero discharge mode, the clean effluents are led to a holding tank for scheduled and periodical discharge. Contaminants should be disposed of at reception facilities in port.

Engines

Viking Line orders Wärtsilä engines

Finnish ferry operator Viking Line has ordered four Wärtsilä 8L50DF dual fuel main engines, the transverse bow and stern tunnel thrusters, and two stainless steel fixed pitch, built-up main propellers with complete propeller shaft lines and environmentally sound shaft line seal systems for its latest ferry currently under construction at the STX Finland.

The propellers for the vessel, which is due for delivery in 2013, are designed with the lowest possible pressure impulses which should significantly improve vibration control.

Viking Line's ferry will be the largest passenger ferry operating on liquefied natural gas (LNG), making it the most environmentally friendly and energy efficient large passenger vessel in the industry to date.

The vessel will operate on the route between Turku and Stockholm, Sweden in the Baltic Sea. The agreement includes an option for the supply of equipment to a similar sister ship. STX Finland is part of the international STX Europe Group.

Viking Line's ferry will be capable of carrying cars, trucks and road trailers on short international voyages. It is also designed to carry 2800 passengers and 200 crew members. The machinery, equipment and outfitting, as well as the structural work, will be under the special survey of the Lloyd's Register classification society.

Meanwhile, TTS, which supplies ro-ro equipment such as ramps, has been contracted by the Turku yard to supply a stern ramp and door, bow doors, a folding frame bow ramp, an internal ramp/cover, a hoistable car deck with ramps, cargo and provision lifts with covers and side shell doors, all with associated hydraulic and electric systems and with a total weight of more than 400tonnes. Installation of this equipment is due to take place during 2012.

Coatings

Raw materials push paint prices up

Steep rises in the price of raw materials during 2010, by as much as 50% in some cases, has forced Jotun into price increases for some of its products.

"Throughout 2010 the market price of major raw materials used in coatings, such as epoxies, titanium dioxide, acrylics and metal-based materials has increased by as much as 50%," said the company.

Jotun said that unexpectedly high global demand with the decrease in capacity following the 2007 financial crisis "has caused an imbalance in the raw materials market for coatings, which has resulted in shortages of many raw materials and consequently caused prices to spiral".

The situation is not expected to improve in 2011 as crude oil prices soar to their highest levels since 2008 putting upward pressure on petrochemical-based raw materials and metal prices reaching new heights.

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Propulsion

TCA44 completes the range

Revealed in January 2011 and weighing 1.970kg, the TCA44 recently underwent an extensive test programme on MAN Diesel & Turbo's turbocharger test bed in Augsburg.

The TCA44 completes MAN's TCA turbocharger range for two-stroke engines at its lower end. Stefan Mayr, project engineer responsible for the TCA44, said: "This new turbocharger has been specifically designed to meet the needs of small-bore, two-stroke engines and provides optimised turbocharging solutions for engines that exceed the capacity limits of the smaller TCR22 turbocharger."

Until now, the TCA55 with a small turbine and compressor wheel has been used for such engines. The TCA44 is some 40% smaller and lighter than the TCA55, which suffered from its larger size. With the predicted development of the Chinese short-sea and coastal operation and the growing demand for small-bore, two-stroke engines.

Demand for the TCA44 has been strong and MAN Diesel & Turbo has already taken in a significant number of orders from its two-stroke licensees. The company reports that serial deliveries will start in the second half of 2011.

The TCA44 turbine with 45 steel blades displaying the new airfoil profile.

The TCA44 follows the principal design philosophy of the TCA series, but with some major innovations that facilitate production, installation and maintenance, including: 45 steel turbine blades with new airfoil profile, the fixation of turbine blades by one retaining ring instead of 45 individual fixing-plates, oil supply and discharge integrated in turbocharger feet as integral part of the bearing casing, a new compressor-wheel profile, a simplified IRC design, a modified silencer.

Some of these innovations, such as the turbine blade fixation, will gradually be introduced to the other frame-sizes of the TCA family.

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Ancillary equipment

Cargotec to supply cruise ships

Cargotec is to supply MacGregor access equipment for two cruise ships for Meyer Werft, scheduled for delivery in 2013 and 2014.

The contract includes passenger doors, tender platforms, shell doors and platforms for loading stores, bunkers and luggage, and for mooring operations, and the weight of the MacGregor equipment totals around 230tonnes per shipset.

"Each ship will be provided with MacGregor passenger access equipment which enables smooth and safe embarkation of passengers via the passenger entrance doors or embarkation platforms," said Göran Hugon, Cargotec's sales manager for passenger ship and RoRo systems. "Loading luggage, provisions and fuel, and discharging garbage, is efficiently handled with the numerous side shell doors, as are mooring operations. This order highlights the success of Cargotec's strategy to re-enter the cruise ship market."

"Cargotec has a long experience in providing innovative solutions based on proven technology. This, together with a close cooperation with Meyer Werft shipyard, made us successful in securing the order."

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CONTINUAL PROGRESSION

Ancillary equipment

Schoenrock Hydraulik gets Type Approval

The shipbuilding industry supplier Schoenrock Hydraulik Marine Systems has just received type approval from the classification company Det Norske Veritas (DNV) for its latest hydraulically operated Shiptight sliding bulkhead door, as well as for the older variant of the same product.

Tests were carried out on Schoenrock's traditional Hydraulic Watertight Sliding Door, a sliding bulkhead door which can withstand a water column pressure of 0 to 62m. At the same time the new Shiptight model was tested, with a water column pressure of 0 to 15m. Both models passed the tests, including the practical inspection approvals. They will be principally used for commercial ships and yachts. "Our tried and tested Hydraulic Watertight Sliding Door has been further optimised in various ways," said Schoenrock managing director Dr Volker Behrens.

The use of a more rigid frame profile along with the Y sealing ensures a significantly improved balance of the installation tolerances when welding, and means significantly lower commissioning costs. "The guide rail and guide rollers are made of brass and stainless steel, and so are not subject to rust," Dr Behrens added. The sealing surface has also been treated to make it rustproof. The power needed to close the door has been reduced through the optimisation of the door panel guide system.

Schoenrock latest hydraulic doors have received Type Approval from DNV.

Installation of the door has also been simplified, as it proved possible to dispense with the fixed position of the cylinder and guide rail on the bulkhead. In the Shiptight variant, both components are connected to the door frame and so form a totality. "Another innovation is the external electrical motor for the oil pump, which now no longer runs into the oil bath," the managing director explained. This means there is no difficulty about variable or even very short opening times, and the door can be activated at very frequent intervals without any problem.

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Ancillary equipment

Palfinger delivers for research ship

Palfinger Marine has delivered its first Palfinger heavy duty foldable marine crane for one of Japan's latest research ships.

Palfinger Marine- und Beteiligungs-GmbH (PMB) is tapping into the market segment of large marine cranes with its "PFM" range. The cranes have a lifting moment of up to 350m tonnes. The ability to combine different marine-specific winches makes this range unique and particularly attractive to users. The option of certification by international companies completes the concept.

The owner of the vessel is the Japan Oil, Gas and Metals National Corporation (JOGMEC) which together with Mitsubishi Heavy Industries Ltd. "For Palfinger, designing a crane of this size meant a totally new development. We were set this demanding task and we solved it successfully," said Johnannes Lindenbauer, head of sales Palfinger Marine Cranes. "Developing a special extension boom system which features a knuckle boom and a telescopic outreach of up to 21m was a particular challenge with this prototype. The weight-optimised construction combined with the additional installation of two different marine winches turned out exceptionally well. Innovative winch control by means of a manual control system and radio remote control also guarantees that the crane is safe and easy to operate."

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Dealing with dry cargo liquefaction

Liquefaction of cargo is a widely recognised phenomenon that has been implicated in a number of recent casualties which have resulted in significant loss of life. Daria Cabai and Simon Burnay of BMT Marine & Offshore Surveys highlight the issues that surround cargo liquefaction and suggest how naval architects could assist in addressing the problem.

In recent months there has been a spate of bulk carrier related casualties that have involved vessels either sinking or experiencing significant stability problems. Within the period of 39 days, three bulk carriers sunk and 44 seafarers lost their lives. All the vessels involved were carrying bulk mineral ore and although the investigations of these casualties are on-going, the liquefaction of the cargoes with the resulting free surface effects and loss of stability has been identified as a likely cause. Table 1 summarises the recent incidents:

All three vessels were reportedly carrying the same cargo (nickel ore), were loaded in the same country and were bound for China to deliver the nickel ore for use in the steel industry. Similar incidents have occurred in previous years with iron and nickel ore cargoes from India, The Philippines and Indonesia.

Ships have long carried liquid cargoes and consequently vessels dedicated to the transport of liquids are designed accordingly. The problem arises when a ship designed to carry a dry bulk cargo suddenly finds itself carrying a bulk liquid as well.

So how does an apparently dry cargo turn into a liquid?

Liquefaction of cargo can affect many types of material being transported in bulk. Iron ore, nickel ore, coal slurry, sand slurry, and other wet minerals or fines are all susceptible. Liquefaction is a particularly dangerous issue as it turns what appears to be an apparently safe cargo into something that can have a significantly detrimental effect on a vessel's stability. The mechanism that causes liquefaction is often triggered by a ship's motions. It can also be affected by other cyclical loads such as vibration. Bad weather will therefore exacerbate the effect.

Daria Cabai, BMT Marine & Offshore Surveys.

Liquefaction occurs when the combination of cyclical movement and vibration compacts the spaces between cargo particles. This causes the loss of inter-particle frictional force to the point where the cargo can behave like a liquid. The resultant cargo shift and free surface effect has a detrimental effect on ship stability which can lead to capsize. Another issue that makes liquefaction of cargo so dangerous is the rapid change from the stable to the unstable condition with little warning, potentially giving crews very little time to abandon ship.

The cause of cargo liquefaction is not a new problem. Current regulations therefore reflect this in terms of transport, loading and shipping. The International Convention for the Safety of Life at Sea (SOLAS) provides general guidance on the carriage of all cargo types including dangerous cargoes. Recently enforced regulations - International Maritime Solid Bulk Cargoes (IMSBC) Code (which superseded the Code of Safe Practice for Solid Bulk Cargoes or "BC Code") - provides specific requirements for the carriage of a range of bulk cargoes.

With the problem of this liquefaction of certain cargo types in sharp focus, the International Group of P&I clubs and the Association of Dry Cargo Ship owners (INTERCARGO) both expressed their concerns about the risks that those cargos present at the last International Maritime Organisation (IMO) Maritime Safety Committee (MSC). Ironically, with the IMSBC coming into force on 1st January 2011, the shipper is now obliged to provide information on the cargo in advance and the Master of the vessel is entitled to refuse the cargo if the certification is not adequate or if, he/she is not happy with the information provided. The IMSBC code specifies that Group A bulk cargos that are liable to succumb to liquefaction must be accompanied by a certificate specifying the transportable moisture limit (TML), which is calculated as 90% of the flow moisture point (FMP). The reality of complying with this is that each cargo to be loaded should be subject to sampling and testing to identify key physical properties in a controlled environment such as a testing laboratory.

Vessel	Date of Incident	Loss
Jian Fu Star	27/10/2010	13 fatalities
Nasco Diamond	10/11/2010	21 fatalities
Hong Wei	03/12/2010	10 fatalities

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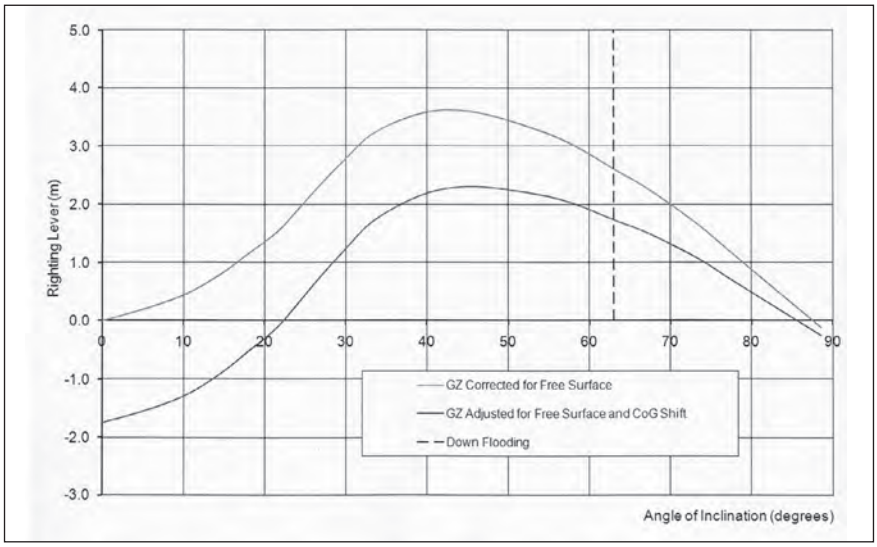
However, there is evidence that in some cases, the data shown on the cargo certificate may not be accurate for the actual physical properties of the material loaded into the hold. Errors might come from genuine mistakes in sampling, the fact that the cargo might originate from several places and it is not homogenous, or even that heavy rain between sampling and loading has changed its physical characteristics. There is also the possibility that the certificate provided has purposefully been produced to demonstrate compliance with the IMSBC Code but in reality is not from the cargo being loaded. The significant commercial pressure that the ship and her Master are under to ship the dangerous cargo without a proper certification has been widely reported, with stories of crew's being threatened if they did not accept the cargo.



GZ curves demonstrating free surface effects of cargo shifting.

So, given that we have seen the same types of incidents regularly each year, what should be done to stop what is an entirely preventable loss of life?

Clearly for a long term solution, it is better to treat the cause (cargo with too high a moisture level) rather than the symptoms (a dramatic loss of stability), but we as naval architects have a role to play in finding a solution to ensure safe ship operations. After all, many of these ships are well into their service lives and have long since forgotten the 'drawing board' but we have a responsibility for operational improvements as well as the initial vessel design.

The following does not intend to solve the issue by itself, nor is it an exhaustive list but hopes to provide some points and ideas that might be explored to help solve this issue:

A better understanding of stability: Ship's crew's are taught ship stability as it is critical to their safety, but how many really understand the implications of free surface effects. It is the author's view that a more rigorous programme of improving the understanding of ship stability and free surface would help. With the focus on the risk of free surface effects, the crew should be able to make the decision not to accept a cargo if they are concerned about its tendency to liquefy. This programme needs to be industry wide, worldwide and led by 'Class', P&I Clubs and nautical colleges.

Longitudinal hold division: As with grain cargoes, there may be possibilities to put longitudinal hold divisions in place to reduce the free surface effects. However, this needs careful consideration due to the trading nature of many bulk carriers where different cargoes may be carried and hence whether such division is permanent or temporary will need to account for the practicalities of loading and discharge.

Hold Pumping Systems: There are bulk carriers that trade loading slurries or water / mineral mixtures. The cargo is loaded and then the water is distilled down through the hold and pumped out to leave a dry cargo. It does not remove the free surface effect altogether but provides a means of removing the water once loaded. However, it is not without its problems as evidenced by the *Taharoa Express* incident in New Zealand, June 2007 .

There are of course, more operational solutions ranging from the simple (in theory) such as covering up of the cargo on the dockside to protect it from the elements, through to the more involved such as insistence on independent cargo surveys to verify and oversee the moisture testing of appropriate cargo samples.

The tragic loss of life that took place in late 2010 demonstrates how serious an issue cargo liquefaction is. Mineral ores and slurries can contribute to major stability problems and their transportation needs to be treated with special care. An enhanced regulatory framework is now in place and ship's crews, ship owners, ship managers and the cargo shippers need to fully understand the risks and implications and each be strong enough to resist the commercial pressure that will, undoubtedly continue but must not be at the expense of seafarers lives. *NA*

Simon Burnay, BMT Marine & Offshore Surveys.

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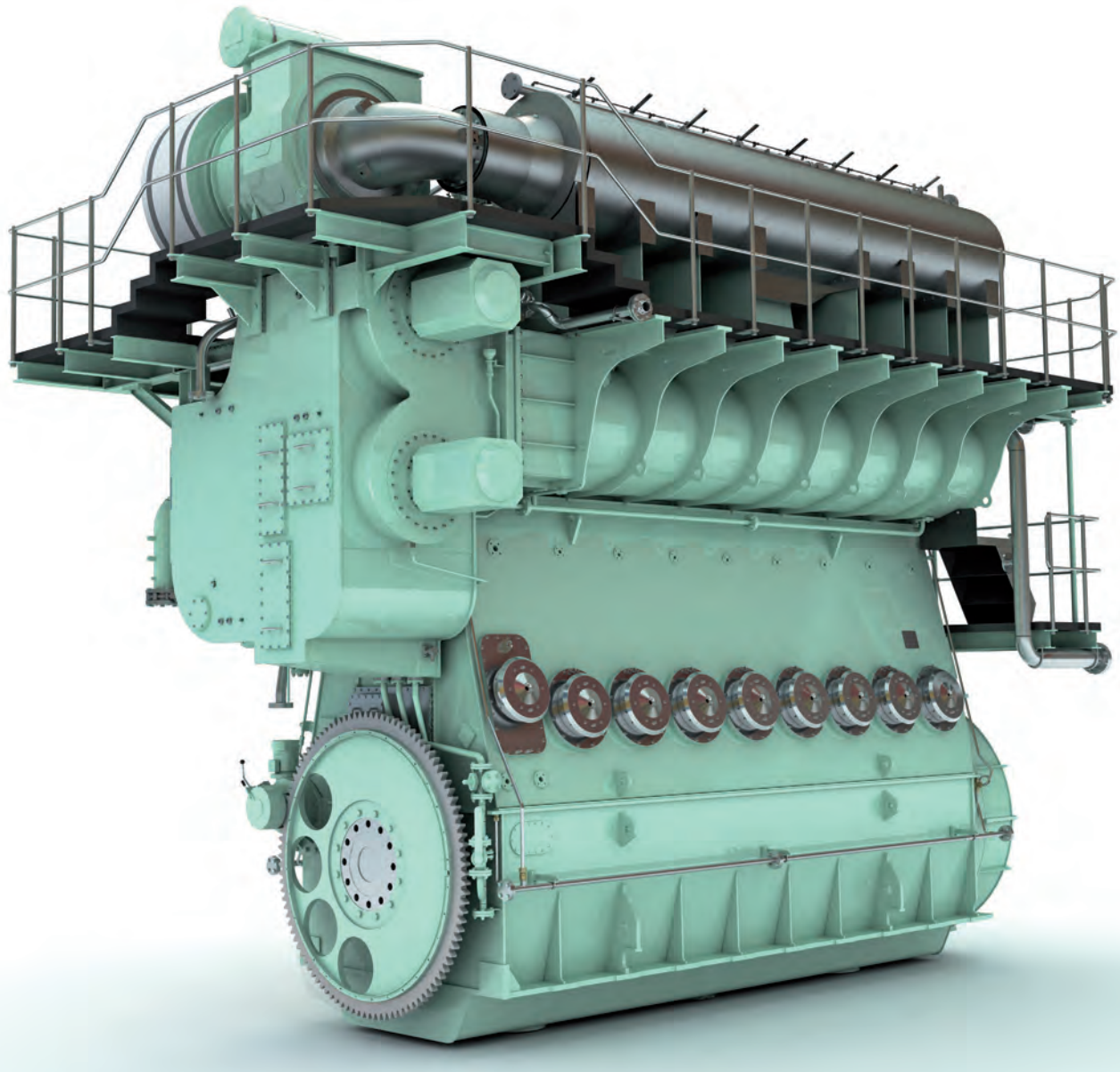

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Systems on the Vossnack Cylinder Tanker

Helge Kringel, a Bremen-based naval architect looks at the systems for the Vossnack Cylinder Tanker in the second and final part of the story on the triple-skinned tanker design.

Lightweight could be a significant disadvantage of the Vossnack design, but the safety and preservability of the cargo is significantly improved with the cylinders offering a third protective barrier. Additionally the coatings on the cylinders could help to maintain the temperature inside the cargo tanks minimising the evaporation losses that can occur onboard crude oil tankers.

Coatings

The following types of steel preparation and coating are anticipated:

- Inner surface of the cylinders: SA 2.5, 3x100 µ EP
- Outer surface of the cylinders: SA 2.5, 4x100 µ Zn Si, sealer, 2x 2K PU
- Double Bottom: SA 2, 2x175 µ EP

To increase sunlight reflection and to reduce the evaporation of valuable, gaseous, cargo components, the outer surface of the cylinders above main deck should be finished with a white, matte coating. The success of this measure has been proven by the Hellespont ULCCs, [8] which were delivered in 2002.

The necessity of heating coils and insulation for the cylinders above the main deck depends on the service routes of the vessel. The crude oil is embarked at 50-70°C .

Due to the distance of 500mm between cylinders and the side structure and the 1m- cofferdam below the cylinder bottom, there is no direct contact between the warm crude oil and the void side spaces and double-bottom, hence less corrosion in the ballast tanks may be expected [6], and furthermore, the cargo cools down more slowly.

Though the coating area of the cylinder tanker is approximately 150,000m² greater than that of a double-hull, the cost of its coating probably will not be higher, because the area of the double-hull ship requiring a higher-quality coating is larger.

Inspection and maintenance feature

The cylinders must be fully accessible internally for inspection and maintenance. The author proposes two aluminium inspection and maintenance rigs per ship. These will be lowered by a floating crane into the tanks during maintenance via the 2m tank hatches.

The rig consists of a centre column of 0.85m diameter, internally equipped with an emergency escape ladder. A ring-type lift shall surround the column which can be lowered to equi-distant stations and locked there. The lift is equipped with a foldable walkway jig, rotary through 360degs designed for two workers with equipment.

Inertisation

Vossnack, referring to [4], proposed to abandon any inertization by double-scrubbed flue gases due to their residual sulphur compounds, like H2S, SO_2, H2SO4 , and the formation of elemental S. H2S can be the main cause of super-rust with material losses of up to 3.08mm / year. The CO_2-content of flue gases creates tonnes of carbon acid which remain in the fully-inertized tanks after cargo discharge [6].

In [4], Vossnack's concept of N2-Inertization was welcomed, and omission of the tank washing system was proposed. The author doubts that this is recommendable. Sulphur-reducing bacteria in many crude-oils, create micro-climates in the ullage region and on the tank bottom [5], [6]. Under this humid ceiling H2S dissolves and forms sulphur crystals under waxy distillates. On the bottom, underneath the cargo sludge deposits, sulphuric compounds and elemental sulphur enhance corrosion. Consequently all deposits have to be removed by tank washing before the tank coating starts to fail, however less tank washing may be necessary for a cylinder tanker.

Pure N_2-Inertization implies cost and problems, of course. One reverse-osmosis membrane separator can supply 1250kg /h of 95-98% super-dry N_2. The remaining 2-5% consists mainly of O_2. To avoid an explosive gas mixture of volatile hydro-carbons, N_2, and O_2 in the void space during unloading, the O_2-content must never exceed 8%. This means that O_2 has to be limited to between 5% and 8%. The total gas pressure in the void space must also be kept below the overpressure setting of the P/V-valve which is 0.2bar while the vessel is being discharged by three cargo pumps, each having a capacity of 5000 m³/h at 15.5° (60°F). The rules require an hourly N2-supply of 19000m³/h. The previously-described membrane separator is capable of delivering 21800m³/h of N_2 at a partial pressure of 0.05bar. GL requires two 100% power-redundant compressors, each of 360kW.

Vapour emission and recovery

In the ullage space, the sum of partial pressures of volatile organic compounds (VOC), N_2,and O_2, especially in warm regions, is substantially higher than the P / V-valve setting. The mixture of gases would evaporate into the atmosphere, if not recovered. The evaporation of VOC, which is valuable cargo, during a transit from the Arabian Gulf to Japan and, assuming brown-coated cylinders above and including the main deck,

would amount to 860tonnes. With white-coated cylinders, the evaporation would still be 520tonnes. The advantage of the white coating is obvious. Such cargo losses can be avoided by using a vapour recovery system (VRS). The environmental impact of VOCs on nature and on humans is detrimental in many aspects. Therefore the installation of a VRS is required by the IMO and the USCG.

Systems based on re-absorption and/or re-liquefaction of the VOCs exist. The VOCs are collected in one main line and transferred into one tank. The contents of this tank are circulated by a pump. The circulating oil drives a Venturi-ejector which transfers the bubbles of the VOC/N_2-mixture into the tank, where it is re-absorbed. The question is whether VOCs of all cargo tanks can be re-absorbed in one tank.

Cargo oil and ballast water (B.W.) system

Since the midship section of the cylinder tanker differs significantly from that of a double-hull tanker, the geometrical cross-section figure 4 and the General Arrangement plan, figure 5 present the arrangement of the main piping. Due to limited space at CL, the main pipes are stacked above the cylinder bottom and also above the main deck. The cargo oil-piping system is designed to provide independence for three grades of cargo. The capacity of the three, self-priming, centrifugal, cargo-oil pumps is 5000m³/h each. They can serve the other grades in case of a pump failure. The pump room is located below cylinder No.1 with a pump-drive room on a flat above. The electric pump drives are frequency-controlled.

A stripping ring-line is located above inner bottom. The stripping pump will transfer the residual cargo from the cylinders, grade-by-grade ashore. After stripping, standard tank washing follows. Then the stripping pump will transfer the tank washing slop to the slop tanks. After the time needed for draining wash water from oil sludge, the drained water will be transferred from the slop tanks by the stripping line to a bilge tank in the pump room and thereafter, via the de-oiling plant, to sea. The sludge in the slop tanks will be pumped ashore by a steel -enclosed sludge pump located at the slop tank.

Two B.W. pumps of 3000m³/h each pump B. W. from sea via two, redundant, treatment plants to the B. W. tanks. The B.W. ring-pipe system enables the exchange of B. W. between the tanks.

Conclusions

The feasibility of a Vossnack Cylinder Tanker has been investigated, demonstrated, and confirmed. Advantages of this concept are:

1 High safety against oil spillage in case of a grounding or a collision using a triple-hull structure. Low oil spillage, if at all, may be expected in case of a collision due to wide-side tank structure and the use of ductile, TM-rolled material for the cylinder shells; No bottom spillage occurs in case of grounding due to high, double-bottom and a cofferdam above;
2 No direct contact between the shell and oily media due to the arrangement of cofferdams. The H.F.O. bunker is located at the CL between two entirely-independent main engine rooms and steering gear;
3 No direct contact occurs between the warm cargo oil and B.W. tanks and void spaces, thus there is less corrosion of the double-hull structure;
4 Long service-life of the vessel is expected due to the smooth, internal surface of the cylinders which can be cleaned easily. Thus, significantly-reduced corrosion and hence less maintenance cost of the cargo tanks will result;
5 Substantially-less corrosion by N_2-inertization and high-quality coating;

In the author's opinion, the Vossnack cylinder tanker represents the optimum tanker design from an ecological point of view. The initial cost is very high. This will be caused, as anticipated from the beginning, by a substantially-higher, net steel weight. The high initial investment however will effectively be compensated, over time, by lower maintenance cost, primarily for less tank preservation during the vessels' long service.

Further investigations

Further Investigations should deal primarily with the following topics :

- Energy absorption calculations for collisions, based on the materials impact energy
- Statistical oil spill calculations for collisions
- Investigations of the rolling and heaving behaviour with dynamic stability calculations
- Dynamic FEM calculations of cylinders, including the surrounding hull structure.

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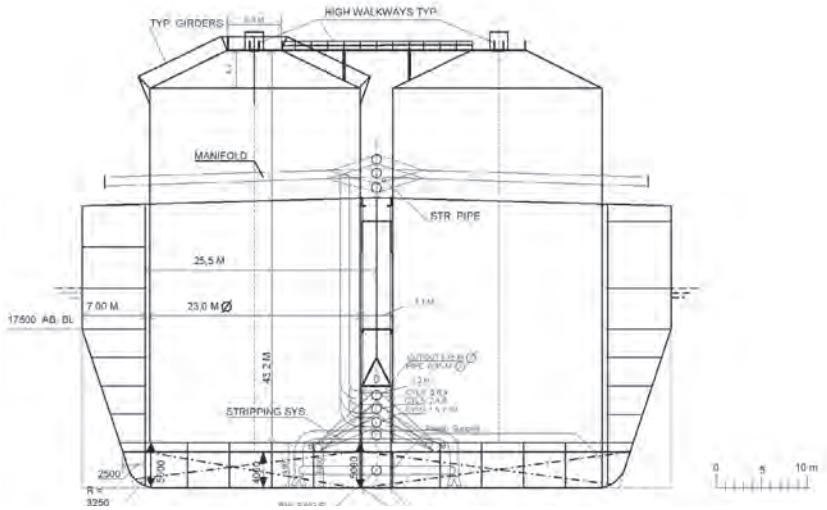
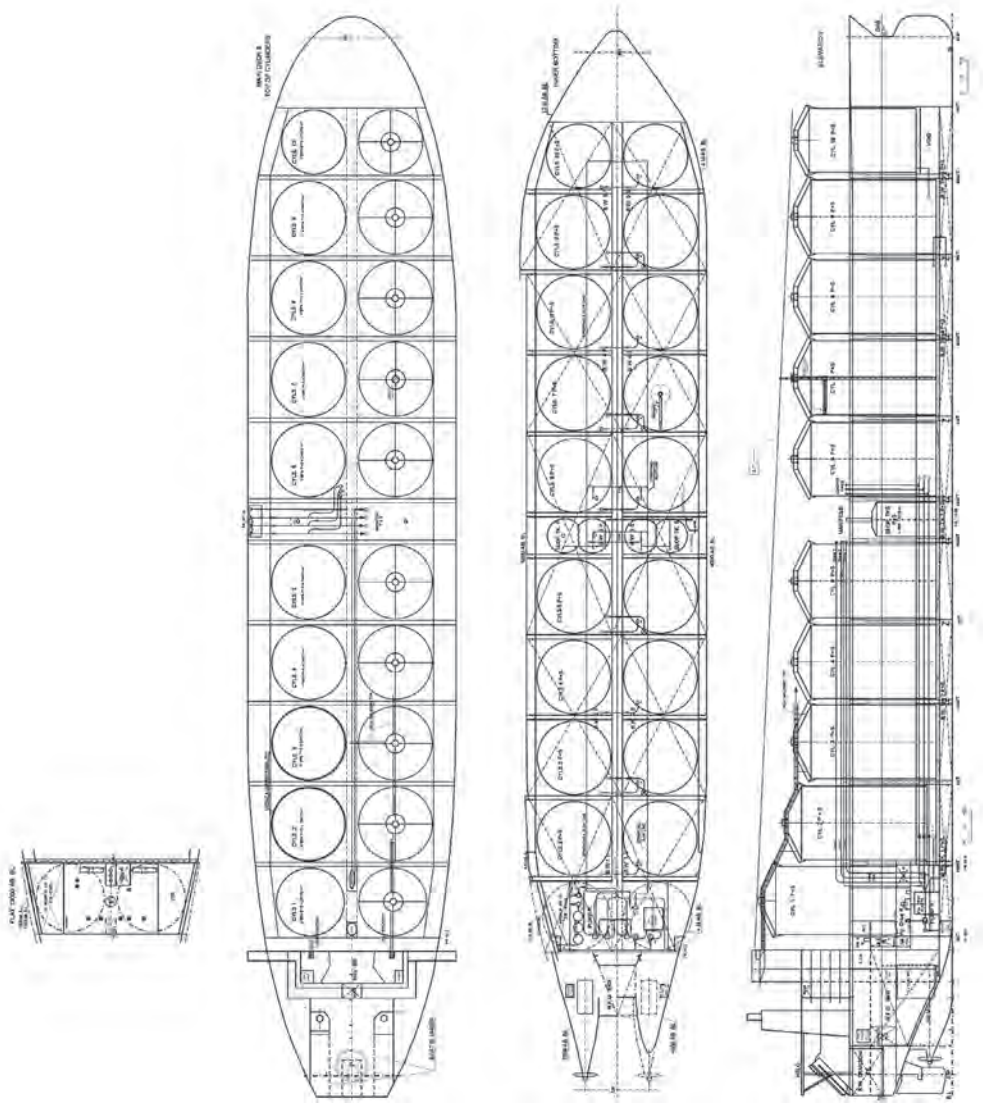
Acknowledgements

The author thankfully received basic information and advice regarding coating from A. Biermann of the Muehlhan Company. J. Bergmann from DNV Hamburg contributed useful information about vapour losses. The author thanks Prof. Dr. Ing. Hansheinrich Meierpeter for information on the recycling of volatile organic compounds. Rolf Jürgens deserves thanks for assisting the author in systems design. Thanks to Peter Hoes, Canada for improving the wording. *NA*

GA plan of Vossnack Cylinder Tanker.





Damaged ship rules debate rolls on

The end of January saw some of the world's experts on ship damage assembled at The Royal Institution of Naval Architects (RINA) in London for the "Damaged Ship" conference. A broad range of papers covering many aspects of ship damage including: fundamental research; design; regulations and their development; operation; and education were presented. Patrick Couser reports.

Long-standing ship-damage expert Prof. Dracos Vassalos, director of the Ship Stability Research Centre at the University of Strathclyde presented a historical perspective of the way in which ship stability, and in particular damaged-ship stability is assessed. Prof. Vassalos' paper highlighted the rapid increase in complexity of the methods used to evaluate and compare damaged ship stability over recent years and gave an insight into possible further developments in the near future.

The hydrostatic stability of damaged ships has been considered only since quite recent times. Archimedes first established the principles of buoyancy and stability around 250BC. However, it was not until 1928 that, in response to heavy loss of life (notably the Titanic in 1912), the first SOLAS (Safety Of Life At Sea) convention was established [Vassalos].

Since that first SOLAS convention, developments in damage stability analysis methods and regulations have progressed at an ever-increasing rate, demanding a steep learning curve. Initial damage stability conventions specified relatively straightforward criteria such as minimum residual GZ for prescribed deterministic damage conditions. However, legislative rules governing damaged ship stability have evolved towards a probabilistic approach whereby a much wider range of ship damage scenarios are to be considered.

These sophisticated probabilistic methods currently consider only the vessel's survivability from a hydrostatic stability point of view (albeit with some implicit account taken for hydrodynamic effects). The trend now is also to consider the ship's operational capability and residual strength after damage from a "safe return to port" perspective.

Traditionally, rule development has generally been reactive in response to ship casualty incidents. However, there is a developing trend to approach ship damage stability from a more first principles approach. Working towards this goal, the dynamic effects, both on stability and structural strength, of sloshing floodwater are now the subject of focused scientific research, both numerical simulation and experimental modelling.

In this vein, experimental and numerical simulation results from researchers at the UK MOD Damaged Ship Research Group at University College London as well as the University of Southampton were presented. These fundamental research programmes will provide analysis methods and verification data contributing to improved damaged ship assessment frameworks and future rule development.

Safety as a design objective and 'risk-based design' have been the main focus of SAFEDOR (www.safedor.org). The four-year, EU-funded project, completed in 2009, has established a framework for risk-based design. The framework includes an assessment of the residual structural strength of the vessel as well as its residual hydrostatic stability, with the goal that the casualty vessel can be its own lifeboat, remaining afloat for five days. This habitability requirement is aimed at providing sufficient time for the vessel to return to port under its own power or to await the arrival of external assistance.

Mr Seungmin Kwon from the Ship Stability Research Centre at the University of Strathclyde presented a methodology for the assessment of progressive structural failure. Essentially a LEFM (linear elastic fracture mechanics) and Paris law crack-propagation model is proposed to track the residual structural strength of the vessel in the time-domain. This provides a first-principles approach to estimate the length of time a damaged vessel can be expected to remain afloat which depends on the initial damage, weather and flooding. A validation study, using data from the *Prestige* incident off the coast of Spain in November 2002 is described.

The International Maritime Organization (IMO) is working towards a new, holistic risk-assessment philosophy to address ship damage [Vassalos]. The key theme areas of this new approach are:

1. Prevention and protection: i.e. aiming to prevent casualties from occurring, but also provide sufficient protection so as to limit the consequences that may arise from the damage sustained.
2. The time-frame in which events occur (this subject was also discussed by several other speakers). How long will the vessel remain habitable after an incident and to what extent will its operations be compromised as a consequence of the damage incurred?
3. The casualty threshold up to which it is safe for passengers and crew to remain onboard while the vessel attempts to return to port or waits for assistance to arrive.

The "Project Genesis" ships, *Oasis of the Seas* and *Allure of the Seas*, as described by Prof Vassalos in his paper, highlight how this design framework has been used to design not only the largest but also the safest vessels ever built.

In his paper, Keith Hutchinson, principal naval architect of Babcock Integrated Technology, gave a very detailed description of the legislative structure of rule development and application. The structure and procedures of the IMO are described and the paper gives some insight into the difficulties faced by the rule developers. It is also apparent that further clarification is required for the relatively new probabilistic rules so as to enable consistent and accurate interpretation, ensuring equivalent application of those rules across the board.

Mr Hutchinson also explained how feedback is provided to the IMO via IACS'

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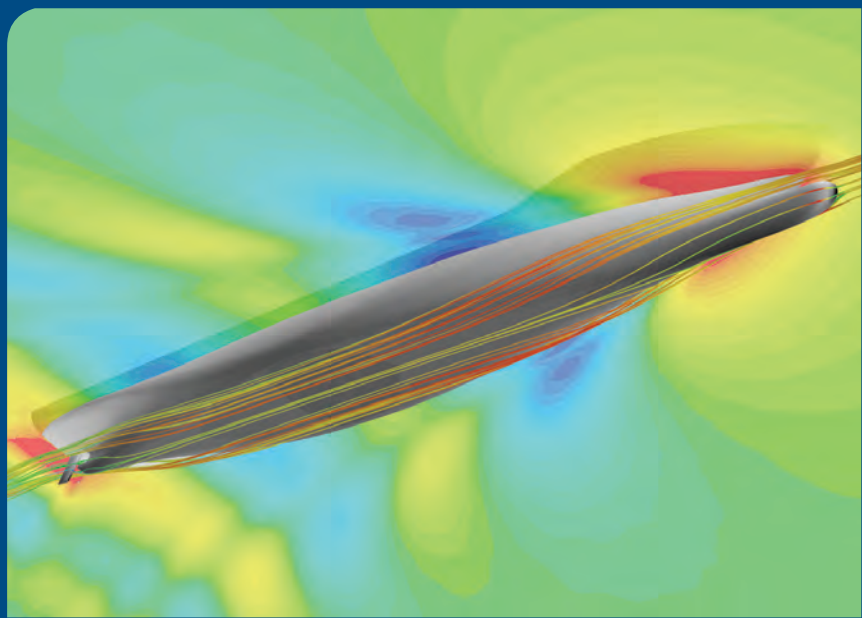

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(International Association of Classification Societies) Unified Interpretations. IACS' agreed interpretations, arising from queries from industry relating to IMO Regulations and Explanatory Notes, are submitted to IMO for consideration. From the point of view of practical application of these probabilistic rules to design, Mr Jóannes Gullaksen provided a detailed outline of the probabilistic damage stability calculation steps as applied to cargo vessels. He also provided a Microsoft Excel spreadsheet to evaluate the probabilistic damage factors (though a suitable hydrostatic analysis programme would be required to evaluate the survivability indices).

Following the comments of the papers by Prof Vassalos and Mr Hutchinson, it appears likely that there will be at least some revision of the SOLAS 2009 regulations in the not too distant future.

The two authors highlighted several key areas of difficulty:

1. Prof. Vassalos showed that the SOLAS 2009 A-index can be interpreted as "a value that reflects the average survivability of a vessel following collision damage" [Vassalos and Jasionowski 2007] and this value can be used to provide an analytical inference model for the cumulative probability that the vessel will capsize in a given time. When this analytical model is compared with a performance-based assessment, using for example time-domain simulations of damage scenarios, good correlation was obtained for RoPax vessels whilst cruise ships were found to be an order of magnitude safer than the SOLAS 2009 A-index would imply [Vassalos et al. 2008]. This is because the SOLAS 2009 A-index is unrelated to cruise ships; there were effectively no cruise ships in the casualty sample used to develop the SOLAS 2009 rules. Thus designing a cruise ship to the R-index actually results in a much safer ship than might be expected.
2. The probabilistic method in SOLAS 2009 is designed to give an "equivalent level of safety" to the deterministic method in SOLAS 90. Mr Hutchinson, in particular, noted that there is no unified interpretation as to whether SOLAS 2009 is equivalent to SOLAS 90 plus WoD (water on deck), as required by the Stockholm Agreement and EU directives. This is an area of ongoing investigation by IMO.
3. Several speakers raised the issue of LLH (long lower hold) RoPax vessels which can be designed to pass SOLAS 2009 but fail SOLAS 90 criteria. Also "the loss of the margin line non-immersion criterion is of much more significance for RoPax ships than conventional passenger ships so it is difficult to understand how, in future, these two, very different, designs of passenger ships can both be covered by the same probabilistic damage stability formulae." [Hutchinson]

From a practical point of view, the probabilistic rules present some difficult challenges. These were elucidated by Mr Hutchinson:

1. From a designer's point of view there is essentially no guidance on how a vessel's compartmentalisation should be laid out. With the older prescriptive rules, the damage conditions examined were directly specified, essentially determining the general compartment layout. However, in the probabilistic approach there is no such guidance.
2. The probabilistic rules also create a considerable challenge to provide useful information to the Master in a clear, concise, consistent and above all usable form. This is because, from a design perspective, the rules provide a probability of the vessel surviving a given damage; however, in the operational context, it is not immediately apparent to the Master if the vessel should be safe given a damage event. The older rules gave a black and white pass/fail status; the new probabilistic rules give a "shade of grey" in the form of a probability of survivability.

Addressing this second point, Mike Simpson's paper showed a non-computer-based method of providing decision support to the Master in the event of damage to the ship. An example "Damage Decision Support" book was provided for a high-speed catamaran ferry. The contents/index of this book is a colour-coded "damage condition" vs. "incident severity" matrix. The damage matrix consists of single- and multiple-adjacent compartment damage; for each damage condition the incident severity is indicated by its colour. Full details of the vessel under a particular damage scenario may then be found on the relevant page. The key outcome of this system is that the incident severity is immediately apparent to the ship's Master. The proposed "Damage Decision Support" book provides a means of presenting the vast array of damage stability data generated during a probabilistic damage analysis in a format that is more accessible to the Master should an incident occur.

A point that was raised from the floor on a number of occasions was that in many cases research and regulation developments seem to have a primary focus on design aspects with operational issues being less well covered. The primary instrument/document for the Master is still the SIB (Stability Information Booklet). Tools for decision support based on assessment of stability and structural viability under damage were the focus of several papers. Some of the key points raised were as follows:

- Onboard computer software systems become statutory instruments requiring official approval
- Information provided to the Master needs to be clear, concise, consistent and usable
- Due to the volume and type of data generated, especially for probabilistic damage stability analysis, fulfilling the above requirements is a non-trivial task
- Condition monitoring
- How can the progress of floodwater be tracked
- How can initial structural damage be assessed and its propagation tracked
- Residual strength can depend significantly on previous incidents (e.g. grounding resulting in deformation of hull plating) which may then lead to plate buckling.

This review has focused on issues that were raised relating to SOLAS 2009. However during the conference, some interesting fundamental research and some enthralling accounts of real-life incidents were also presented. *NA*

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Expensive, elaborate and exclusive Triple-E takes centre stage

In the summer of last year, Jochen Döhle the president of container ship operator Peter Döhle, said that ships had reached their optimum size and slow steaming would stop due to a surge in cargo unless companies "like Maersk" set the pace. This year Maersk has challenged its competitors with its latest orders for the Triple-E, 18,000TEU slow steaming vessels.

As fanfares go the announcement of the 10-ship order from Maersk at the South Korean Daewoo Shipbuilding and Marine Engineering (DSME) yard in late February was comparatively low key.

A power suited announcer on a stage in the Isle of Dogs in London's East End, the old docklands of the city, was the location, but the effects of the announcement may ripple through time and space like the proverbial rock in a pool. Maersk has taken a massive risk in ordering 10 monster 18,000TEU ships, dubbed the Triple-E, that will be energy efficient, offer massive economies of scale, and be environmentally friendly, said Maersk Line's CEO, Eivind Kolding as he explained the significance of the three E's, though he might have added a fourth 'E', exclusive. At close to US$200 million a piece few companies are likely to join the ultra-large container ship club.

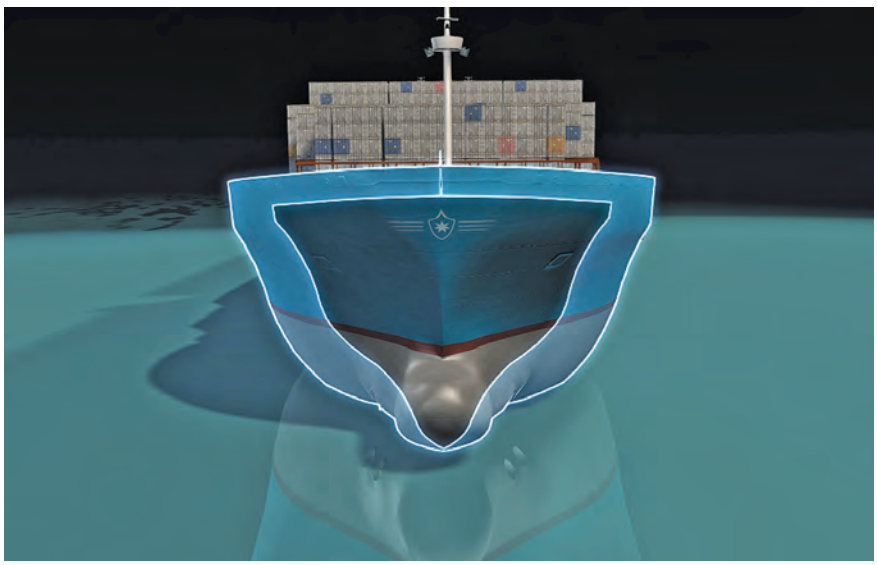
Maersk and DSME claim that the new vessels will cut emissions by 50% and that the cost per slot will be 26% lower than the standard 13,100TEU vessels operating in the Asia/Europe trades today. These statistics, if achieved, will certainly change the container shipping landscape.

Maersk Line, CEO, Eivind Kolding said that the Triple-E design was constrained by the port facilities that are available today.

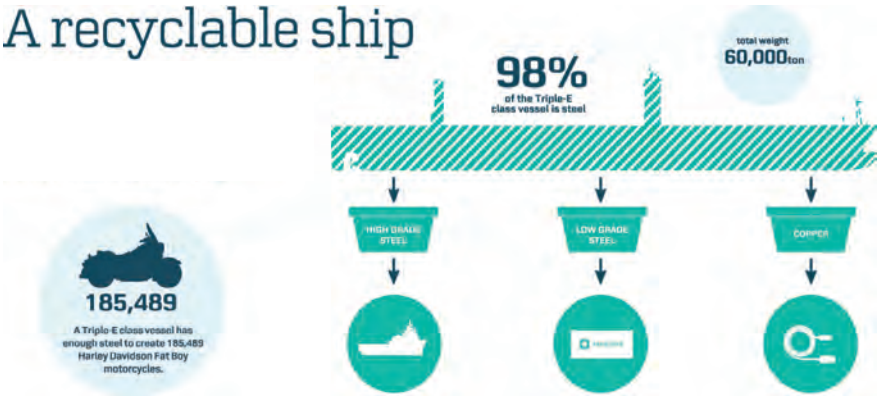
Lloyd's Register's global marine risk advisor Vince Jenkins believes that the industry needs an "outpacing" technology such as nuclear power. That is a method for cutting emissions at a greater rate than global shipping is growing so that the net effect will be an overall decline in emissions from the shipping industry even as more ships are operating. However, Maersk, with these latest ships, claims to have achieved a level of emissions reduction that will outpace the expected growth in shipping over the next 30 years. And it will be achieved through the use of existing technology and with a long term cost benefit to the line.

Costs for the 10-ship order are, however, US$1.9 billion and a second batch of 10 are likely to be ordered by the end of this year with a third option for a further 10 coming possibly next year. Total outlay for what amounts to three strings on the Asia/Europe trade is US$5.7 billion. With that kind of up front cost it seems unlikely in these uncertain economic times that many operators will be ready to follow Maersk's lead and order a raft of new ships. Yet the industry must applaud Maersk for having the courage to literally put its money where its mouth is, talking a good green game is all very well, but actions speak louder than words.

A cross section displaying the Triple-E's fuller figure compared to *Emma Maersk* class ships.



TECHNICAL PARTICULARS	
Triple-E	
Length overall	400m
Beam	59m
Height (above baseline)	73m
Height (above waterline)	58.5m
Draught	14.5m
Main engine	MAN Diesel
Carrying capacity	18,000TEU
Reefer capacity	600 plugs
Standard crew	19



The Triple E-class will be designed for future safe and sound recycling. We will develop a new 'Cradle-to-cradle passport', which will list and describe the materials used to build the vessel, where they are located, and how they can be correctly disassembled and recycled.

Or as a German philosopher once said: "Philosophers interpret the world, but the point is to change it." That same social scientist also said that capitalism is the greatest social system the world has ever seen with the drive to find solutions to problems that can appear insurmountable.

Solutions are what the Triple-E offers in abundance. Reduced fuel consumption based on a round trip for the *Emma Maersk* DSME calculates that the Triple-E will be 20% more fuel efficient. That means reduced emissions by about 50%/TEU km. Of course the later vessels will carry 16% more cargo, but with a smaller main engine than *Emma Maersk*, 65-70MW ultra-long stroke engine as opposed to an 80MW engine. The Triple-E ships will use 8% less fuel compared to *Emma Maersk*, but crucially will operate at a slower speed, 18-23knots, compared to 25knots.

Triple-E ships are 4m longer and 3m wider than their Emma Maersk-class predecessors and are designed with the bridge and accommodation block forward and the engine room at the back of the vessel. The separation of the engine room and accommodation areas allows for a better utilisation of the hull space, allowing the ships to carry a further 500TEU, but also the fuller hull form, more of a U rather than the V shape of previous designs means greater cargo storage space in the hold.

The hull form has been optimised to an operational profile rather than a single speed as with previous designs and the vessels will have some US$30million each lavished on them purely for energy saving purposes.

The ships will include a waste heat recovery system which, Maersk's head of sustainability, Søren Stig Nielsen, said would cost US$10million each, but will bring energy efficiencies of 9% and, depending on the price of fuel and service speed the payback time is estimated at between five and 10 years.

Decisions on whether to have one or two engines and the precise propulsion system design have yet to be taken, said Maersk, though a slow moving, long stroke engine design will be used with larger propellers are considered to be more energy efficient.

A space for SOx scrubbers has also been designed into the vessels, but Mr Kolding said that a scrubber system had not been included in the design as yet because "the technology was not ready yet".

Due to be delivered in 2013 the Triple-E will carry, what Maersk calls, "a cradle to cradle passport" that will travel with the ship and will include details of every single component and material used in the 60,000tonne vessels which will be the first ships that are entirely recyclable, said Maersk.

In effect Maersk and DSME have responded to Jochen Döhle's rhetorical question of 18 months ago: "Can you take the risk of ordering ships designed to operate at slower speeds if the rest of the industry is moving fast?"

Maersk and DSME have engaged in a process that could prove to be a game-changer for the container shipping industry, but also plants Maersk firmly in the lead of an industry that has feared the environmental lobby, up until now.

In ordering these new vessels with their array of cost cutting environmental technology has laid down a marker for the rest of the industry. The question now is can their competitors afford not to respond to this latest challenge? *NA*

A cut away of the Triple-E design.

Maersk's bubble bursts

Having recently ordered the world's largest container ships, the 18,000TEU Triple-E class vessels, Maersk has turned its attention to the world's smallest bubble. . .its WAIP (Winged Air Induction Pipe) microbubble air lubrication system may cut emissions by 10%, says Maersk. . . when experts can get it to work.

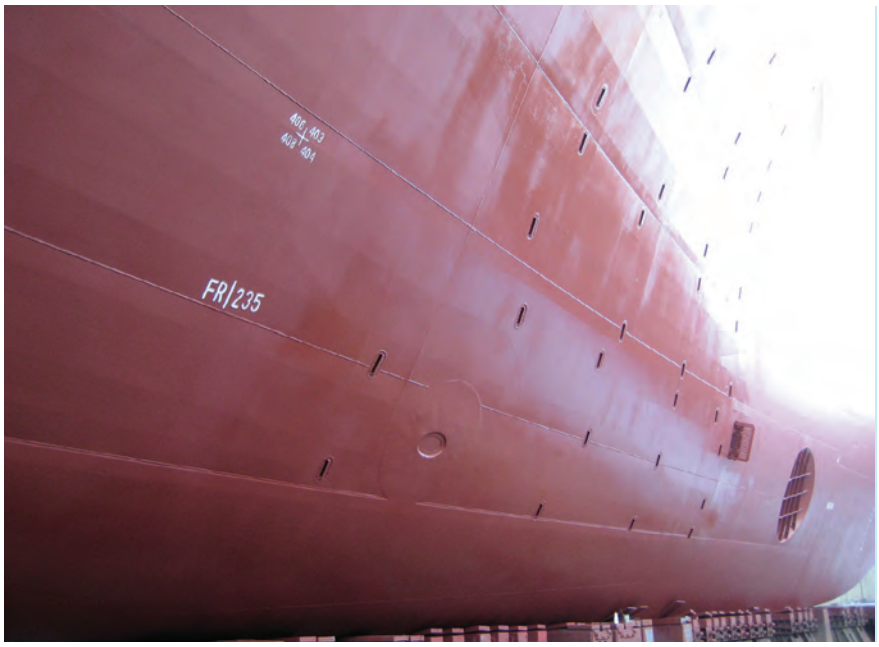
Designs for air lubrication systems date back at least as far as the 1950s with new versions being designed regularly, but few have been successful and fewer still have made it as far as an operational ship.

One system that has become operational was fitted to NYK-Hinode Line's *Yamatai*, a 162m long advanced module carrier. The ship was built at Mitsubishi Heavy Industry's Nagasaki Shipyard and the operator claims that the net fuel savings from the air lubrication system (ALS) amount to around 10%, after taking into account the extra fuel used for operating the blower system that creates the air cushion underneath the ship.

However, the company does admit that the ALS does lose some efficiency in some sea states. Even so *Yamatai's* success should offer encouragement to Maersk which installed the WAIP microbubble ALS on its 3000TEU and 240m long vessel *Olivia Maersk* in 2009. In fact, like the *Yamatai* system, WAIP was conceived in Japan by Mr Takahashi, a designer for the IHI yard and is operational on a smaller vessel, an 80m ferry that operates between two Japanese islands, "it [the ferry] has shown 10% fuel savings on this route," said senior director, head of innovation at Maersk Maritime Technology Dr Jan de Kat.

Scaling up the tests by installing the system onto *Olivia Maersk* has not realised the same savings, however, and Maersk technicians are struggling to understand what the problems are with the system and how to remedy them.

"We have tried many different combinations of tests while the vessel was on its service schedule between Europe



WAIP units staggered over the forward hull.

Freshly installed WAIP unit before painting.

and South America without measuring significant or consistent performance gains. We can't get the same results twice as different conditions, such as vessel speed and draft, wind, waves or currents, change its effectiveness," said Dr de Kat.

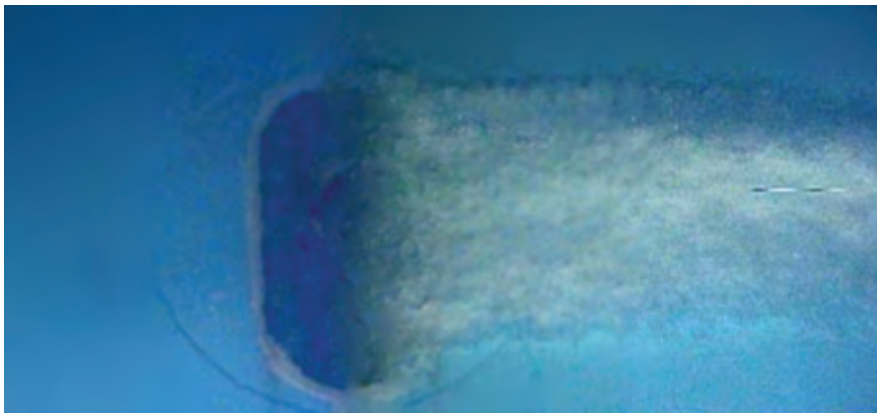
Maersk is confident the issues with the system can be solved and that ALS will offer fuel savings in the future also for vessels with a fine hull form like *Olivia Maersk*, but for the time being the company intends to develop a better understanding of the system and potential improvements in drag reduction. The feeling is that the system needs more air at a higher pressure to operate successfully on a larger vessel.

"When we started we didn't know enough about the creation of microbubbles under pressure," admitted Dr de Kat and the company is looking for partners to help develop the system further.

Initial tests on the WAIP system were carried out in MARIN's High Speed Basin with underwater photographs showing the creation of the microbubbles necessary to make air lubrication work at speeds of between 12-20knots. However, the WAIP system differs from the ALS on *Yamatai* which rides on an aircushion that is pumped out directly beneath the vessel. The attraction of the WAIP system over other ALS's for Maersk was that WAIP uses comparatively little power to create its air lubrication.

Maersk said: "One of the main challenges for this type of ship [*Olivia Maersk*] is the hull shape with relatively small portion of flat bottom surface (as opposed to *Yamatai* which has a flat, barge like bottom). Injection of air with 'conventional' large size bubbles in the bottom of *Olivia Maersk* would result in a marginal reduction in resistance. The WAIP system produces microbubbles, i.e. bubbles having a size in the order of microns, which are more apt to stay within the boundary layer for some time and distance along the hull."

The original concept envisages using a relatively small amount of energy to compress air, and "to generate microbubbles through instability of the air-water interface at each opening in the hull. Friction exerted by the fluid should then be reduced, provided the bubbles stay within the boundary layer close to the hull," said Maersk.



Micro Bubbles at the WAIP tank test at Marin.

A complex piping system delivers pressurised air to 124 ducts in the bow of the ship, below the waterline. Microbubbles act like smoke in water and should, in theory, remain close to the hull providing an aircushion the length of the hull as the movement of the ship takes it over the bubbles. Maersk said that the system requires half a bar pressure for every 5m draught and so for *Olivia Maersk*, which has a 12m draught, 1bar pressure should be sufficient to reduce the resistance of the hull in the water.

One theory as to why WAIP may not perform as it was expected is the absorption of bubbles into the surrounding fluid over a long distance along the hull, which could exacerbated by disturbances in the boundary layer caused by weld seams, but there may also be other, as yet undetected problems. "The system must have more air supplied and we must increase the flow rates, we need more air flow than we originally anticipated," said Dr de Kat, but he added that the company needs to find a method of observing the full scale operation of *Olivia Maersk* and the air flow beneath the water surface to fully understand the problems and their remedies. "Finding a way to make those flow observations is not so easy," he explained.

Investment in the system has already run into millions of dollars, said Dr de Kat, but the benefits of a working system would soon repay this outlay.

Installation of WAIP on *Olivia Maersk* "was preceded by detailed engineering which included besides the model basin tests, design of the air supply and piping system, global strength analysis and local strength analysis, including the ability to withstand peak loads associated with slamming, and damage stability assessment. The construction of the system was a massive undertaking, with complex discussions with the yard that saw more than 2000m of galvanised piping being procured purely for the retrofit of the WAIP system. All these pipes were pressure tested and the installation of the system and the vessel modifications were approved by Lloyd's Register."

Costs associated with this system would be expensive to retrofit onto Maersk ships. However, the pay back from the system when it achieves its operational standard could also be considerable.

AP Møller-Maersk estimates that its entire fleet "consumed approximately 10million tonnes of fuel annually when this project was conceived. A 10% [fuel] saving would enable a CO_2 reduction of approximately 3million tonnes annually. This prompted the group to take on a sizeable technological risk in pursuing this fuel saving initiative."

In reducing fuel consumption by 1million tonnes and assuming that fuel will cost around US$600/tonne, as is confidently predicted by many in the industry, an effective ALS could bring

Welding the WAIP counter-box in place.

fleet savings of US$600 million a year. Such savings would dwarf any outlay for research and development made by the AP Møller-Maersk group.

Meeting the requirements of an increasingly climate and environment conscious world and the ever higher oil prices are driving owners to look at ways that they can reduce, costs and emissions. If new regulations are providing owners with significant environmental challenges rising fuel costs are also focussing their minds like never before.

Old ideas married with new technology and design will have an impact on the environmental footprint of the industry and Maersk's attempts to develop the WAIP system into a commercially viable design for larger ships will benefit the industry and society as a whole, in the long term. *NA*

GSF research into scrubber technology

A new Green Ship of the Future (GSF) initiative will study technologies that will help the industry meet the International Maritime Organization's (IMO) emission controls in Emission Control Areas (ECA).

A group of companies affiliated to the GSF group will conduct a study into technologies that will help the industry meet new strict emission regulations coming into force within the next few years.

Already operators calling at European union (EU) ports must not exceed sulphur emission levels of 0.1% in fuel oil and this level will be extended to all ECA areas by 2015. Meeting this stringent target could be difficult and costly.

As a result Aalborg Industries, D/S Norden, the Danish Shipowners' Association, Lloyd's Register, Maersk Maritime Technology, Maersk Tankers, MAN Diesel & Turbo, Schmidt Maritime and the GSF secretariat as co-ordinators will study three possible answers for meeting the regulation; distillate fuel, liquefied natural gas (LNG) and scrubber technology.

D/S Norden's 38,500dwt tanker, *Nord Butterfly* will provide a reference case for the GSF group.

Using D/S Norden's latest 38,500dwt tanker, *Nord Butterfly* as a reference ship operating on distillate fuel the group will seek to establish the feasibility of using LNG and scrubbers as a means to reducing sulphur emissions sufficiently to meet the new regulations.

"The alternative solutions will be evaluated by means of various scenarios considering operational profiles and fuel prices and evaluation will take into account that the vessel will be sailing in both ECA and non-ECA waters," said a group statement.

Alex Hjortnæs, senior newbuilding manager at D/S Norden, said: 'As owner and operator of vessels operating both inside and outside ECA waters, we are following the rules and regulations regarding the SOx limits closely. We find it very important to find the optimum solution for both our existing fleet and for future newbuildings, and we expect that participation in this project will give us a valuable insight in that respect.' *NA*

Norwegians collaborate with Danes on Quantum concept

Quantum, the concept container ship designed by DNV technicians, has had an update with MAN Diesel & Turbo offering a liquefied natural gas (LNG) solution for the main engine power plant.

In its original guise Quantum was designed to operate in the South America/Europe trades the latest incarnation of the baby post-panamax 6210TEU (see page 40 *The Naval Architect* October 2010) vessel is the 9000TEU Quantum 9000.

In their scenario for Quantum 9000 DNV and MAN Diesel have adapted the basic vessel design for a ship operating between Asia and the USA East Coast, via the Panama Canal after the expansion of the lock system in 2014.

Quantum 9000 will have an overall length of 313m, a design draught of 13.5m and a beam of 48m, but the major difference with its predecessor is its MAN 9580ME-C9.2-GI dual fuel engine that is capable of operating on heavy fuel oil (HFO) and LNG.

Ship designers have moved the accommodation block forward and placed two pressurised LNG tanks, with a combined capacity of 6500m^3, underneath, standard HFO tanks have a 4000ml capacity.

There is a 10-15% premium in the cost of the dual fuel engine and the additional double walled piping and double wall gas protection including large volume accumulators and specialist valves and safety systems.

Lys Ryberg Juliussen believes investments in fuel efficiency systems such as waste heat recovery installations will show a return in the long term.

In addition Quantum 9000 would be fitted with an exhaust gas recirculation unit and a waste heat recovery system further reducing emissions and reducing fuel efficiency by up to 12%.

One possible stumbling block for the use of LNG as a fuel for a container ship is the need for bunkering to take place within the period that the cargo servicing is taking place. With bunkering for LNG taking up to eight hours it is essential for the fast paced container industry LNG powered vessels can refuel during their stay in port via a bunker ship.

Lars Ryberg Juliussen, a senior research manager at MAN Diesel admitted that operators would: "still need permission from each individual port authority to allow the ship-to-ship bunkering to take place at the terminal".

While Quantum 9000 does not have all the answers DNV and MAN Diesel see the design as providing solutions to key problems that the industry faces in the short-term. DNV's segment director for containers Jost Bergmann said: "Quantum 9000 is not a design it's a concept study, DNV is not a ship designer, but we play back these to the industry and then discuss it with customers, the level of detail doesn't facilitate the building of these ships." ***NA***

Quantum 9000 concept ship offering solutions to owners as new regulations force owners to reduce emissions.

CAD and production in the shipyard: what lies beneath?

A completely integrated shipbuilding process, driven and supported by technologies that combine traditional CAD/CAM with much wider information management benefits, is a stirring proposition - but how do shipyards actually achieve it? Aveva Solutions Stéphane Neuveglise, explains how this can be done.

The answer to this question is in two distinct parts. The first part concerns the closeness of the fit between the design technology itself (the CAD/CAM and production information elements) and the shipyard's activities. In other words, the technology must offer features, functions and benefits that support every key process in the shipyard, and in a way that reflects how engineers, designers, managers and other specialists naturally work. Separate processes cannot be integrated if the constituent parts of each process are hindered or incomplete because the technology simply does not support them! We will explore a few examples of this later on.

The second part of the answer to the question is rather more fundamental and has to do with the underpinnings of the technology, rather than how users actually engage with individual applications. It is these underpinnings that will determine whether critical applications in the shipbuilding process will actually be able to communicate with each other or not – and whether any effective degree of process integration can therefore take place.

3D is not just about design information – it can be used to link together every other relevant piece of shipyard information as well. A design component like this valve can be used to generate comprehensive reports on all the engineering and business processes in which it plays any part.

Integrate or interlock?

Broadly speaking, industry thinking has focused on three possible approaches to the integration challenge. The first approach is to use specific adaptors, gateways, and the like, to effectively interlock (or "close couple") certain applications in the shipbuilding process, creating very controlled processes of communication between the applications, on a prescribed "point to point" basis. In this scenario, the applications are usually supplied by one vendor.

The second alternative is the diametrical opposite, where there is no close coupling and the only means of communication between the applications is through a centralised point into which all the applications – regardless of vendor - in some way connect. Lastly, there is a combined approach, which enables some applications to communicate on a close-coupled basis, while linking others together through a centralised resource.

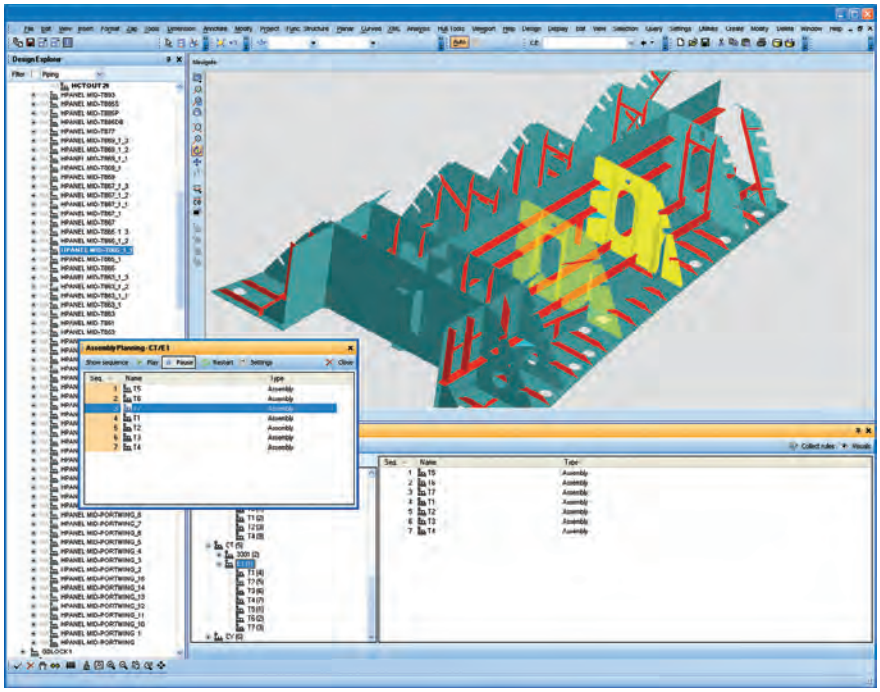
It is fair to say that each approach has its merits. The close-coupled approach certainly has its champions in some of the detailed, engineering-rich design disciplines, such as Process, Instruments, Mechanical and Piping, Electrical, and HVAC, for example, where information has to be exchanged in very specific form between applications. But, there are also massive issues with this approach. The task of manually engineering effective information flow between these disparate systems – and training users to understand how the coupling works - consumes specialist resources, which could be deployed more constructively. The complicated nature of the various interfaces and interdependencies also affects the ease with which applications can be replaced or upgraded. In addition, the high level of interdependence between these disciplines means that a configuration change in one application can have an unknown and immeasurable consequence in another.

More fundamentally still, the effort needed to create complicated dependencies between applications is out of all proportion to the actual level of information required by most project users. The overriding reality of information use in the shipbuilding environment is that the majority of users simply need to know only three things: what information should be released by when, what its status is, and whether they can trust it. Implicitly, they also need a very simple means of accessing and viewing it. The integration challenge is therefore how to guarantee this level of information sharing across the needs of different shipyard users, without arriving at very complex interfaces, and a solution architecture that is difficult and costly to maintain.

The second approach, where applications are not closely coupled but are linked together through some sort of central resource, has much to commend it. It does away with the need for complex and restrictive interrelationships at individual application level, and places the value squarely where it should be – on the information itself. It should be remembered that the shipbuilding environment often involves the use of scores of different applications from different vendors, and without a mechanism to share information between them, processes simply cannot integrate properly. The amount of information being exchanged will grow over the life of the project, so an integration problem that initially seems manageable will quickly become a real project hazard.

These two approaches are highly polarised, and, in reality, the sensible solution is to be found in the middle ground. In this scenario, the central information resource still does its work of linking applications together, to enable them to share information and to enable conformity to information standards, but it also connects existing clusters of selected close-coupled applications into the overall arrangement. Specialist information flow between applications continues unhindered, while project information that has more enterprise-wide significance can circulate freely.

But, much of this sound's like it refers to non-3D information. So where, then, does this put 3D? The answer, as we have said many times before, is "right at the heart of the integrated shipyard" – but only on condition that it is integrated into the wider information management picture. The 3D element should not be marginalised because of its implied focus on the design process. On the contrary, some kinds of 3D model have intelligence built into them and so can act as a universal "binder" for all types of associated shipyard project information.



The many different types of production information should ideally be deliverable from one single source of data, as an integral and automated part of the overall process. This assembly planning application, for example, enables the production engineering personnel to work in parallel with designers.

In other words, from a bilge pump represented as part of a 3D model on a screen, say, the user can accomplish "traditional" 3D design tasks, like measuring the clearance between its mounting and the edge of the foundation that it sits on. But, he can also instantly access the datasheets associated with the pump, the purchase order that has been raised to acquire it, the stock and logistics application that shows where in the yard it is being stored, and the sales tender relating to the design in which the pump is being deployed, among many other kinds of (non-3D) information.

Any of this information can, in turn, automatically be fed to any other business or design application, or indeed any user that has need of it. So, for example, a resource planning application can receive vital information about timescales contained in the sales tender. Likewise, the user's view onto those other applications can incorporate navigation via the 3D model. So, for example, reporting on how many of a specific type of valve have been successfully fitted and how many are still awaiting work can be accomplished simply by clicking on a representation of that type of valve on the 3D model.

Completeness before integration

So, integration is a crucial concept in attaining a truly effective shipyard, but let us turn now to design specifics. Can any degree of clever integration make up for a 3D design solution that does not have within it the capability to address and support every key design process in the shipyard?

The answer, of course, is no. Aveva knows this better than most, as it has been through an extensive process of creating a fully integrated shipbuilding solution from

existing marine technologies, in order to combine their respective strengths. There is not the space here to explore all the critical shipyard processes and how they should be represented within the technology, but here are just two examples of capabilities that are a fundamental part of a complete shipbuilding solution:

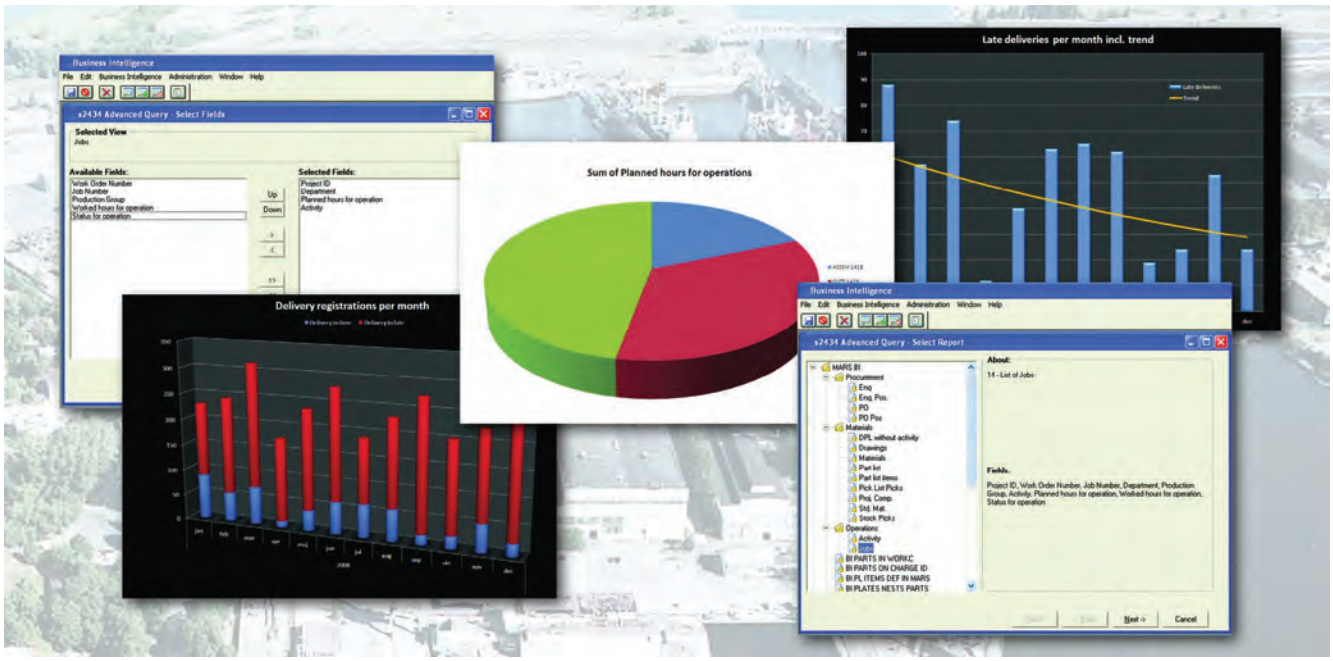
Synchronised design and production – The design tasks, the creation of the ship's build strategy, and the detailed assembly information are all natural bedfellows, but historically they were performed by very different groups of workers with very different priorities. Rather shamefully, shipbuilding technology has all too often tended to perpetuate these distinctions, rather than eradicate them! What shipyards require is the ability to select, view and manipulate information from both a designer's point of view and a production engineer's point of view, from exactly the same source data. This brings enough flexibility to support system-oriented design in the early stage, and the zone-oriented work distribution of later detail design.

Production engineering "on the fly" – The many different types of production information that are needed for parts manufacture and assembly should, ideally, also be deliverable from one single source of data, as an integral and automated part of the overall process. This enables the production engineering personnel to work in parallel with designers in order to first develop the build strategy and then, later on, to group designed objects into production assemblies. If all elements of hull lofting can be automated in the hull application modules, for example, considerable savings in man-hours and elapsed time will result. In addition the automated routines will give a consistent output, which will create savings in production.

Whether naval or commercial, historically, the technology that supports shipbuilding has only ever been partially integrated. The rest was stitched together by manual effort, leading to errors and rework.

Happily, this complete solution is not just a vision – it is reality. However, getting there has been an extensive process, involving the combination of different technologies with different inherent strengths and shortcomings. Inevitably, this has resulted in some of the component technologies becoming obsolete in their original form. A real-world example can be seen in Aveva's acquisition of the

3D information can act as the universal 'binder' that drives the delivery of all different kinds of shipyard data, including the detailed performance reporting shown here.



Tribon M3 product in 2004, an evolution that we explore briefly below.

Tribon M3 - that was then, this is now

Tribon was the number one marine technology provider at the time of its acquisition. It added a heavyweight marine capability to Aveva's (at that time) largely plant-focused design technology. Over time, it underwent integration with the strengths of the existing Aveva technology approach. The resulting suite of integrated solutions for marine design and shipbuilding (Aveva Marine) fully addresses the user requirements discussed above, and so now provides far richer functionality and opportunities than its Tribon predecessor.

However, Tribon had an established customer base, and so a programme of migration was always going to be a real necessity. Bruce Douglas, a former Tribon senior manager who presided over the acquisition, explained that migration is often an uncertain process. "There is a very robust and straightforward migration route available for current Tribon customers, and there is absolutely no doubt that what they will get at the end of it significantly outperforms what they are using at the moment. But, it's change, and change can be difficult, so our customers need to be mindful that we are here to help."

Yet history speaks for itself. Ships have been turned out in their millions without anything like the degree of design and information management that is now available. Must the industry invest in more advanced technological integration, or can it, in these economically straitened times, simply survive doing things the way it always has done? According to David Thomson, marine consultant at Aveva, economics is precisely the issue: "Historically, the technology that supports shipbuilding has only ever been partially integrated. The rest was stitched together by manual effort, and this led to lots of errors and rework. Ships still got built – they always will – but often it took as much money as water to float them!" It's a rather powerful image of waste and inefficiency.

In conclusion, we must remain balanced. Technology is not the answer to everything. At the beginning of this piece, we asked "what lies beneath," and it's true that 3D design technology is now capable of acting as the upper layer of a much more extensive and integrated shipbuilding information management universe than was ever previously the case. But, there will never be any substitute for skilled and dedicated personnel, or for canny management who use experience, judgement and instinct to understand when it's time to bite the bullet on change, and move to something better. As Mr Douglas concludes: "Migration from one technology to another involves inevitable upheaval. We couldn't credibly propose it if we weren't absolutely sure that that what the customers are moving to is significantly better than what they have come from." *NA*

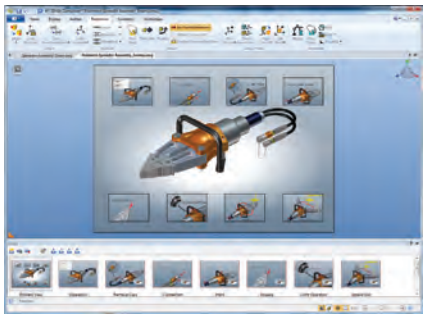
Dassault launches SolidWorks 2011

Dassault's main line computer-aided design tool sees an update in 2011 to bring it in line with customer's latest demands.

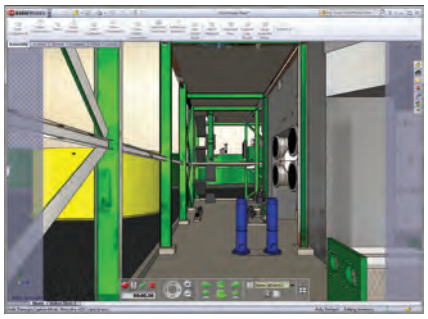
As part of the update from Dassault which includes updates and features, the core of the software has been enhanced allowing for designers to work more efficiency and also save costs when it comes down to the engineering of a project. Dassault has noted that there are many more people now using its software and the projects that are being taken on are getting larger. Dassault now sees that projects are getting more data intense and has looked at the memory management of its software, which has now been enhanced in this version meaning that designers will be able to stay in assembly for longer without seeing a degradation in the operation of the software.

Dassault has launched this latest update with the customer's expectations in mind. One of the most significant features that has been added to the software is the Defeature tool, which allows the designer to strip out important details out of models to have control over how much of the model can be viewed. Simon Booker, VP marketing EMEA, highlights the importance of the tool: "With this feature you can strip the model back to the sub assembly and then fill in the space. So essentially you keep the keep the skin and turn the model in to a solid block, but are still able to do intelligent modelling. This gives the customer better IP protection."

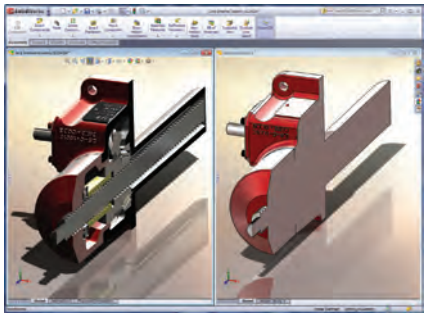
The other significant feature that has been added to SolidWorks 2011 is the 3DVIA Composer software.3DVIA has come from Dassault's sister company Dassault Systemes. What 3DVIA Composer brings to SolidWorks is the ability for the designer to instantly create linked views and videos and has the capability to do a storyboard. Mr Booker commented: "This is a great piece of software for communicating the technical content if you using it to communicate with a client or a partner how things are meant to work or fit together. You can add direction arrows showing which way objects are meant to move as well. People are really starting to pick up on this type of presentation."



The user can create interactive storyboards by drag-dropping views that link with each other and create a guided experience for recipients, be it step-by-step procedures or product manuals.



The new walk-through functionality inside SolidWorks allows the user to navigate through the design at fixed eye (camera) height off a base of reference surface.



The Defeature command enables users to repurpose their existing detailed assemblies by controlling the level of detail in one simple operation.

Mr Booker also highlights that with the drive of technology is pushing software further and more is expected from the design packages, "People will not be happy until they can view a model of a jumbo on their iphones", he comments. But, Dassault has already thought of that with its 3DVIA package, which has 3DVIA Mobile which does allow customers to now view designs on their smart phones. "This is becoming more popular now. The debate for the designer is where am I going. As he is not going to design on a tablet, but he can show customers. This will become more important in the future as this type of technology booms. It also gives richness in communicating the idea", added Mr Booker.

Walkthrough capability has now been added to the software using photorealistic images and animation. The walkthrough facility has a computer game-like feel to it, highlights Mr Booker. Further, additions to the software are the fast drawing detailing, allowing for quick and easy alignment. Planar simplification and enhanced beam analysis, which uses planar simplification to analysis parts geometry instead of analysing the entire structure. Dassault has also tailored it flow simulation for unique challenges of electronic packaging and HVAC systems. The user can now create faster piping in the enhance, with the addition of piping weld gaps, cosmetic weld beads, groove and filet welds and weld summary tables that include all the weld data can now be created. Along with this a smart weld selection tool has been added. *NA*

The efficacy of air-bubble lubrication for decreasing friction resistance

Reducing the frictional resistance by air injection is an active area of research; alleged performance gains are large. The paper gives an overview of model and full scale measurement results of ships with air bubble lubrication by Evert-Jan Foeth, Maritime Research Institute Netherlands, Wageningen.

The experiments were performed performed within the European Union (EU)-funded project SMOOTH. The experiments focused on an inland shipping vessel that was tested both on model and on full scale, with and without air lubrication. No appreciable effects of air bubble lubrication were found during the resistance and propulsion tests at either model or full scale.

At the Maritime Research Institute Netherlands (MARIN), for a number of years air lubrication as a means of reducing the frictional resistance of ships has been investigated and three approaches are recognised:

- Injection of air bubbles along the hull
- Air films underneath the hull
- Air cavities in recesses in the hull.

Thill et al. (2005) studied the capabilities on theoretical and numerical grounds and by extensive model tests. The reductions in resistance found encouraged two follow-up projects: PELS 2, focusing on air cavity ships and the EU-funded SMOOTH project, focusing on air-bubble and air-film lubrication. This paper presents the results of model and full scale tests within the SMOOTH project. The effect is discussed of air lubrication by bubble injection on resistance and propulsion, using both model and full scale experiments.

Background

Friction is the dominant resistance component for low-Froude number ships.

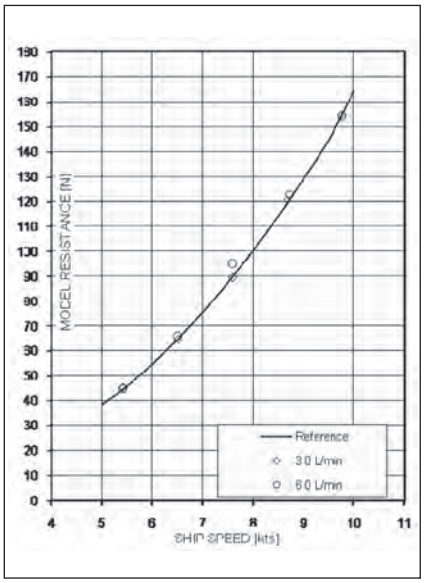


Figure 1: Measured resistance of the model. A 1% increase is measured (except for one outlier).

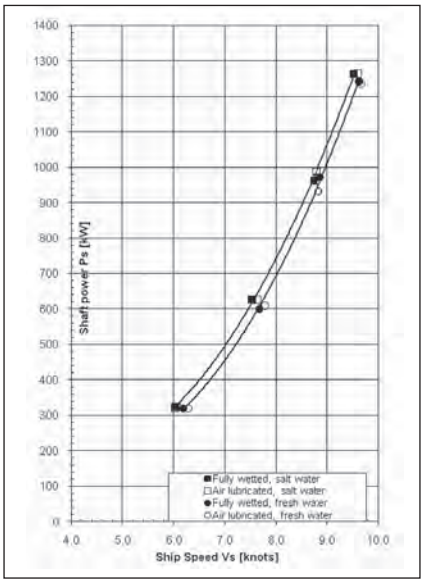


Figure 2: Measured shaft power onboard the *Till Deymann* with and without air lubrication both for salt water and fresh water conditions.

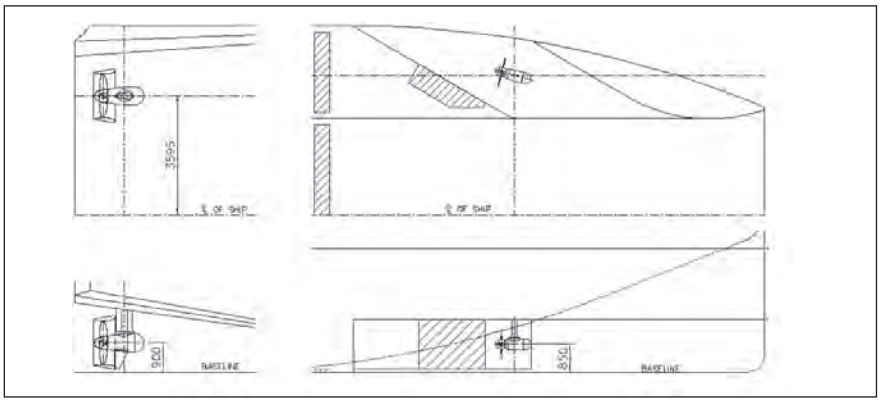


Figure 3: Drawing of the bow and stern of the vessel, showing the location of the air injectors.

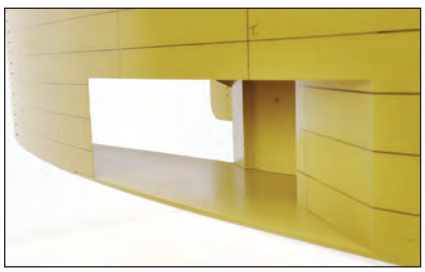


Figure 4: View of the model of the *Till Deymann* showing the typical bow shape and the fore thruster recess. The right image shows the opening for air injection on the inner wall, prior to the fitting of the porous material.

Pressure drag (i.e., form resistance) and wave resistance are frequently optimised using computational fluid dynamics but, the total wetted surface area remains a given. Reducing the frictional resistance by air lubrication is attractive and any reduction of the local skin friction leads to a decrease of the resistance and hence fuel costs, provided that the power needed to inject air under the vessel remains smaller. As the ship speed increases, the wave resistance becomes progressively larger, and the effect of air lubrication on the total resistance is expected to decrease.

Laboratory results of micro-bubble injection by Madavan et al. (1983) showed that a reductions of the frictional drag up to 80% is possible. At very low speeds, around 1m/s, micro-bubbles can cause a 10% decrease in resistance at only 1 volume percent of air in the boundary layer (Park & Sung, 2005), but the effect lessens with increasing speed. Still, this reduction far exceeds the effect of density reduction; note that viscosity actually increases for an air-water mixture.

However, micro-bubbles are difficult to create in a laboratory, let alone for a ship. As the bubbles increase in size, so do their tendencies to deform and oscillate in turbulence of the flow and bubbles no longer remain spherical. For current ship applications bubbles are on a millimeter scale and the term micro-bubble no longer applies; these bubbles are actually mini-bubbles on the order of tenths to several millimeters.

Watanabe & Shirose (1998) used a 40m plate to test the persistence of air bubble lubrication at a flow speed of 7m/s. Skin friction sensors indicated that the skin friction reduction diminished downstream from the injection point. However, after 20m, the effect of lubrication had nearly vanished.

Making a splash; testing out the air lubrication system onboard *Till Deymann*.

Sanders et al. (2006) performed experiments in a recirculating water tunnel with a large flat plate of 13m length for flow speeds of up to 18m/s with bubbles ranging from 0.1 to 1.0mm at Reynolds numbers that were not previously tested. The experiments showed that near bubble-free liquid layer was formed near the wall after a few meters and the effect of air lubrication almost disappeared. Van Gils et al. (2011) used a Taylor-Couette setup consisting of two counter-rotating cylinders where the 0.2 to 3.0mm bubbles remained trapped and could not escape from the shear in the flow. At high Reynolds numbers a 50% drag reduction was measured at a 4% volume fraction. The above experiments indicate that bubble drag reduction is a boundary layer effect and that air lubrication will not persist over long length or time scales when bubbles can escape. This is reflected in ship trial results.

The full-scale test vessel *Seiun Maru* showed a 2% power decrease for a limited speed range only, with an increase in required power for other speeds, notwithstanding resistance decreases measured at model scale (referred to in Kodama et al. 2002). Tests on the cargo ship MV *Filia Ariea* fitted with air injection devices did not show a change in shaft power after the air supply was switched on (Belkoned, 2008).

Resistance and propulsion of *Till Deymann*

Simultaneous with most of the research outlined above, a consortium of industrial companies and research institutes initiated the EU-funded project SMOOTH. The

project focused on air lubrication and its effects on resistance, propulsion, maneuvering, and sea keeping of ships. The first full-scale vessel tested was the 109.8m inland-shipping vessel *Till Deymann*, see Figure 4. The tests focused on air bubbles only.

The vessel has a semi-twin-hull bow with two openings in the sides fitted with two 1050mm azimuthing thrusters rotated 15degs outboard and two nozzled azimuthing 1300mm thrusters fitted aft. The air was injected at the far wall of the recesses in the bow and a strip in the bottom, through a porous medium with a 20μm pore size.

Model scale results

An 11.8m model at a scale ratio of 1:9.286 has been constructed. Even for such a large model, the propeller diameters are small, making the test less suitable for extrapolation to full scale, but well-suited for comparative tests between fully-wetted and air-lubricated conditions.

The porous medium is not scaled and has a 20μm pore size as on the real ship. In order to properly scale the effect of the atmospheric pressure, the model was tested in MARIN's depressurised towing tank. Nitrogen instead of air was injected from a pressurised gas canister where the nitrogen expanded and was subsequently heated before being injected. Mass-flow controllers calibrated for nitrogen gas maintained a constant supply. The model was set at the correct draught and trim with chambers filled with nitrogen gas.

The model was tested at a ship speed range from 5 to 10knots with the air-volume flow rate set at 0 (reference), 3, and 6L/min. Figure 1 shows the result of the bare-hull resistance test. A 1% increase of the resistance was measured—although this falls within the measurement accuracy—while most model tests wit air lubrication typically show decreases. The amount of air may have been insufficient to have any effect while the air injection may have disturbed the boundary layer too much. The propulsion tests, however, showed a decrease of about 2% of the required shaft power.

Full scale results

The full-scale trials for the *Till Deymann* were performed at the same draught as the model tests. These tests were performed in both fresh and salt water, as the coalescent behavior of bubbles is known to depend on salinity. The ship was fitted with an anemometer, a six degree-of-freedom accelerometer, strain-gauge shaft torque and optical rpm sensors, a boroscope placed aft of the air injection array fitted with an image intensifier capable of a frame rate of 200Hz, and two GPS antennae to determine the course within 0.5degs.

The tests consisted of sailing in 10-minute intervals in opposite direction (track length permitting) and taking the average of six runs per measured point. Several 11kW compressors were used for air injection. The weather conditions were very good with wind condition mostly at Beaufort 1 and occasionally up to Beaufort 3. The repeatability of the tests—within 2%—is good. Although the measured trend is constant and consistent, the effect of air lubrication is not significant and it is concluded that for the current setup the power required for air injection exceeds the power reduction by air lubrication; the optimum point was found at the break-even point. The behavior of the bubbles in the boundary layer of the full-scale ship—insofar as they could be seen— showed that bubbles did not remain attached to the hull.

Conclusions

Experiments have been performed with the ship *Till Deymann* with and without air-bubble injection at model and full scale. The results of model scale experiments showed a small increase in resistance and a small increase in propulsion efficiency around 1-2%. A trial with the *Till Deymann* with air lubrication at full scale showed a 2% reduction in required propulsive power with air lubrication, excluding pump losses. The total average power reduction was measured at –0.6%, i.e., an increase, for both fresh and salt water conditions.

Although, air lubrication by mini-bubbles decreases frictional resistance for ships, the obtained power reduction is not significant. The problem is that effective resistance-reducing micro-bubbles cannot be produced on ship scale and that the bubbles that can be produced are forced away from the hull by the ship boundary layer, shortening their effective life span. Barring unforeseen effects of special coatings and other surface treatments, an ad hoc application of bubble injection for ship hulls is not expected to yield any appreciable savings. When excessive amounts of air are injected, an air layer is formed that can have a resistance-reducing effect and conclusions with regard to the efficacy of bubbles no longer apply. Research within SMOOTH now continues with air-cavity ships, including extensive testing at both model and full scale for an inland-shipping vessel, where net power savings up to 15% have been confirmed during trials at both deep and shallow water conditions.

Acknowledgments

SMOOTH is supported with funding from the European Commission's Sixth Framework Programme with participation of MARIN, DST, SSPA, Damen Shipyards, Imtech, AkzoNobel, Bureau Veritas, Istanbul Technical University, Atlas Copco Ketting Marine Centre, New Logistics & Thyssen Krupp Veerhaven. *NA*

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Maxsurf integrates into the future

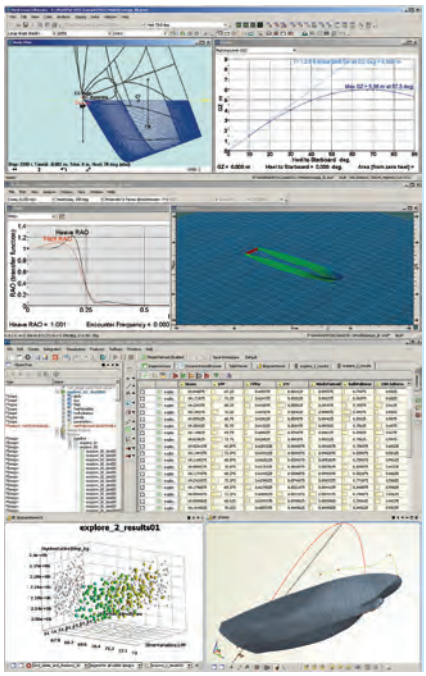
Formsys have been continuing to add new features to their Maxsurf suite of naval architecture design software.

Development of the suite continues to be very much user-driven as requests for features and suggestions for improvements are received from their large user-base which covers virtually all aspects of naval architecture and shipbuilding. The software development focuses on three key areas: increasing user productivity; integration with other systems; and additional functional capability.

One of Formsys' fundamental goals has always been to provide software which promotes high user productivity. Considerable effort is spent designing user-interfaces which are both intuitive and efficient. As CAD models become more and more detailed and analyses more and more complex, it is vital that mechanisms for effective model and data management are provided. Sometimes these features can be quite subtle but still provide considerable improvements in user productivity. It is also important to realise that different people have different workflows and perceptions of how software should function. During the user-interface design, these subtleties must be addressed. To improve performance, the Maxsurf suite is now available in 64bit executables, and where possible, the power of multi-core systems is leveraged. To help users get the most from their software, Formsys have started a series of on-line seminars and videos. Automation, where the Maxsurf suite can be driven from external software (such as a macro in Microsoft Excel) facilitates repetitive tasks as well as greatly increasing the scope of what can be achieved with the software.

Maxsurf now reads and writes native Rhino files and we have also developed a plug-in for Rhino to provide the functionality of the Maxsurf assembly in Rhino. Hydromax now reads and writes GHS (Creative Systems) files, including the compartmentation definition and critical points. Hydromax, Seakeeper and Hullspeed also read native nuShallo panel files for direct analysis.

The range of analyses in Hydromax continues to expand. Probabilistic damage has been included quite recently and in the latest version, MARPOL "Oil fuel tank protection" and "Accidental oil outflow performance" analyses are included. Tank calibrations can be carried out for tanks and compartments at a range of vessel trims and heels and the results can be exported in a form suitable for Fredyn. Formsys have been enhancing their structural analysis software, Multiframe, so that it now includes many more marine- and offshore-focused features; these include plate elements and marine-specific loadcases.



Simulation-driven design with FriendshipFramework (Friendship Systems) using Hydromax and Seakeeper (Formsys) for analysis.

> "As CAD models become more and more detailed and analyses more and more complex, it is vital that mechanisms for effective model and data management are provided"

Simulation driven design – accessible to all

Due to the availability of cheap, yet extremely powerful desk-top computers and a broad range of structural and hydrodynamic analysis software, simulation driven design is now very accessible to all naval architects. The Maxsurf suite provides a comprehensive range of analysis tools suitable for initial design. Design-space exploration can be rapidly achieved by coupling these tools with parametric modelling techniques and taking advantage of the automation capabilities within the Maxsurf suite. For instance, Microsoft Excel can be used to generate models within the design-space (by manipulation of a suitable basis design in Maxsurf), then the required analyses can be performed in Hydromax, Seakeeper, Hullspeed, etc. and the results brought back into Excel for post-processing and review.

The whole system can be taken up a level by using a more sophisticated integration platform such as the Friendship Framework (FFW) from Friendship Systems. The FFW provides sophisticated parametric modelling tools as well as tools for design-space exploration and optimisation. The FFW integrates with a wide range of analysis software including the Maxsurf suite. The integration of Maxsurf and the FFW has been documented in a paper (*Numerical Hull Series for Calm Water and Sea-keeping* by Couser, Harries and Tilling) to be presented at the 10th International Conference on Computer Applications and Information Technology in the Maritime Industries –COMPIT 2011– in Berlin in May (www.compit.info). ***NA***

ShipConstructor offers more in 2011

Shortly after announcing it latest subscription package for customers, Canadian-based ShipConstructor has announced it latest upgrade to its main computer-aided software package, ShipConstructor 2011.

The latest upgrade from ShipConstructor has been developed out of customer requests and market demands. Although, this version will not see any enhancements from the new subscription package launched earlier this year; the enhancements from that package are now expected at the next update. ShipConstructor 2001 R2 features better performance, batch updating of production drawings, enhanced product hierarchy, project equipment list and enhanced associative DWG.

Mark Waldie, PR writer and coordinator, ShipConstructor points out that one of the most significant enhancements of the software has been the batch updating of production drawings, which now has increased efficiency by providing the ability to update multiple arrangement, assembly, spool, or support construction drawings in a single operation. "This enhancement now allows the user to highlight all product drawings and batch them together", Mr Waldie commented.

Further, the enhanced associative DWG has been upgraded to simplify change management and production document revisioning. This will give the user more ease of use in the area of association activity. That will also contain all the documentation relating to that project. In addition the latest enhancement will see automatic changes to the drawings as the model changes, along with these update users will also be able to bring back in old drawings into the design.

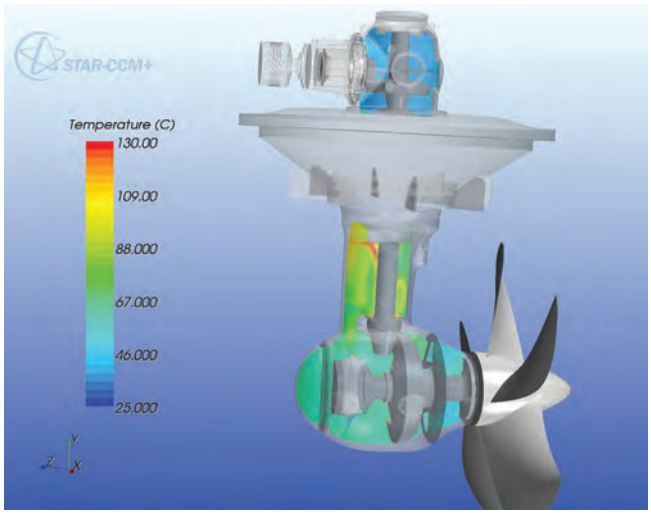
The other enhancements such as enhanced product hierarchy will provide the user with a more flexible and powerful way of organising project data by the removal of the unit constraint from non-primary product hierarchies. Project equipment list allows the management and reconciliation of the project master equipment list to the 3D model in ShipConstructor. *NA*

CD-Adapco releases v6.02

CD-adapco has launched v6.02 of it successful computer-aided design (CAD) software Star-CCM, focused on bringing customers designs up to speed.

The update from CD-adapco sees new simulation technologies, expanded integration with other software packages, whilst also improving upon the existing simulation processes.

Jean Claude Ercolanelli, senior vice president product management: "We maintain a constant dialogue with our customers, carefully observing new trends and challenges. Each new release of STAR-CCM+ is a balance between fulfilling the requests of our customers, and the introduction of new technology that expands the use of the software into new industrial applications, such as battery design, and electro-deposition painting."



Star-CCM + V6 motion superposition allows muliple modes of motion to be easily combined, such as in this simulation of a bow thruster (turning and spinning).

The main update for the maritime industry is motion superposition feature which allows the user to prescribe more complex body motions within a simulation and combine multiple rigid body motions or rigid body motions with mesh morphing. Allowing designers to study two motions at once, making the upgrade useful for simulations of bow thrusters.

The update has also seen further intergration with other software and making the overall workflow better, to save time and cost for designers. Also, the new capabilities have been added to the software opening it up to new industries. *NA*

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5 - 6 May 2011, Genoa, Italy

Second Announcement

DASSAULT SYSTEMES

Following a highly successful conference in 2009, RINA is pleased to return to Genoa for the second edition of the super and mega yachts conference.

The luxuary yacht sector has not been unnaffected by the global financial situation, but it has survived in good form and is growing again. New regulations are being developed to deal with the increasing size of vessels and these are both helping and challenging designers and builders of the latest generation of yachts. This growth in size and complexity coupled with the new technologies becoming available bring new challenges requiring innovative solutions.

Today's owners are demanding ever greater levels of comfort and luxury, not only in terms of the vessel fittings and styling but also in the vessels behaviour whilst underway and at anchor. They are also increasingly aware of the impact of their vessels on the environment. Many vessels are now used for charter and this has implications for the way in which the vessel is designed and classed.

RINA invites papers on all aspects of large sail and motor yacht design, construction, and operation, from designers, researchers, manufacturers, operators, and regulators. Suggested topics include the following:

- All Aspects of Design - Hull, General Arrangement, Interior, Features etc.
- Operation
- Regulation & Classification
- Powering & Propulsion
- Sea Keeping
- Auxiliaries
- Features, Technologies & Finishes

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Skarven breaks the Baltic ice

There is little full scale data of dedicated ice trials for ferries with azimuth propulsion. To address this, a Joint Industry Project (JIP) involving Ålands Landskapsregering, ILS Oy, Rolls Royce, BLRT Group and Lloyd's Register (LR) studied the icebreaking Baltic ferry, Skarven. This is an extract of a LR's paper delivered by senior project engineer Robert Bridges at the class society's recent Technology Days conference in February.

Shipping activity in cold climates has increased significantly in recent years and this has been coupled with new operational performance of ships in ice, which may be attributed to improved ship design and technology.

The ship-ice interaction for these vessels is a significant component of ship performance and capability in ice. The project represents the first full scale measurements in ice on a ship fitted with controllable pitch azimuth thrusters with a complete measurement system for the hull structure, engineering systems and underwater observations. This valuable ice load data can be used in a multitude of ice-related projects, such as ice management icebreakers using azimuth thrusters or podded propulsion, large stern first ice class tankers, hull structural fatigue in ice for LNG and tankers, as well as ice class rule development for typical merchant vessels operating in the Baltic.

Ålands Landskapsregering placed an order for the new construction of a double-ended icebreaking car/day passenger ferry, *Skarven*, which was designed by Finnish consultants, ILS Oy, and built in Lithuania at the Western Shipyard in Klaipeda, part of the BLRT Group.

TECHNICAL PARTICULARS	
Skarven	
Length oa	65.4m
Length pp	58.67m
Breadth	13.0m
Depth	5.9m
Draught	4.1m
DWT	350tonnes
Main propulsion	2 x 1,800 kW Wartsila "9L20" diesels
Azimuth thrusters	2 x Rolls-Royce "Aquamaster US285"
Speed	13.5knots
Crew	7
Passengers	250
Cars	60

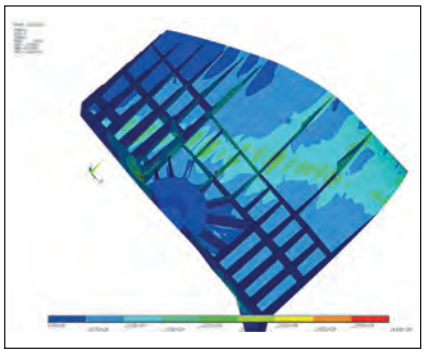


Figure 3: Von Mises stress distribution of finite element model of the aft end of Skarven with ice load applied along the waterline.

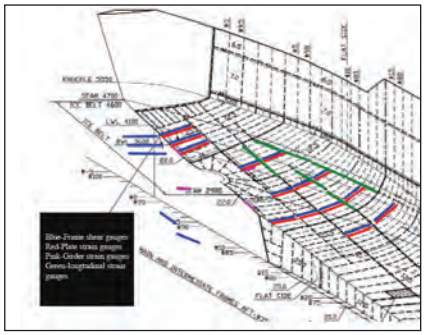


Figure 5: Aft end hull gauge arrangement.

The ship

The double-ended ferry operates year round in the Baltic Sea between Degerby on the island of Föglö and Svinö on the main island of Åland. The Åland Islands are an archipelago of more than 6500 islands in the northern Baltic Sea and they form an autonomous region of Finland. Due to their location, the Åland Islands have become the shipping hub of the Baltic Sea.

Figure 7: Bending failure of ice in the forward region of the ship

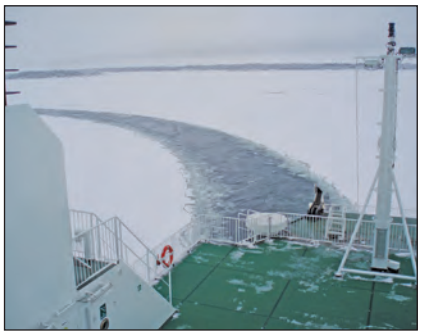
The design had to transport passengers, cars and heavy goods traffic within the archipelago, on the same ferry year round, regardless of ice. The design therefore incorporates properties both for open water and ice. The ferry is assigned the Lloyd's Register ice class notation 1A FS.

Since the ferry is fitted with bow and stern thrusters, measurement equipment was installed to gain data on the ship's performance during the ice trials. The following provides a brief summary of the measurement programme.

General measurements included equipment to record weather conditions, vessel speed and heading during each trial run. The acquisition of this data was obtained through equipment installed on the bridge. Furthermore, periodic sea temperature, ice thickness, ice type, and ice salinity were measured by ILS.

Measurements were made on each of the azimuth propulsion units when undertaking the trial runs. Measurements included engine rotational speeds, shaft torques measured on the intermediate shaft, azimuthing angles

Figure 12: Turning in 0.17m level ice.



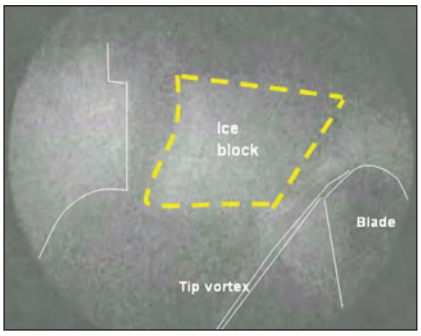


Figure 13: Ice block just before impact with the propeller. A strong cavitating tip vortex was also observed, indicating a bollard-push loading condition.

relative to the ship's centreline, and the propeller blade pitch angles for both units.

A system of rosette (three element 45degs), uni-axial strain and shear gauges were installed by LR at critical locations on the hull structure at the nominal locations of the ship. The measurements embraced both the ship's general structure and also a limited distribution on the pod unit's foundation structure.

Propulsor observations were achieved through the use of LR's borescope observation capability. A small number of tapped holes were inserted in the hull at predetermined locations to enable observations of the propeller action to be made during normal open water and ice operation. These observations were synchronised with the other measurements described above.

Hull structural measurements

The hull structural measurement system was one of the largest projects undertaken on an ice class ship and involved a high level of complexity and utilised some of the latest measurement technologies available. The measurement system needed to have a clearly defined purpose to provide useful data and the following measurements were identified:

- Ice loads acting on the hull structure
- Local ice loads due to icebreaking in the forward region
- Local ice loads in way of shoulder while turning and proceeding ahead
- Corresponding midship loads
- Corresponding aft loads
- Ice loads acting on the propulsion and transmitted to the hull structure.

To identify the critical locations a finite element model of the aft end of the ship was created with ice loads applied through level ice interaction along the waterline (Figure 1), ice impact on the forward bow region and ice impact on the azimuth thruster.

As a result of the analysis and considering the purpose of the measurement system, the critical locations were identified. This resulted in a measurement system which sub-divided the aft port side into a system with gauges applied to the frames and adjacent plate panels. In addition, the port side primary longitudinals and primary girders located in the fore/aft directions around the azimuth thruster were fitted with strain gauges.

For all of the frames that were to be instrumented, shear gauges were applied to each end of the frames and on both sides of the frame directionally opposing each other; that is, four gauges per frame. The gauges in the ballast tank followed a similar application. However, the gauges and cables had additional water protection measures against ballast water ingress.

In addition, a number of frames were fitted with an additional two shear gauges located at either end of the frame on the same side. This was to investigate the influence of additional ice loads acting on the frames. Traditional ice load measurements have adopted the installation of two shear gauges; however, this method may include other loads such as torsional and bending components. By installing four gauges per frame these loads are removed. The difference between these two readings will give an insight into any additional ice load moments acting on the frames.

Due to the machinery and structural arrangement in the midships region, the same frame could not be used for shell plating and bottom plating locations in the void space and were subsequently offset. In the forward region, the gauges were installed on a section of two frames in the forward azimuth space on the port side. The frames and sections corresponded to similar ones instrumented in the aft azimuth space.

Rosette strain gauges were installed at the mid span/spacing of plating adjacent to the frames on the forward side (except midships, as detailed above), while six uni-axial strain gauges were installed on primary longitudinal members on the port side of the aft azimuth space. All the strain gauges were temperature compensated.

Machinery measurements

Both the stern and forward azimuth thrusters had a series of measurement equipment fitted.

The thruster angle and propeller blade pitch angle was obtained through the Rolls-Royce central processing unit in the azimuth space. The shaft rpm and torque measurement system were fitted to the intermediate shaft in the azimuth machinery space. The rpm recording system used an infrared pickup, while the torque was recorded using a twin chevron torque strain gauge arrangement via telemetry and demodulator. The pitch control and steering gear pressures were connected, via the Rolls-Royce azimuth system, to the test point connectors on the thruster unit terminal blocks.

General measurements and visual observations

The ship speed, position and wind speed were recorded from the Sam Electronics navigation system installed on the bridge. Acquisition of external bridge wing camera data for ice interaction observations was obtained from the central ships computer system once the trials were concluded.

A centralised control station was set up on the bridge. The main computer and fibre optic systems were located below the bridge floor, with the monitor, keyboard, mouse, internet cable connections and a CD drive connected for periods to back up data on the workstation. In addition, a series of external hard drives was installed along with an internet connection to remotely provide a summary of the data acquisition status while the ship was in service post ice trials.

Table 5: Maximum recorded measurements.

Run	Channel	Description	End first	Mode	Test	Thruster angle	Ice conditions		Power setting	
									forward	aft
Frame gauge										
83	P10.5cSO	straight line	aft	combinator			channel edge	55	100	100
157	P48eSC	turning	aft	combinator	anti-clockwise	25 deg same directions	level ice	33	75	75
168	P47eSO	manoeuvring	bow	combinator	change of direction - fwd in thicker level ice					
75	S12.5cSO	straight line	aft	combinator			channel edge	55	55	55
157	P47eSC	turning	aft	combinator	anti-clockwise	25 deg same directions	level ice	33	75	75
Plate gauge										
157	P48cPL	turning	aft	combinator	anti-clockwise	25 deg same directions	level ice	33	75	75
95	P7cPL	turning	aft	constant rpm	zig zag	15 deg different directions	level ice	35	60	60
157	P47ePL	turning	aft	combinator	anti-clockwise	25 deg same directions	level ice	33	75	75
157	P48cP3	turning	aft	combinator	anti-clockwise	25 deg same directions	level ice	33	75	75
61	P12.5dPL	straight line	aft	constant rpm			level ice	30	100	45
Longitudinal members										
83	P10.5dL	straight line	aft	combinator			channel edge	55	100	100
57	P10.5dL	manoeuvring	aft		moving from level ice into channel					
161	P10.5dL	manoeuvring	aft	combinator	navigation in slightly deformed ridged ice then level ice					
183	P7dL	manoeuvring	aft	combinator	return to port short time in level ice					
83	P7cL	straight line	aft	combinator			channel edge	55	100	100

The trials

The trials took place between 13 February and the 16 February, 2010, and numbered some 182 trial runs. The ice trials were carried out in the vicinity of Lumparn depending on selected ice conditions during the trials.

For most of the trials, the vessel navigated astern and just below the load waterline of 4.1m. The vessel also had a slight trim by the stern, with the typical draughts of 3.92, 4.02 and 4.12 taken from the ship's measurement system and checked visually to give approximate agreement when at port and during ice measurements.

The azimuth propulsion units were both operating in the pushing mode: that is, with the hub forward and propeller aft, during all of the runs. The approximate propeller tip submergence was a minimum and maximum of 1.3cm and 3.7cm respectively from the waterline at the aft end with the forward end approximately 20cm deeper.

The pitch and engine rpm operate in combination to develop the thrust required on demand. However, when navigating in ice, it is preferred to maintain the engine rpm at a high level. Therefore, during the trials the runs were made using the combinator and maintaining a constant rpm value with variations in pitch. The modes were then varied with different forward and aft thruster combinations.

These combinations were undertaken for straight line navigation and while turning using preset angles of thrusters, 25 and 15degs, both with the thrusters operating in different directions and operating in the same directions. During turns, the ship's speed was established at the preset combination mode and then the turn was made. This approach was adopted for all turns except turning on the spot with the thrusters at 90degs. In addition, a zigzag manoeuvre was carried out, principally for the channel ice tests due to the confined width of the channels while turning.

The sequence and combination of trial runs was determined on the basis of ice conditions, the available navigation conditions and time. In addition, a number of general manoeuvring measurements were recorded while the ship was navigating between runs.

Ice and weather conditions

During the open water trials there was only a light to moderate wind present, typically 10 to 12knots. The wave state was also light to moderate. There were some ice floes present; however, these were avoided during the runs.

The winter season of 2009-2010 was considered an average winter based on the ice extent, with some severe ice conditions due to significant ice drift and movement in localised areas; for example, off the Swedish coast at the south of Bothnia Bay. The maximum ice extent was reached in March. The ice conditions in the Ålands, therefore, presented an ideal opportunity for the ice trials.

The ice conditions encountered during the trials were recorded periodically between runs, depending on the variation/change in conditions, trials sequence and location. It may also be noted that there was very little ice pressure, since there were few ice ridges.

The level ice thickness ranged from 15cm to 40cm, with an average of 28cm for all of the days. During the first day of ice trials the ice thickness changed 7cm, while the following days experienced slightly larger variations of 10cm and 20cm respectively.

Channel breadth typically ranged

from 20m to 30m. Using a channel angle of 2degs, the corresponding maximum channel thickness would range from 0.5m to 0.8m respectively. This aligns reasonably well with the measured channel thickness, which indicates values of 30cm to 40cm for the latter two measurements, which were measured at the margins of the channel and could be expected to increase to 50cm to 60cm at the channel edge.

The mid-channel thickness corresponded approximately to the level ice thickness, in the range of 25cm to 35cm. The old brash ice channels were typically 100% ice coverage.

Ice interactions

From the observations of ice breaking formations some general correlation between the ice loads in different ice thickness and manoeuvres may be made.

When navigating in level ice, the initial point of contact was the stem. Here there was crushing of ice for a short length. This was followed by the bending of ice once the inclined angle of the side shell promoted bending failure of the ice. The bending of ice started by crushing the ice edge until enough vertical bending force was created. The inclined sides created this force and the bending failure of the ice created a cusp breaking pattern. This bending failure created an ice load patch which is long horizontally and of quite small height. This effect was visually observed: Figure 2 shows the breaking ice in a cusp as a result of the inclined surface of the ship acting vertically down.

On failure of the cusp, the ice piece was then displaced. The displacement depended on the hydrodynamic flow around the ship and also the interaction with the other ice pieces and surrounding ice, as well as the hull form. In general, the ice was either submerged or pushed up on the level ice.

During the process of displacement, the ice cusps were often broken into smaller segments, due to the interaction between the ice cusp and edge of the ice sheet, although more typically, the ice cusp and ship. This process predominantly took place from the shoulder region and towards midships. During the process, the pieces were often tipped onto their side, due to the hull angle, and this, coupled with the forward movement, pushed pieces onto the surrounding level ice.

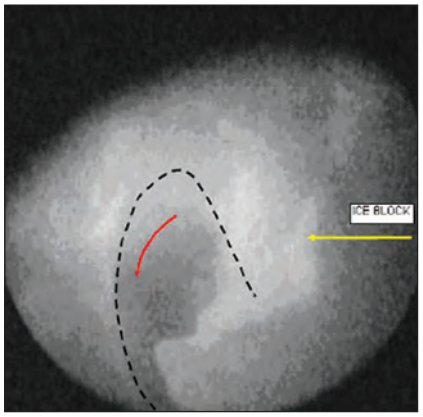


Figure 14: Ice blocks being entrained into the propeller during a stern-first manoeuvre.

The ice breaking pattern along the ship was quite random; however, some general observations may be made. It was noted during the morning a trial at Lumparn that the distance the ice broke from ship side was relatively small, which is indicative of the thickness and strength of ice, but also implies a small load length. As noted previously, the average length of the cusp may indicate the load length, being larger forward and smaller midships due to the subsequent breakage of ice.

While the process of ice breaking is a complex phenomenon, a further investigation of the ice breaking cusp pattern may provide an indication of the ice load contact dimensions.

Another effect noticed during the ice trials was the break up of ice from the resulting wave form when operating at full power in 0.17m level ice. Although this does not influence the ice loads in the forward region, it may be noted that the wave form would have been established by the midship and stern region and would be assisting in the ice breaking for these regions.

During ship turns, it was observed that the ice breaking principally occurred along the inside shoulder and outside midships to aft shoulder regions.

The ice interaction along the outside edge at the aft shoulder resulted in a large amount of water spray pushed up onto the ice edge and was broken in large ice pieces. The large ice pieces were then pushed under the hull due to the movement of rotation. After breaking the ice, the wash from the propellers moved the ice pieces under the outside edge of the channel (Figure 3).

The forward shoulder on the inside edge also broke the ice in large pieces, although these were made much smaller with the interaction with the hull at midships, resulting in a relatively straight curve when compared with the jagged edge on the outside channel edge.

During the 90degree azimuth angle turns, the ice was broken in the same regions; forward to midships on the inside edge and midships to aft on the outside edge. The ice interaction mechanism was much the same as the larger radius turns, except for the additional wash from the propeller, which moved the ice away, and the impact with floes on the completion of the first rotation.

Boroscope observations

The following provides a summary of the video images captured using a borescope which were made at two locations; the port azimuth space and starboard void in the azimuth space. These locations provided a transverse profile view across the thruster housing and an oblique fore and aft view from the hull towards the thruster housing.

The borescope was deployed through a customised hollow bolt (M35 HST) with a sapphire glass observation window in order to be scratch resistant and to prevent damage to the thin-walled borescope. Two bolts were used; one with a 45degree and one with a 90degree orientation. The bolts provided 360degree viewing around their axis, thus allowing observations from ahead to astern. Video images were captured under natural daylight, although an artificial light source was also tested, utilising the borescope's fibre-optic light path. This proved to be ineffective in the prevailing conditions due to reflections from the ice blocks and from suspended particles in the water.

The main observations of propeller-ice interaction were captured during backing and ramming runs, where the ship was backed a short distance (approximately a ship length) from the unbroken ice sheet and then driven into the level ice.

One ahead observation from the azimuth space location, which was above the waterline at rest, provided a short view of the breaking ice sheet. However, as the floe tilted under the weight of the 'bow' and passed along the

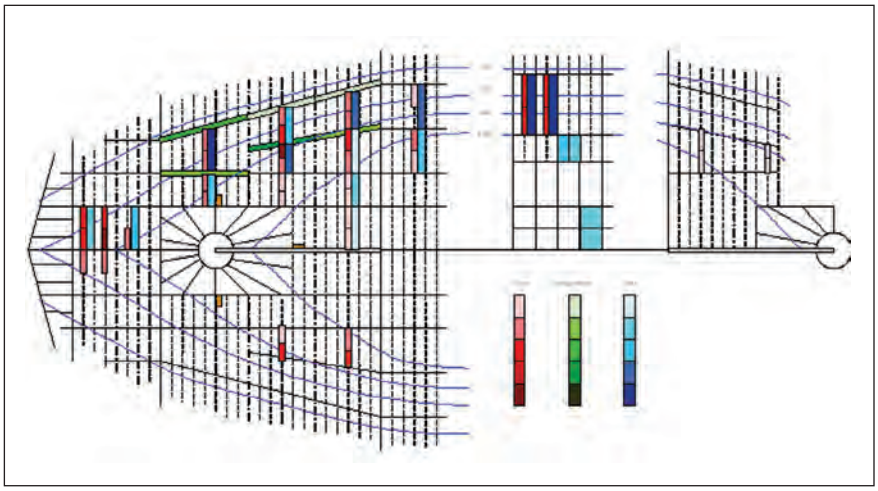


Figure 25: Colour intensity plot for distribution of maximum measurements in ice (for illustrative purposes and not to scale).

shell plating it impacted on the observation bolt and jammed into a recess created to protect the sapphire glass. Few clear images were thus obtained from this location due also to the amount of ice passing between the observation position and the thruster. The alternative observation location was placed deeper and at a frame position between the thruster axis and mid-ships, thus allowing an oblique view across the propeller.

The ramming and manoeuvring runs also created more open water around the propeller and good images of subsequent propeller-ice interaction were captured for short periods of time before the broken ice blocks obscured the propeller and reduced the ambient light.

The 'normal' navigation mode during the trials was 'stern first', since the borescope positions were fitted close to the thruster at frame zero.

When approaching the ice edge the first interactions were through broken ice containing small ice pieces (approx ½ blade chord) which passed around the thruster housing and made contact with the propeller blades, as shown in Figure 4. The clarity of the water reduced continuously due to suspended air bubbles, slush and smaller blocks of broken ice until the ice sheet was reached.

Larger ice floes generated by hull-ice contact travelled along the hull surface and were felt to impact on the protruding M35 observation bolt and, in the latter stages of the run, were seen to make contact with the azimuth strut before being displaced downwards towards the propeller tips or travelling along the hull plating. These large ice floes had dimensions up to 2/3 times the blade chord by length and the ice thickness by depth.

During the backing and ramming runs the thruster was used to manoeuvre the vessel in partially broken ice, close to the edge of the unbroken sheet. In this case large blocks of ice were forced under the hull in an oblique, transverse direction towards the propeller. Figure 5 shows such a case, where the dark surface of the propeller is shown outlined, for clarity, with smaller ice pieces above its tips and with a large block of ice being entrained towards the blades. The size of the larger blocks was of the order of the blade radius.

Preliminary data analysis

A summary of the top five maximum measurements is shown in Table 2 in rank order: top being the highest. It may be noted from Table 2 that the highest measurements occur during the largest ice thicknesses. They are also a mixture of straight line and turning runs, with a number of occasions due to general manoeuvring. Turning with 25degs, 75/75 power setting is also the highest run for plating and framing on more than one occasion. The highest measurements on the longitudinal members are in at the channel edge at 100/100 power, which is also the highest for the frame gauges. The longitudinal members also generally experience the high measurements during the general manoeuvring runs. The location of the maximums is frame 10.5c, and the midships (although one plate instance is on Frame 7c and 12.5d), and one instance on 12.c for the frame. The plate strains are all in the longitudinal direction except one which was in the 45degree direction.

Figure 6 shows an overview of the measurement distribution through a colour intensity plot for the runs in ice. The maximum measurements generally follow the waterline, as expected. There are, however, a few noticeable features, one of which is the longitudinal girder at frame 7, which shows a higher stress on the upper longitudinal member than the lower one; this may be attributed to the scantling size of the member, although the plating also shows a higher value. A later conversion to ice pressure may identify this effect in more detail. Also of interest is the frame P10.5, which shows the highest measurements. This may be attributed to the increased loads due to turning, since the equivalent gauges on the starboard side are lower, which would indicate the increase would be due to turning to the port side.

The maximum measurements were plotted against the measured ship speed for each run in ice conditions. Theoretically, the ice loads should increase with increased ship speed and in general this is seen for the thicker level ice conditions, but significantly less so for the thinner level ice conditions. Equally, it would be envisaged that the loads would increase with ice thickness and again this is also supported for level ice runs, but again less so with thinner ice conditions. However, it may be noted that both the channel edge and mid channel runs have the opposite trend.

Conclusions

The project is one of the few measurements undertaken with controllable pitch azimuth thrusters coupled with a comprehensive measurement system and with large combinations of trial runs. The preliminary results have provided a unique insight into ship-ice interaction and ice loads. The ice data measurements have also provided greater knowledge of the environmental conditions in the Åland Islands and the shipping activities in the Baltic, as well as high technology systems that may be used in ice navigation research. *NA*

Flensburg boosts trailership capacity

Through the adaptation of the last vessels in the series at a late stage in the construction programme, substantial gains in capacity and unit cost efficiency have been achieved with Cobelfret's already highly versatile, new class of German-built ro-ro freight carrier, reports David Tinsley.

Blending the Belgian owner's through-transport and shortsea expertise with Flensburger Schiffbau-Gesellschaft's skills in ro-ro design and production, the first four vessels of the ConRo220 type, starting with *Mazarine*, were delivered in a three-deck configuration. The recently commissioned fifth and sixth ships, *Opaline* and *Amandine* respectively, have each been completed with four fixed freight decks.

The modified version of the ConRo220 gives a 35% increase in linear ro-ro cargo intake, using the same engine plant and power, and within the same length, as that of the preceding vessels. The adoption of sponsons, or shell blisters, to confer extra stability, has added an extra 3.8m to the beam in the mid-body section.

Giving first form to the ConRo220 design towards the end of 2009, *Mazarine* afforded the requisite flexibility to sustain and develop Cobelfret's business mix of general freight, industrial shipments and factory-new vehicles. The vessel can take up to 845TEU or 2907 lane-metres of ro-ro freight. It was followed by sisters *Palatine, Vespertine* and *Peregrine*.

The four-deck *Opaline*, commissioned towards the end of 2010, raised the potential ro-ro payload to the equivalent of 3923 lane-metres. *Amandine*, incorporating the same arrangements has been phased into duty this year alongside *Opaline* on the owner's service linking Rotterdam with the Humberside terminal of North Killingholme. The capacity is on a par with that of two previous deliveries from Flensburg, Cobelfret's five-deck Humbermax sisters *Pauline* and *Yasmine*, which brought new scale economies to the North Sea trade in 2007.

The ConRo220 type as encapsulated in *Mazarine* can accommodate 217 trailers, on the basis of 12.5m mafi-type units. The new version embodied in *Opaline* provides for 122 mafi rolltrailers of 12.5m, on the main deck and tanktop lower hold, plus 155 trailers of 13.955m on the upper and weather decks, or a corresponding mix. The ConRo concept is ideally suited to key elements of the Cobelfret service network, where combinations of trailers, containers double-stacked on mafis or cassettes, and new cars, sustain flows of retail goods and industrial products between the Benelux region and the British Isles and Scandinavia.

Opaline leaving the Flensburger shipyard. (Courtesy: Julian Kleinefield).

> "The modified version of the ConRo220 gives a 35% increase in linear ro-ro cargo intake, using the same engine plant and power, and within the same length, as that of the preceding vessels"

All cargo handling is through a 20m-wide stern door/ramp supplied by TTS, and which gives access to two openings, one being the entrance to the main deck, and the other being the fixed ramp accessing the upper trailer deck. On the *Mazarine* type, the latter is the weatherdeck. In the *Opaline*, this upper deck forms a garage giving a free height of 4.8m, with openings on each side between the vertical frames so as to allow natural ventilation. A fixed ramp leads from the upper trailer deck to the surmounting, fourth freight deck, the weatherdeck. Another internal fixed ramp serves transfers between the main deck and tanktop hold.

Cobelfret has long played an important role in automotive logistics, as regards both European inter-factory component movements and shipments of new vehicles. A decision to fit a car deck section in the ConRo class from Flensburg was taken too late for the installation to be made during the production of the ships. As a consequence, Cobelfret implemented a post-delivery retrofit programme covering all six vessels, and contracted the Polish company Navikon to undertake the work at the latter's Swinoujscie premises. For its part, the Flensburg yard provided certain technical support to the shipowner, such as additional stability calculations.

The car deck, reached by hoistable ramp incorporated on the starboard side, is located in the furthest forward area of

	3-deck Mazarine-type	4-deck Opaline-type
Length overall	195.40m	195.40m
Length b.p.	186.22m	186.22m
Max. breadth, moulded	26.20m	30.00m
Depth, to main deck	9.65m	9.65m
Draught, design	7.05m	7.05m
Corresp. deadweight	13,123dwt	11,890dwt
Draught, full scantling	7.40m	7.40m
Corresp. deadweight	14,552dwt	13,400dwt
Main engine power	10,800kW	10,800kW
Service speed, design	18.5knots	18.0knots
Fixed cargo decks	3	4
Lane-metres, freight	2907m	3923m
Trailer capacity	217 x 12.5m	122 x 12.5m plus 155 x 13.955m
Gross tonnage	25,593gt	33,960dwt
Class	Lloyd's Register	Lloyd's Register

Table. ConRo 220 design series comparison.

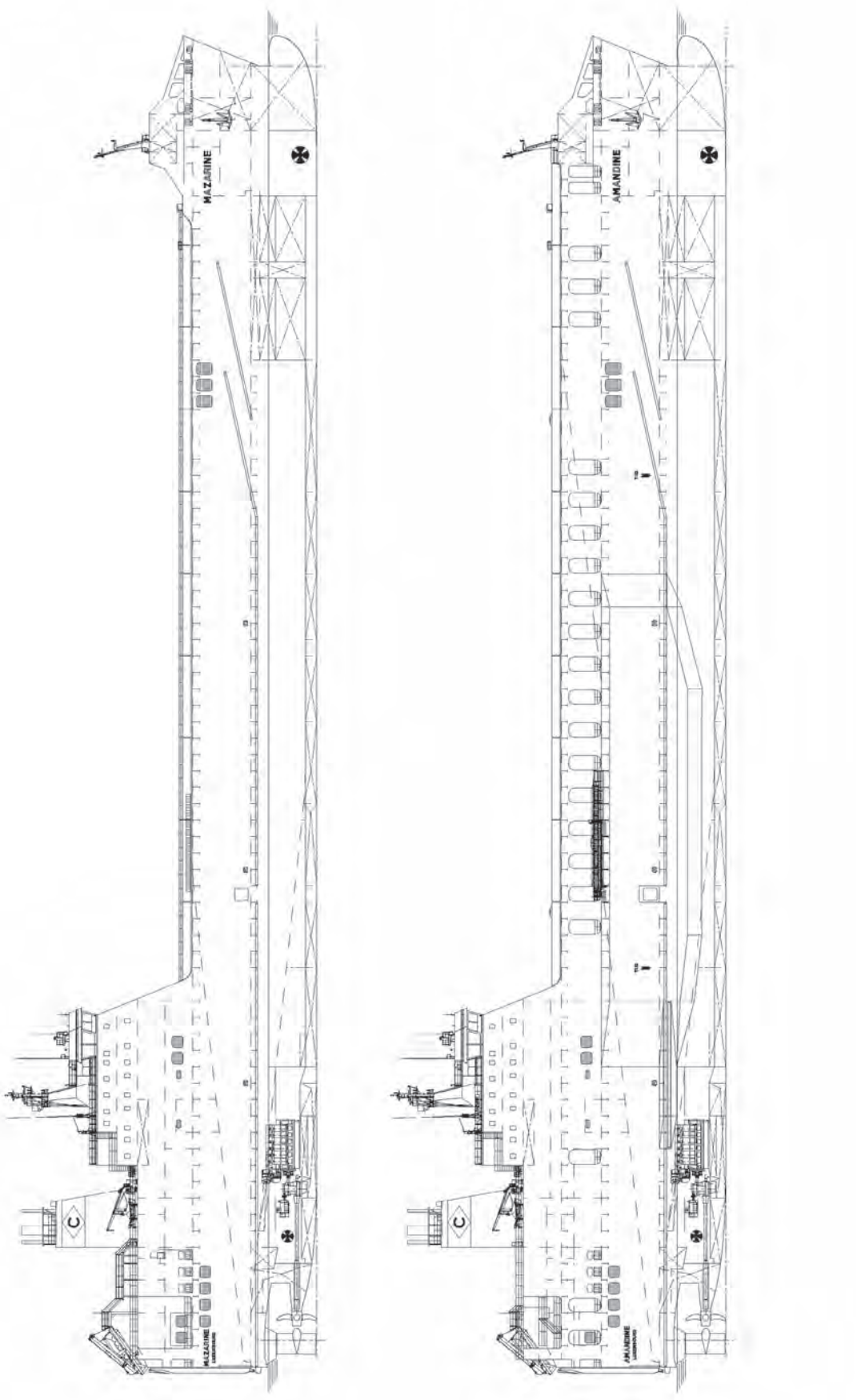
the main deck, between frames 162 and 209, where the narrowing cargo space precludes block stowage of cassette-type trailers. The total area is some 570m^2, and can accommodate 44-55 cars, depending on size. As there is 4.6m headroom below the car deck, sufficient height is available for trailer stowage.

The lightweight consequences of the extra deck structure and the hull sponsons are such that the maximum deadweight of the latest ships is 1150tonnes less than that of the preceding deliveries. The increased internal volume has hoisted gross tonnage by nearly 8400gt to 33,960gt.

Notwithstanding the design modifications and the hydrodynamic consequences of fitting sponsons, the four-deck ships have a speed which is only marginally less than that of the three-deck ro-ro's. In common with the preceding ConRo220 vessels, *Opaline* is powered by a 10,800kW MaK medium-speed, 12VM43 main engine produced in Germany by Caterpillar Motoren. The design service speed is 18knots, relative to the 18.5knots of the *Mazarine* quartet.

The Flensburg yard can offer other variants of the ConRo220 type, including a design with a more powerful engine of 12,000kW, for a 19knot service speed, and a Baltic trading version strengthened to 1A Swedish-Finnish ice class. This is closer to the specification adopted for two vessels under construction to the account of Finnish owner Bore. The pair of newbuilds, dubbed the Bore RoFlex class, is destined for long-term charter to British operator Mann Lines. *NA*

Cobelfret's two latest ConRo 220-class deliveries from Flensburg, *Opaline* and *Amandine* (lower drawing), incorporate a fourth ro-ro freight deck. The four preceding ships, led by the *Mazarine* (upper drawing), have three ro-ro decks.



RINA enters SOLAS 2009 debate

Experts at The Royal Institution of Naval Architects (RINA) have identified anomalies in the SOLAS 2009 regulation regarding the safety of ro-ro passenger ships and have approached the International Maritime Organization (IMO) with proposals that would literally plug any regulatory gaps.

Concerns over the safety of ro-ro passenger ships that are designed with long [or large] low holds (LLH) has been discussed at the IMO's Subcommittee on Stability and Load Lines and on Fishing Vessel Safety, thankfully abbreviated to the SLF Committee.

The concerns raised as far as the regulation goes are primarily two fold. In the first instance RINA has pointed out that SOLAS 2009 has failed to accurately define a rapid capsize.

"There are no definitions within SOLAS which explain capsize or rapid capsize or the criteria, in numerical terms, which the designers can use to determine when a rapid capsize situation exists. This is fundamental to the damage stability assessment and the survivability of passenger and cargo ships other than tankers," the RINA paper states.

RINA says that numerical criteria for the definition of capsize or rapid capsize must be defined so that regulations that can protect vessels with LLH's can be drawn up.

In addition RINA points out that "Regulation 8.3 of SOLAS 2009 contains requirements for the extent of side damage to passenger ships, but makes no reference to how Large Lower Holds are to be protected."

Regulation 9.9 does contain requirements for double bottoms in passenger, and cargo ships other than tankers, which include requirements for increased protection for ships with LLH's.

This is further clarified in the Explanatory Notes, regulation 9.9. It is noted that at SLF 52 the issue of smaller ships with fewer passengers as well as ships fitted with LLH and B/10 longitudinal bulkheads should be the main focus of the work and that the Sub-Committee should await the outcome of further research."

However, as the IMO waits for the outcome of research already begun by industry specialists "ships with LLH could be constructed in accordance with the current regulations, which could leave them at risk in the event that the longitudinal bulkhead to the LLH is penetrated, with subsequent flooding of the LLH," RINA concludes.

RINA's submission to the subcommittee following its appraisal of SOLAS 2009 included the view that ro-ro passenger and cargo ships with LLH's should be included, however, the SLF Subcommittee has a very narrow brief and is looking solely at damage stability for passenger vessels. As such the discussion on ro-ro cargo ships could not take place, even though the same inconsistencies exist in both vessel types, posing the same threat to both vessel types.

Effectively one of the reasons for disallowing the RINA paper to be debated was the mention of cargo ships in the paper which allowed some, unspecified, administrations to claim that the paper was beyond the remit of the SLF.

The reasoning behind the opposition of these administrations and who they are is unclear, though one SLF Committee insider did suggest that the SLF had a very narrow remit for good reason and that time was so limited that to broaden that remit would stall the whole process. *NA*

Action requested of the Sub-Committee

1 the inclusion in the regulations and the Explanatory Notes definitions for capsize and rapid capsize (if there are no definitions for such criteria then research will need to be considered) (paragraph 2);

2 the proposed amendments to regulation 9.9 contained in the annex which extend the level of double bottom protection provided in regulation 9.9 for passenger ships with LLH, to cargo ships other than tankers, with LLH (paragraph 3.1);

3 the proposed amendments to regulation 8 contained in the annex, relating to the inconsistencies between regulations 8 and 9 for the increased protection of long lower holds, from side damages (paragraphs 3.2 and 3.3);

4 the proposed amendments to regulation 8 contained in the annex, relating to the prevention of water on ro-ro decks which are above the damaged waterline (paragraph 4); and

5 the proposed amendments to regulation 8 contained in the annex, relating to the investigation of non-contributing damages to ro-ro decks and long lower holds and develop Explanatory Notes on the investigation process and the actions that are required (paragraph 5.1).

PROPOSED AMENDMENTS TO SOLAS, PART B-1, REGULATIONS 8 AND 9

Regulation 8 – *Special requirements concerning passenger and cargo ships stability 3.6* where long lower holds are provided in passenger ships or cargo ships other than tankers, the Administration may require an increased penetration of 0.2B, but not less than 3m, measured inboard from the ship side, at right angle to the centreline at the level of the deepest subdivision draught.

4 Spaces, that would be flooded, when the assumed extent of damage in paragraph 3 is applied, shall not render emergency power and lighting, internal communication, signals or other emergency devices inoperable in other parts of the ship.

5 Where passenger ships and ro-ro (cargo) ships are fitted with ro-ro decks or long lower cargo holds the particulars of non-contributing damages (s = 0 and p > 0.00), including full details of the calculated factors, should be examined to confirm that these will not initiate a rapid capsize.

6 Where the residual freeboard (fr) is less than 2m between the damaged ro-ro deck and the final waterline at the location of the damage, then the administration may require additional investigations to be carried out to demonstrate compliance with their own requirements or SOLAS/CONF.3 – Resolutions of the Conference of Contracting Governments to the International Convention for the Safety of Life at Sea, 1974 – (November 1995) – Resolution 14 – Regional agreements on specific stability requirements for ro-ro passenger ships – (Adopted on 29 November 1995) – Annex – Stability requirements pertaining to the agreement.

Regulation 9 – *Double bottoms in passenger ships and cargo ships other than tankers*

9 In case of large lower holds in passenger ships and cargo ships, other than tankers, the Administration may require an increased double bottom height of not more than B/10 or 3m, whichever is less, measured from the keel line. Alternatively, bottom damages may be calculated for these areas, in accordance with paragraph 8, but assuming an increased vertical extent.

Second vehicle carrier in line for Hawaii trade

David Tinsley reports on a new American built, but Croatian designed ro-ro ordered by Pasha Hawaii for Hawaian trade with the USA mainland.

A second pure car/truck carrier (PCTC) has been ordered for the Hawaii/California trade lane, giving a fillip to ro-ro vessel construction in the USA. Pasha Hawaii's contract with Singaporean-owned, US shipyard VT Halter Marine calls for a newbuild based on the 37,500gt *Jean Anne*, introduced to the Hawaii traffic in 2005. The proven design originates from the Uljanik yard in Croatia.

Pasha Hawaii anticipates delivery of the US$144 million new vessel during the second half of 2013. Its commissioning will enable the operator to implement a weekly sailing frequency, compared with the fortnightly service currently afforded by *Jean Anne*, the company's sole ship. Pasha Hawaii is a joint venture between automotive logistics specialist The Pasha Group, of California, and Hawaii Ship Management, of Connecticut.

Engineering teams from Uljanik Shipyard and VT Halter Marine are collaborating with Pasha to finalise the nascent vessel's technical specification, aimed at ensuring optimum long-term performance as regards both operating efficiency and environmental standards. Located in Pascagoula, Mississippi, the yard has also signed an option agreement covering a further newbuild, with some scope for variation, for a base price of about US$137 million.

Jean Anne is a product of the Pascagoula yard, having been originally contracted from the shipbuilder when it was Halter Marine, as part of the Friede Goldman Halter group. The vessel was finally completed after Halter Marine's purchase by VT Systems, a US subsidiary of the Singapore company ST Engineering, and following the negotiation of a new deal with Pasha.

Jean Anne was a milestone vessel for the industry, as the first PCTC turned out by a US shipyard. Now in her sixth year of service, and catering to multifarious types of ro-ro cargo through fortnightly calls at San Diego, Honolulu, Kahului and Hilo, it is the only ship of its type in the Hawaiian trade.

As the template for the newbuild project, *Jean Anne* embodies 10 cargo decks, three of which are hoistable and three of which are heavily strengthened, giving a total garage area of 387,000ft^2. Access is by way of a 100tonnes stern quarter ramp and 20tonne shell ramp, both on the starboard side. The single, 11,050kW two-stroke MAN main engine provides for a service speed of 20knots.

"Building a second ship has always been part of our organisation's plans," said Pasha Hawaii's chief executive officer George Pasha IV. "Our second vessel will both better serve the Hawaii/mainland market, and also provide increased frequency and superior reliability," he added. *NA*

Raising the standards of flooring

Due to more stringent rules coming into effect for flooring onboard vessels and for deck coverings GTF Freese has launched two new products on the market to keep up with safety requirements.

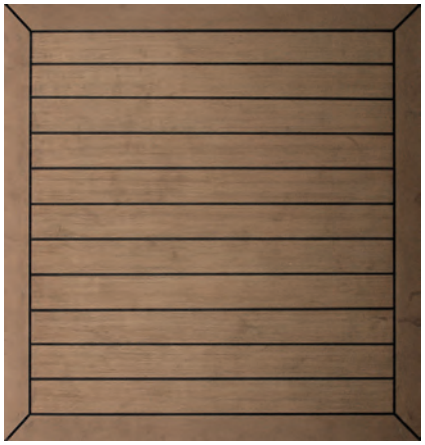
To prepare for the future demands of safety regulations GTF Freese has developed its latest resin floor systems for interior and exterior use. The focus of the development has been on floorings that use Polyurethane and epoxy resin that can be used not just in interior areas but also on balconies, which under the new regulations will also be classed as an interior area. Most of the latest products from GTF Freese also comes with International Maritime Organization (IMO) approval.

The products started development in 2009 and have been launched on to the market in 2010 and 2011. Wolfgang Moewes, export manager, GTF Freese commented on the developments: "In order to follow requirements of the market and in order to complete our range of products for the exterior decks. We already have products suitable for exterior decks on cruise vessels and ferries (Tefroka PU-E Comfort and Tefraoka PU-E Sport) for sundecks, jogging tracks and sport decks."

Tefroteak one of the latest offerings from GTF Freese is a polyurethane based final deck covering material which is applied in liquid form. After several steps the surface looks like a real teak-deck, claim GTF Freese. However, the company adds that the advantages of this type of deck covering compared to real teak is that it is water-tight, more flexible, lower thickness, reduced weight, lower in price, less maintenance, lower weight and faster application.

Adding to the range is Tefroka EP which is a resin based final flooring which can be applied in different ways. Tefroka EP Mortar, a combination of coloured quartzsand-mixture plus transparent epoxy resin. The flooring is available in different designs and can be applied with coved skirting made from the same material. Tefroka EP Coating is a liquid applied resin, which is available in different final surfaces, designs and colours. These flooring systems are water-tight, resistant to different chemicals, vast colour-ways and designs, joint-less, weight less than tiles, can be applied directly on to the deck, or on top of cement-based sub floors, different anti-slip properties and are easy to clean.

New deck coverings will help GTF Freese keep up with regulations that will be coming into effect.



Tefroteak one of the latest developments from GTF Freese.

Further to the developments made GTF Freese in interior flooring, it has launched a further three products for its deck covering range. The deck covering meet with the strict requirements made by the German navy and other countries that also observe the latest IMO resolution.

Mr Moewes comments: "During the past there were a lot of changes and new developments. Deck coverings have much influence in noise-reduction and resin floors offer various possibilities in design. Modern deck coverings help to reduce the weight due to lower densities and lower thickness applied than years ago. The chemical industry develops the new raw materials which allow us to improve products in respects of strength, weight, flexibility, etc. Furthermore, curing-times are reduced and application-method improved in order to follow the generally reduced building-time of the vessels.

In 2012 the fire test procedures (FTP) code will be updated and will mean further stringent test regulations for the industry. Mr Moewes commented about the changes that are starting to happen: "Generally all products used in interior areas have to be tested according to the FTP-code and IMO regulations. It is dependant upon the product and purpose according to low flame spread, toxic gases, non-combustability and/or A-class test procedures. For a few years now approved materials are also need on balconies – means that due to the new regulations balconies are not treated as exterior areas anymore and materials need to be tested too."

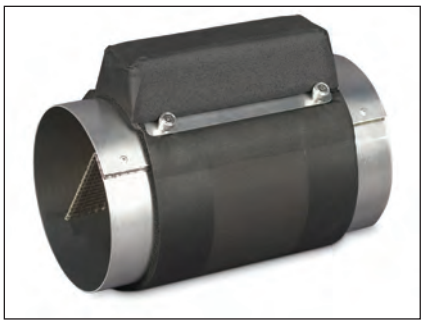
Mr Moewes points out that GTF Freese's main line business is still deck coverings and noise-reduction floors followed by fire-insulation floors. He also adds that with the changes and developments that GTF Freese is making to it products, will ensure that business will be secure in the future. *NA*

Keeping it fresh

UK-based HVAC specialists Dometic Marine has launched two products onto the market for air conditioning and engine start up.

Dometic Marine introduced its in-duct breathe easy air purifier that has been specifically designed to work within the ducting of a vessels air conditioning system. The system operates silently as it puifies and cleanses the air using photocatalytic nano-mesh technology with Ultra Violet (UV) light. Each time the air is circulated it is purified further.

The photocatalytic nano-mesh is constructed of metalised foam. This minutely intricate structure provides 2200% more surface area for holding the molecular catalytic coating than is possible with a simple screen structure. In addition, the titanium-dioxide catalyst is restructured at the molecular level to have an increased number of contact surfaces. This provides 70% more atoms on the catalytic surface for improved reactivity with contaminants.



Dometic Marine's latest solution for cleaner air onboard.

SmartStart give a smoother start for compressors and generators under pressure.

The system has been proven to reduce microbiological contaminants such as bacteria, fungi, and pollen by 90% to 100% and volatile organic compounds (VOCs) by 80% to 100%. VOCs emanate from materials such as carpeting, curtains, plywood and adhesives and are known to cause a variety of health problems.

Paul Hickinbotham, director of sales and marketing, Dometic Marine comments on the new system: "The system is popular especially in America, where they have similar products. However, what we are bringing to the market is a more cost effective solution."

The unit takes up little space and if retrofitted will require no alterations to the vessels exisiting air conditioning unit. The unit can be installed on smaller and larger vessels, with larger vessel you would need to combine more than one product because of this there is no limit to how many units are used, states Dometic Marine. There is no need for any mounting hardware as a section of the air-conditioning duct is cut out and the In-Duct Breathe Easy tube is then inserted, with the ducting reattached.

Dometic Marine has also launched it SmartStart which is design to control the inrush of a compressor. It is a single-phase compressor motor startup control that can reduce the start up current surge by up to 65%. By smoothing the air conditioning compressors startup power demand, the smartstart eases the strain on the vessels generator ensuring a longer life.

The system can save vessel owners money by reducing startup power surge, claims Dometic Marine. This system can be used on a marginally sized engine, where the existing generator can still be used, meaning that there is no need to get a larger generator.

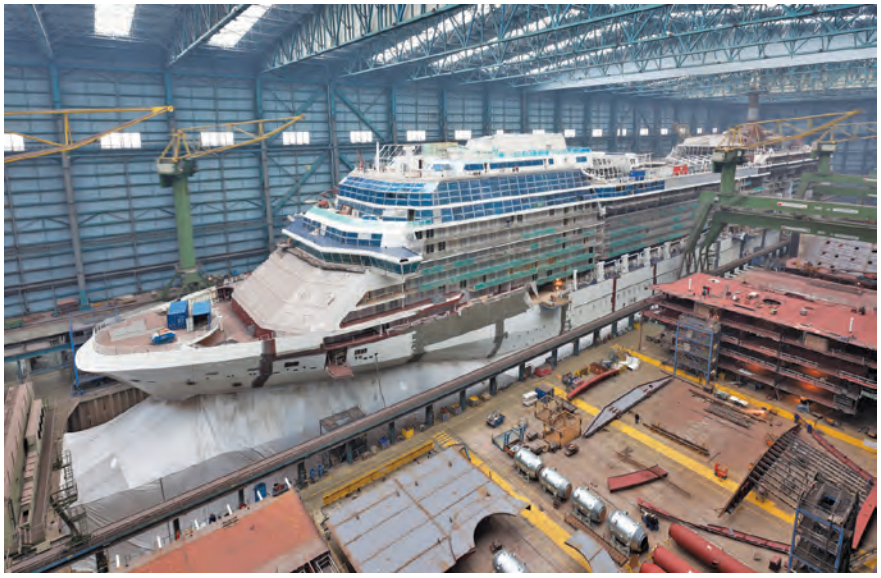
The SmartStart control is suitable for a range of applications in both the commercial and leisure industry. The system is compact measuring 12.7cm x 7.6cm x 5.1cm and weighs 0.43kg. It is also available in three voltage/frequency varieties which can be installed directly into the air conditioning systems electrical box. *NA*

From out of the shadows

The interior of the modern day cruise ships are as spectacular on the inside as on the outside. 2011 will see the delivery of *Celebrity Silhouette*, the next in the solstice class series of vessel from Meyer Werft.

The next generation of vessel to be launched from the German-based shipyard Meyer Werft will see the fourth of five vessels to be delivered to Celebrity Cruise lines, part of Royal Caribbean International, for its Solstice class. *Celebrity Silhouette* will have more services and experiences for the passenger than the previous three vessels that have been delivered to date.

Both Meyer Werft and Celebrity Cruises have hailed this vessel as significant delivery for 2011 with facilities onboard the cruise vessel pushing the boundaries of what can be done onboard. The latest features to be incorporated onboard *Celebrity Silhouette* are the Lawn Club Grill, the Porch, the Alcoves and the Hideaway. *Celebrity Silhouette* has taken advantage of the popular features on past (Solstice) cruise ships and developed them further allowing for new areas to be developed onboard, says Celebrity Cruise Line.



Celebrity Silhouette at Meyer Werft.

Keeping the grass alive, *Celebrity Silhouette* uses specialist technology for its Lawn Club area.

TECHNICAL PARTICULARS	
Celebrity Silhouette	
Length oa:	317.20m
Breadth moulded:	36.8m
Draught:	8.50m
Gross:	122,000gt
Speed:	24knots
Engine output:	67,200kW
Propulsion power:	41,000kW
Classification:	Det Norske Veritas ✠1A1 "Passenger Ship" ECO, RPS, F-M, COMF-V (1) Fuel, LCD-DC, BIS
Flag:	Malta
Number of passengers:	2870
Crew:	approx. 1271
Number of decks:	17
Number of theatre seats:	1095
Number of restaurants and cafes:	10
Number of shops:	16

Kelly Gonzalez, Associate vice-president, newbuildings, Celebrity Cruises commented: "We really understood the first three of the Solstice class ships and from this managed to achieve even more, taking the experience for the passenger to whole other level."

Further, Celebrity Cruises has adopted the use of the ipad onboard its

A new space onboard, the Lawn Club Grill.

vessels. *Eclipse* the first of the Solstice class vessels saw the first use of the ipad in its 'Qsine' restaurant, where it was used for the menus. The use of the ipad onboard has now been extended to some of its lounges onboard the further two vessels, with Celebrity Silhouette featuring the Hidaway 'treehouse-like' location where passengers can relax and with their ipads or a book. The vessel also features the ilounge, which made Celebrity Cruises the industry's first authorised Apple retailer; the ipads that are used onboard the vessels for its facilities are on rental from Apple.

Coming up with better ideas onboard these vessels is done by a "think tank" made up from marketing, hotel operations and newbuild staff within the company. Ms Gonzalez adds that by having this mixture of people allows for creative ideas come through and to be discussed and given a direction, then the final stage is to hand the idea over to the architects to implement into the design of the vessel.

Having many people working on one idea may produce many creative approaches, but this in itself can be a challenge, she highlights: "We have had a number of designers working on this project. The challenge has been how to marry all the idea's together, so that when onboard each area flows on from the other and that you don't jump from one style to another, keeping a clean transition."

The Porch offers passengers quick and simple breakfasts and lunches.

The most significant feature onboard *Celebrity Silhouette*, apart from the 2.5m real-life tree in the Grand Foyer, has been the grass area of the lawn club, which has also been acclaimed as an engineering marvel by Celebrity Cruises. To implement a real grass lawn on to the deck involved digging into the flow and geometry of the lawn itself, whilst caring for the lawn involves a watering and fertilising system. Ms Gonzalez commented about the system: "The grass is also able to capture rainwater, but due to stringent regulations about discharging overboard there is also a drainage system to clean the water. With this type of system onboard you have to be so much more careful as it is really a delicate piece of equipment."

Celebrity silhouette also features a range of artwork onboard. Half of the collection has come from the 'Mercury Art Collection' from another cruise vessel that is being decommissioned, with the other half sourced and commissioned especially for the vessel, featuring some significant names from the art world, such as Anish Kapoor, Damien Hurst and Gilbert & George. Mariangela Capuzzo, art consultant, International Corporate Art, commented: "The curatorial direction of the overall theme onboard the vessel has been based on the organic development of a Silhouette. This has been explored through the use of line, curve, shadow, and form through different media's."

The commissioned art work onboard the vessel is believed to cost around US$4 million, adding the Mercury Collection raises the price to "much more than that", said Ms Capuzzo.

The development of the interior space for the fifth solstice vessel, Celebrity Reflection, is already underway. Ms Gonzalez highlights that: "We are constantly thinking ahead. Where it takes off and lands we never know." *Celebrity Reflection* is expected to be delivered in late 2012. ***NA***

How does interior design affect the bottom line

With the financial downturn impacting the industry, vessel owners are looking for new ways to bring a turn around in business. Shelia Sparks from Lime Cut, Australia has highlighted that both vessels and owners could benefit from better interior design onboard passenger vessels.

The interior design of a vessel is not just about the arrangement of the seating and equipment onboard, but also involves the actual styling and the experience that the passenger gets whilst onboard the vessel, Ms Sparks highlights that this is where a design team can help. With correct design the vessel will not only look better, but will also enable the owner/operator to increase its business.

Ms Sparks highlighted what the bottom line means for the passenger ferry sector in her presentation at the Interferry conference in New York last year. "The whole idea was looking at the importance of using designers on ferries [interior design] as there has been little use in the past. It is also important to think of people as passengers, not cargo or the "hotel load" if you treat people that way how can you expect them to recommend your ferry", comments Ms Sparks.

Since then this principle has been redefined into the triple bottom line, Ms Sparks explains: "Leading business now think of the "triple bottom line" when running their businesses. They now balance environmental, social and economics to ensure a sustainable business. We as designers really focus on the social aspect, we think about the people and care about them so by taking time to listen to the users, owners, operators and staff we get a better understanding of what is required and get it right so everyone has a positive experience."

Ms Sparks also highlights that designers are an important factor in helping to improve the bottom line, as they will take onboard what has to be achieved and with this are able to deliver a better interior design that will change the way people feel by enhancing the look feel onboard the vessel. Working with naval architects and engineers, ensures we achieve a design that not only increases the vessel owner's profits, but will also help to meets with weight, speed and fuel efficiency requirements can be achieved. "We work on behalf of the owner and listen closely to their needs and desires. Having established a clear brief we then facilitate good communication between owners, naval architects and builders, ensuring a positive experience for all parties. Good communication leads to informed decisions and reduces the risk of poor or inappropriate design and saves valuable time and expenditure", said Ms Sparks.

Shelia Sparks from Limecut, Australia presenting at Interferry in 2010.

Ms Sparks highlights a case study from Air New Zealand as a company that was suffering in decline until they brought in a design team to help design the entire operation, from the passenger experience inside the aircraft to the terminal building and beyond. The design team "challenge" accepted wisdom and brought fresh and new ways of thinking. Air New Zealand is now the number 1 long haul leisure carrier in the world Also, part of the design process was to understand the type of passengers that were going to use the service. "There are five different types of passenger, if you only cater for one then you will lose 4/5 of your business", said Ms Sparks.

Currently, Ms Sparks is in discussion with two clients. She has highlighted that the Middle East has been the most responsive to taking a closer look at the design onboard its passenger vessels, which wants a younger and fresh design approach, showing the countries culture and identity. "The Middle East market is passionate about its interior design [on vessels]. The rest of the world needs to catch on to this", commented Ms Sparks. "There is a perception that engaging a designer is an uneccessay expense, this is not the case. We get the design right the first time so there is no rework and by creating good design we attract more customers and repeat business", she added.

Ms Spark hopes that with increased awareness for the need for good design on passenger vessels that there will be a rise in seeing vessel owners seeking the expertise of design companies to enhance the appearance and experience of their vessels. But, for now there is still the balance of the triple bottom line that still needs to met, along with increasing passenger numbers. *NA*

Dockwise meets market demand

With the ever expanding offshore oil and gas market, demand for larger equipment to be delivered across the oceans is rising. Dockwise has developed its Type-0 vessel design to meet the future needs of this market.

Dockwise has been studying the feasibility of investing for a new semi-submersible monohull vessel, bigger than its current largest vessel. The Type-0 will have a capacity of 100,000tonnes and a decksize of 275m x 70m with a total investment of US$200 million in to the project.

"The development of the Type-0 came from looking into the type of cargo that it is currently transporting and from this predicting what the client will want in the future. This also involved looking at the current capabilities of heavy-lift vessels on the market. From this Dockwise looked at developing a vessel that would give more flexibility and be capable of much larger cargoes. Bigger production platforms are coming on the market, which are getting even bigger", said Michel Seij, manager engineering, Dockwise.

Type-0 will meet the future demands of the offshore oil industry.

The adaptive design of Type-0.

TECHNICAL PARTICULARS

Type-0

Length oa:	275.00m
Length bp:	270.00m
Breadth moulded:	70.00m
Breadth max:	78.75m
Depth:	15.50m
Draft submerged:	31.50m
Summer draft:	11.00m
Engines:	2 x 8700kW 2 x 4350kW coupled to AC generator, diesel electric propulsion
Propellers:	2
Type:	Controllable pitch four blade, electro driven
Output:	6000kW each
Retractable azimuthing thrusters:	2
Output:	3000kW each
Bow thrusters:	1
Adaptations:	2 x streamlined semi-spade rudders
Aux. engines:	1 x 1200kW 2 x 655kW
Fuel:	Diesel
Ballast:	four main ballast pumps 5300m^3/hr

To achieve this capability of handling larger cargoes the vessel is wider and longer, and has a larger sailing draft. Another feature of the vessel is that it does not have a normal bow, but has been removed to enable it to carry longer cargoes, such as a long spar buoy and FPSO's. The vessel can also submerge 16m about the main deck. The vessel's strength and propulsion power has been specially developed for carrying out specific heavy-lift work.

"At the moment our largest vessel is capable of 72,000tonnes, but in reality probably only handles around 60,000tonnes, which is the *Blue Marlin*. The Type-0 will be able to handle up to 110,000tonnes", comments Mr Seij.

The vessel will be 275m in length overall and 270m in length between perpendiculars and moulded breadth of 70m. The vessel

will be powered by 2 x 8700kW, 2 x 4350kW, coupled to AC generator, diesel electric propulsion and have two controllable pitch propellers, two azimuthing thrusters and one bow thrusters.

The design and analysis of the Type-0 was carried out in conjunction with Finnish-based Deltamarin who did the feasibility study, concept studies, Finite Element Method (FEM) and basic design. Paivi Haikkola, marketing director, Deltamarin highlights the interesting points of the vessel: "The structural analysis of the vessel was interesting because of the type of the vessel that it is. This type of vessel has a lot of structural issues that need to be looked into, which we did with the FEM studies."

Ms Haikkola has highlighted that there is interest in this type of vessel in the market, which is driven by the oil industry. If the oil companies continue to search for oil in deeper waters then there will be a need for more of this type of vessel in the market. She adds that Dockwise came to Deltamarin with a very clear understanding of its business wants and needs, which made the project easier to carry out for Deltamarin.

The vessel is under construction at Hyundai Heavy Industries (HHI), Korea and will be delivered in Q4 2012. C.J. Kang, executive vice president and COO, Hyundai Heavy Industries, said: "As EPIC contractor for offshore projects, we agree strongly with Dockwise that there is a rapidly emerging need for a vessel of this capacity, given the scale growth of offshore projects. The benefits for our ultimate clients of dry transports of integrated structures and of large FPSOs are clearly apparent to yards and offshore services firms focused on the future evolution of our markets."

The vessel once delivered is expected to service Australia in its offshore developments; the vessel will be able to transport its cargo to the main producing oil areas in the world without the need for full assembly at the location.

At the moment the Type-0 is a one off vessel, with no others expected at current. However, Mr Seij believes that we will see more of this type of vessel in a couple of years once the predicted super large cargoes start to come through. *NA*

Beluga gets another P-1 delivered

German heavy-lift vessel operator Beluga has received its second P-1 series heavy-lift vessel *Beluga Cape Town*. The vessel was delivered earlier this year. The vessel will operate on a world wide service.

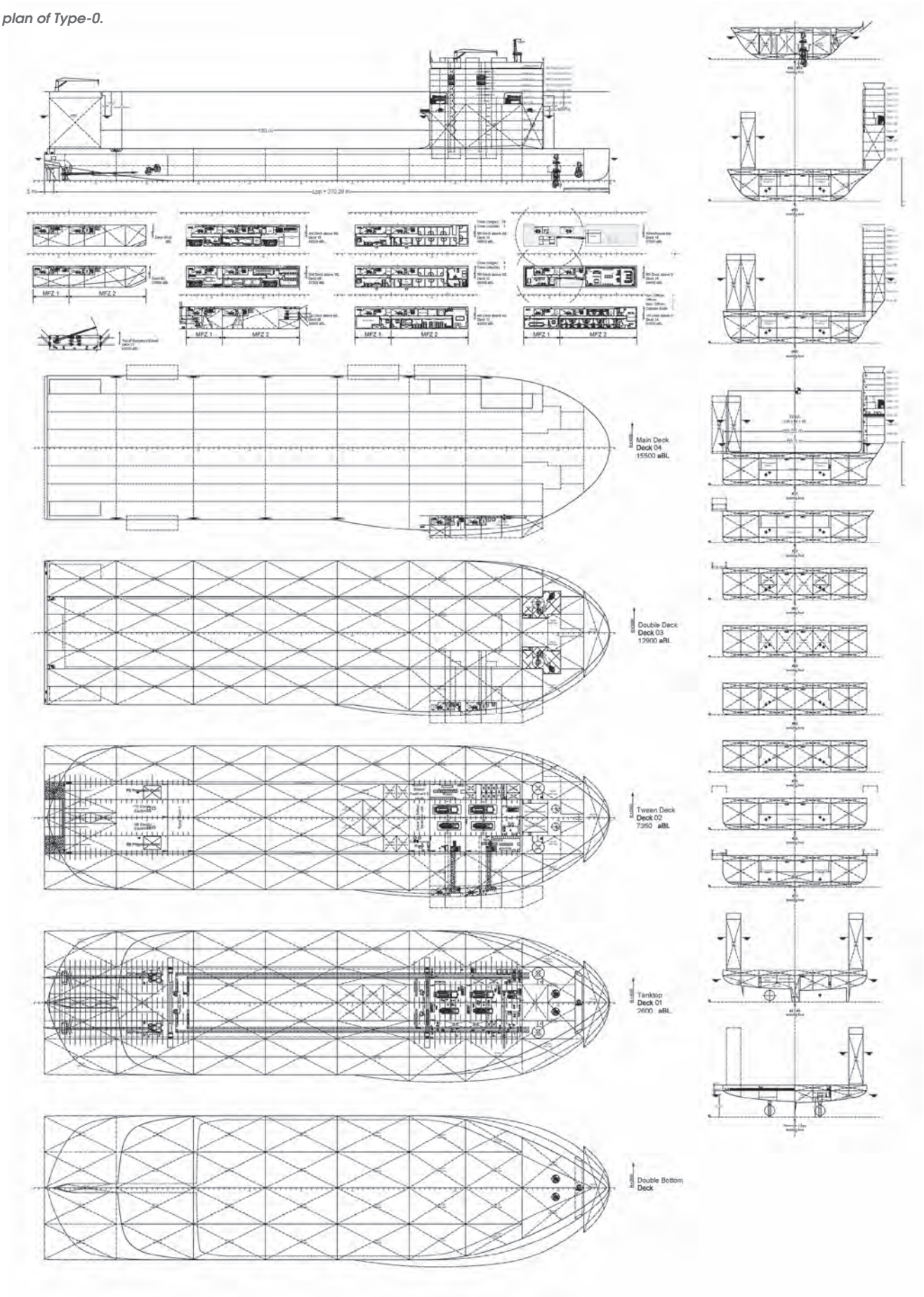
***Beluga Cape Town* had its maiden voyage at the beginning of the year, where it transported oil and gas equipment from Mokpo, Mexico and Pyeong Taek, Korea to Skikda in Algeria.**

The Beluga P-class is the next generation of a series of heavy-lift project carriers. The onboard cranes provide combined lifting capacities of up to 800tonnes, some of the sister vessels will have capacities of up to 1400tonnes. The ship designers have created an especially efficient hull form which reduces the flow resistance to the level of much smaller ships. *Beluga Cape Town's* loading capacity amounts to 20,000dwt with box-shaped holds opening more than 86m. The vessel also features adjustable tweendecks and a strengthened hull to pass through polar regions.

Beluga Shipping saw the first delivery of the P series Beluga Houston that was delivered at the end of the 2009. The P series is split in to two types the P-1 and P-2 type, the main difference between the two designations are crane load and capacities. The P series project has a total of 16 heavy-lift vessels, which have been scheduled for delivery between 2009 and 2011.

Beluga Houston was the first vessel in the P-series to be launched at the end of 2009.

GA plan of Type-0.



Svenja is joined by second Type 183

German-based shipping company SAL shipping has received the second of its Type 183 heavy-lift vessels *Lone*.

SAL commissioned JJ Sietas back in 2009 for the construction of two heavy-lift vessels of a new generation, the Type 183. The two vessels *Svenja* and *Lone* were constructed at the Hamburg Neunenfelde shipyard. The delivery of *Svenja* took place in December last year and saw the largest heavy-lift vessel delivered to the SAL fleet. The latest delivery of *Lone* now sees the second vessel of that order now delivered.

The two vessels are the largest in the fleet to date, boasting a capacity of 2000tonnes and a speed of up to 20knots. The order of the vessels was worth €120 million. According to

Lone joins its sister in March.

First of the Type 183's to be delivered, *Svenja*.

Lars Rolner, managing director, SAL, at the time of the order: "The global economic crisis has also had an effect on the heavy-lift sector. However, we are already seeing signs that the market will recover in 2011. We have already received enquiries for expansive orders from the wind-energy sector, as well as from the oil and gas industries. To make sure that we are properly equipped, we are investing in two innovative heavy-lift vessels, with which we can consolidate our leading position in the world market."

"Together [JJ Sietas and SAL] we have developed a type of ship that is based on market demands, one that has been planned and developed with a good deal of innovation. The result is a new generation of heavy-lift ships. The Sietas yard and the Neuenfelder Maschinenfabrik are synonymous with innovative design and quality components. Moreover, the fact that we can order the ship and the cranes from the same company was a decisive factor for our commission. That is one of the primary reasons why we chose the Sietas yard. Now we are looking forward to receiving two top quality ships, which are being built by one of Germany's leading shipyards. Furthermore, we are happy to honour and support the Sietas group's new corporate concept", he added.

Lone has come into service three months after its sister vessel *Svenja* was delivered and like its sister was constructed in six months. The only difference between the two vessels is that *Svenja* has dynamic positioning (DP)1 and *Lone* has DP2. Both vessels are fitted with Neuenfelder Maschinenfabrik (NMF) cranes that have an outreach of 38m. The vessels also feature an open top, allowing the vessels to transport exceptionally large cargoes with the hatches open. The vessels are 138m in length overall and 27.5m in length overall and has a loading capacity of 11,000tonnes and 40,000m^3. The vessels are fitted with diesel engines which have an output of 12,600kW giving the vessels a speed of 20knots. Lone also has an environmental passport, meaning the vessel meets with the highest environmental standards. ***NA***

TECHNICAL PARTICULARS

Lone

Length oa:	160.50m
Breadth:	27.50m
Deadweight:	12,500dwt
Tonnage:	15,000gt
Deck:	128.50 x 27.50m
Hold:	107.10 x 17.00 x 13.70m
Hold Capacity:	11,850m^3 Capable of trading with open hatch 3-fold adjustable tweendeck
Cranes:	2 x 1000tonnes SWL combinable up to 2000tonnes SWL
Crane outreach (Crane I & II):	16 m – 1000tonnes 25 m – 800tonnes 38 m – 500tonnes
Main Engine:	MAN 9L 58/64 Diesel Engine of 12,600 kW
Thrusters:	Fitted with two bowthrusters of 1200kW eac Fitted with one sternthruster of 800k Fitted with two retractable azimuth thrusters of 1200kW each
Rudder:	High efficiency rudder
Service Speed:	20.0 knots
Classification:	GL+100 A5, General Cargo Ship, BWM, Heavy Lift Ship, Environmental Passport, Equipped for carriage of containers, Strengthened for Heavy Cargo, SOLAS II-2, Reg. 19, MC AUT, DP-2

Oil Discharge Monitoring System

Could the "white-box" be the answer to help ships stay clean and out of trouble?

The "White-Box" might sound like a knight in shining armour charging in to the rescue, and I know most captains would wish for just that. With numerous examples of magic pipes, bypass valves and the resultant fines for accidentally or purposely pumping bilge water exceeding 15ppm (parts per million) into the sea, vessel masters are ever fearful of having little control over pollution violations but all the responsibility. Even the new amendments to the Oil Record Book which entered into force on 1 January 2011 to better clarify the movements of oil residues, still requires the master's signature at the bottom of each page not the chief engineer's.

With lesser accountability, rogue engineers still persist in the illegal dumping of oily water with in excess of 15ppm despite MARPOL Annex 1. In the past, these pollution violations only ever came to light during flag/state inspections. Now, with the increased numbers of spotter planes utilised by countries such as France and the USA, as well as the large payouts given as incentives to whistle blowers - the WikiLeaks of the ships engine-room world, masters are finding themselves being held personally accountable and on the receiving end of lengthy jail sentences.

Enter Marinfloc's White-Box System. Like all oil discharge monitoring systems, it essentially consists of four elements, An oil content meter, A flow meter, a computing unit and an overboard valve control system, thus ticking all the boxes of Resolution MEPC.107 (49), which requires vessels to provide, "fail-safe arrangements to avoid any discharge in case of malfunction."

The system is designed to only allow, the discharge of bilge water with an oil content of less than 15ppm. The oily water separator pump feeds the bilge water through the White-Box system. An adequate flow of this sample water is continuously fed by the flow control device to the oil content meter. An optical sensor within this unit measures light scattered and absorbed by oil droplets in the sample water.

The sensor signals are then processed by a microprocessor, if the oil in the bilge water is less than 15ppm, a signal is sent to a 3-way valve and this valve will allow the discharge overboard only if other criteria are met. Namely, there is sufficient flow through the flow-switch, the solenoid rinse water valve to flush the meter with fresh water for cleaning purposes is not activated by the push button, and the recorder is on. Conversely, if the content of the oil is greater than 15ppm or any of the above conditions are not met, the 3-way valve switches to the 'return' position, returning the water to the bilge water tank.

The components of the White-box are housed in a steel cage with physical padlocks, as an added deterrent visible tamper-proof tape seals critical accesses. The system is calibrated according to the International Maritime Organization regulations by the manufacturer, and its operation is digitally recorded to a PCMCIA memory card. This information includes, if there is a flow through the oil content meter, the oil content itself, the position of the 3-way valve and the volume pumped overboard in litres. The ability to record the GPS position is also available. A screen display that can be remotely mounted in the engine control room gives a graphic indication to the engineer on watch the same information.

Like the mythical unbreakable safe however, no equipment can truly be 100% tamper proof or infallible. Three-way valves by the nature of their construction can malfunction. OCM's especially the older models that require daily cleaning can give erroneous readings and finally the flow switch that utilises a sight glass has an adjustment screw that can be tampered with.

The latest White-box systems have rectified some of these potential hotspots. The flow switch which monitors the processed bilge water samples is now digital, with no moving components or sight glass making it essentially maintenance free and tamper resistant. The oil content meter requires weekly intervals for cleaning and a memory card within the unit stores information up to 18 months.

Cruise lines that in the past were on probation by the US Department of Justice use the White-Box as an addition - a security blanket if you like. The system acts as an added barrier for anyone thinking of committing pollution violations, and as a redundancy in case of a malfunction with the bilge alarm system. Restricting access to the White-Box by the use of padlocks and keys to senior engineers further narrows the loop. Unless there is a determined collaboration between the ships engineers and electricians, the White-box in my opinion is a worthy champion for captains. *NA*

Nuclear Confission

Sir,

It is good to see that January's Editorial Comment has triggered a debate on Nuclear Power for Commercial Ships as a means of reducing shipping's contribution to global carbon emissions.

Firstly I would like to clarify a point in Vaughan Pomery's objection to that Editorial - he consistently refers "nuclear fusion". Currently there are no viable nuclear fusion power systems ashore or at sea. The technology has been "forty years" away for the past fifty years and continues to be so. However, once achieved it has the potential to address most of the green lobby's objections to current nuclear fission plants. It is this technology that I assume is under discussion.

Nuclear fission technology plants are used successfully but very selectively in the marine sector where the capability advantage is fundamental to the vessel's concept of operations and thus offsets the appreciable costs of ownership through life. In addition there are all the "soft" issues attached to nuclear that the Editorial correctly refers to. The totality of this equation led the UK MoD to opt for a non-nuclear propulsion solution to its requirement for the Queen Elizabeth Aircraft Carrier even though the Royal Navy clearly has in place much of the investment in design required to design, build, operate and de-commission a nuclear powered design. In this instance the risks would have been under-written by the UK Government and been implicit whereas the owner of a truly commercial vessel would need to obtain insurance cover from the market and such costs would be explicit.

Land based plants have gone down a different development path from the Marine nuclear power systems. The trend is to increase plant (or site) capacity from the current 0.5-2GW to 10+GW. This provides

> "The technology has been "forty years" away for the past fifty years and continues to be so"

the benefits of scale without a proportional increase in regulatory and other fixed costs. This trend is constrained for commercial shipping.

Low power land-based plants may be a more attractive starting point for commercial ships than either future land-based plants or the current specialised marine plants but the additional technical challenges and non-recurring costs of "Marinising" plants need to be fully understood.

In the meantime we should note the advances in more conventional approaches to the challenge. Maersk and others are showing the way in significantly reducing Shipping's carbon emissions in rather more prosaic ways. With the right research & technology investment there is a lot more that will be achieved through innovation in Naval Architecture and Marine Engineering. In addition the Marine sector is able to tailor a lot of innovation from other transport sectors – not just in terms of Design but also new Fuels (including synthetic from renewable energy sources), Operations, Regulation and new Business Models.

Over the next forty years I am sure that large capacity land-based nuclear fission power will form a key part of global carbon emissions reduction. Commercial shipping will make a proportionate saving to carbon emissions – whether or not this includes a nuclear power component is a complex subject which highlights the need to harness those with experience of both Nuclear and Marine matters so as to get the full picture. Nuclear fusion will still be just over the horizon.

Professor Paul Wrobel (Fellow)
University College London
Chair of the "Low Carbon Shipping" consortium

Treasure Ships

Sir

I note with interest the letter by Colin Mudie printed in the February 2011 issue of *The Naval Architect* concerning watertight bulkheads in ship construction in Ming Dynasty China. I would draw his attention to the paper by Prof. Xi and myself published in the 2004 Transaction (Vol 146 Part A2, page 59) reviewing the construction of the "Treasure Ships" of that period and the exploits of Zheng He. There is also some correspondence in The Mariner's Mirror of 2004/5 in which doubt was cast on the possibility of such huge vessels being constructed in wood, and where I demonstrated that large hull structures were indeed technically possible, though of course it does not follow that they existed in reality. Following from that debate I made a proposal to Southampton University, in association with the Society for Nautical Archaeology, to support a post-graduate project to "reverse engineer" what we believe the hull structure might have been using modern analysis techniques to establish what the likely scantlings could have been and where the critical parts of the structures were. Unfortunately no student was forthcoming who had the time or commitment to undertake the task so it remains on the table.

> "doubt was cast on the possibility of such huge vessels being constructed in wood"

Dr David Chalmers (Fellow)

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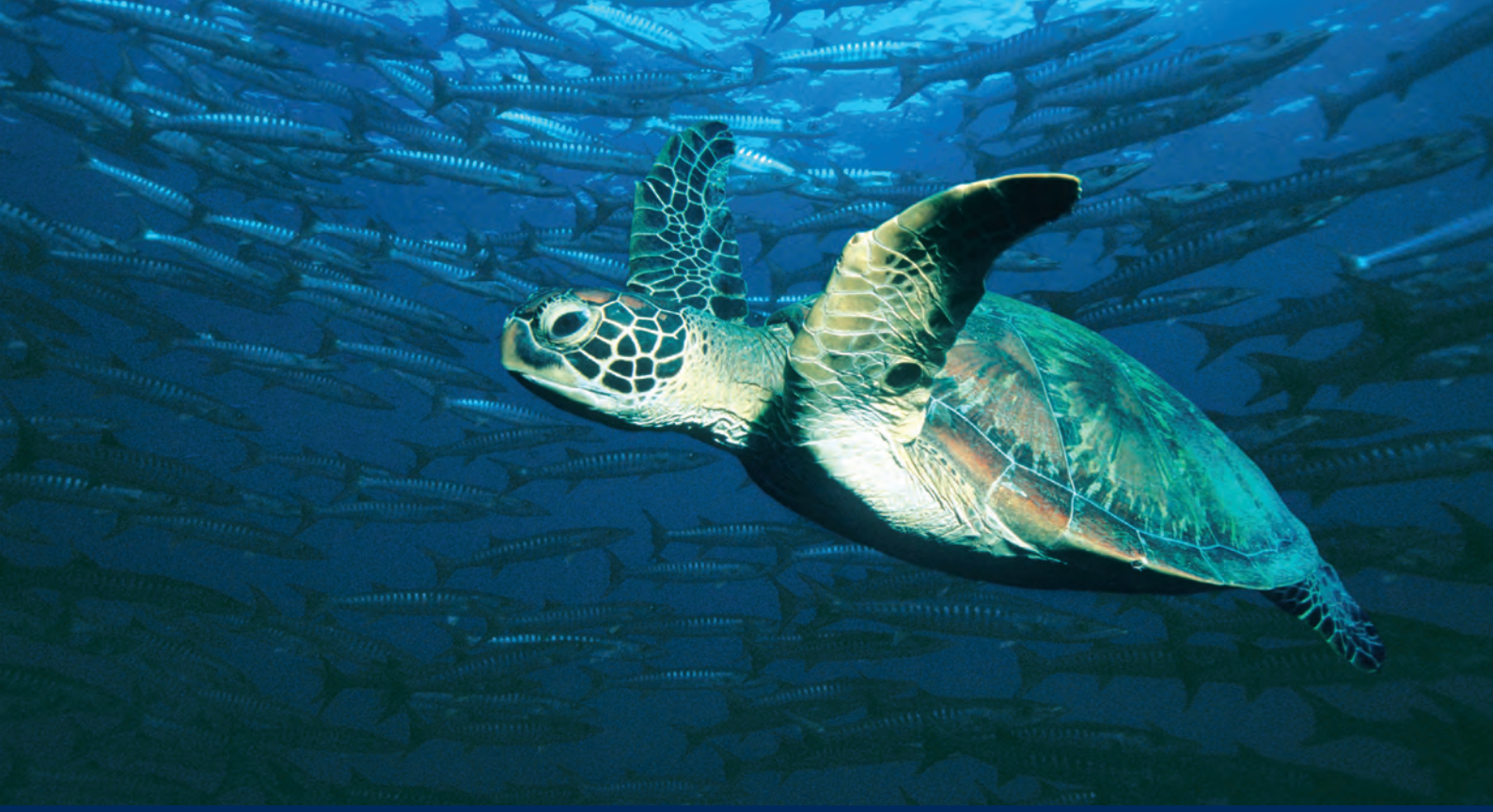

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Contact Mast Event Ltd, 58 Maidstone Road, Pembury, Kent, TN2 4DE, UK.
Tel +44 1892 824418
Fax +44 1892 824455
www.mastconfex.com

June 29-30, 2011
Warship 2011, international conference, Bath, UK.
Contact Conference Department, RINA, 10 Upper Belgrave Street, London, SW1X 8BQ, UK.
Tel +44 20 7235 4622
Fax +44 20 7245 6959
E-mail conference@rina.org.uk

June 29 – July 3, 2011
IMDS, international conference, St. Petersburg, Russia.
Contact Rosoboronexport State Corporation Morskoy Salon JSC, 80, Marata st.., St.Petersburg, 191119, Russia.
Tel +7 812 764 66 33
Fax +7 812 764 56 47
E-mail info@navalshow.ru
www.navalshow.ru

September 6-8, 2011
Offshore Europe, international conference, Aberdeen, Scotland.
Contact Gateway House, 28 The Quadrant, Richmond, Surrey, TW9 1DN, UK.
Tel +44 208 439 8890
Fax +44 20 8439 8897
www.offshore-europe.co.uk

September 13-16, 2011
DSEI, international conference, London, UK.
Contact Exhibit Reservations, Clarion Events Ltd, Earls Court Exhibition Centre, Warwick Road, London, SW5 9TA, UK.
Tel +44 20 7370 8551
E-mail anna@dsei.co.uk
www.dsei.co.uk

The Royal Institution of Naval Architects

WARSHIP 2011: NAVAL SUBMARINES and UUVs

29 - 30 June 2011, Bath, UK.

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- External installation of weapon delivery systems, towed sensors and communications systems.
- Submarine power, propulsion systems and signature management.
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- The environmental impact of submarines.

www.rina.org.uk/warship2011

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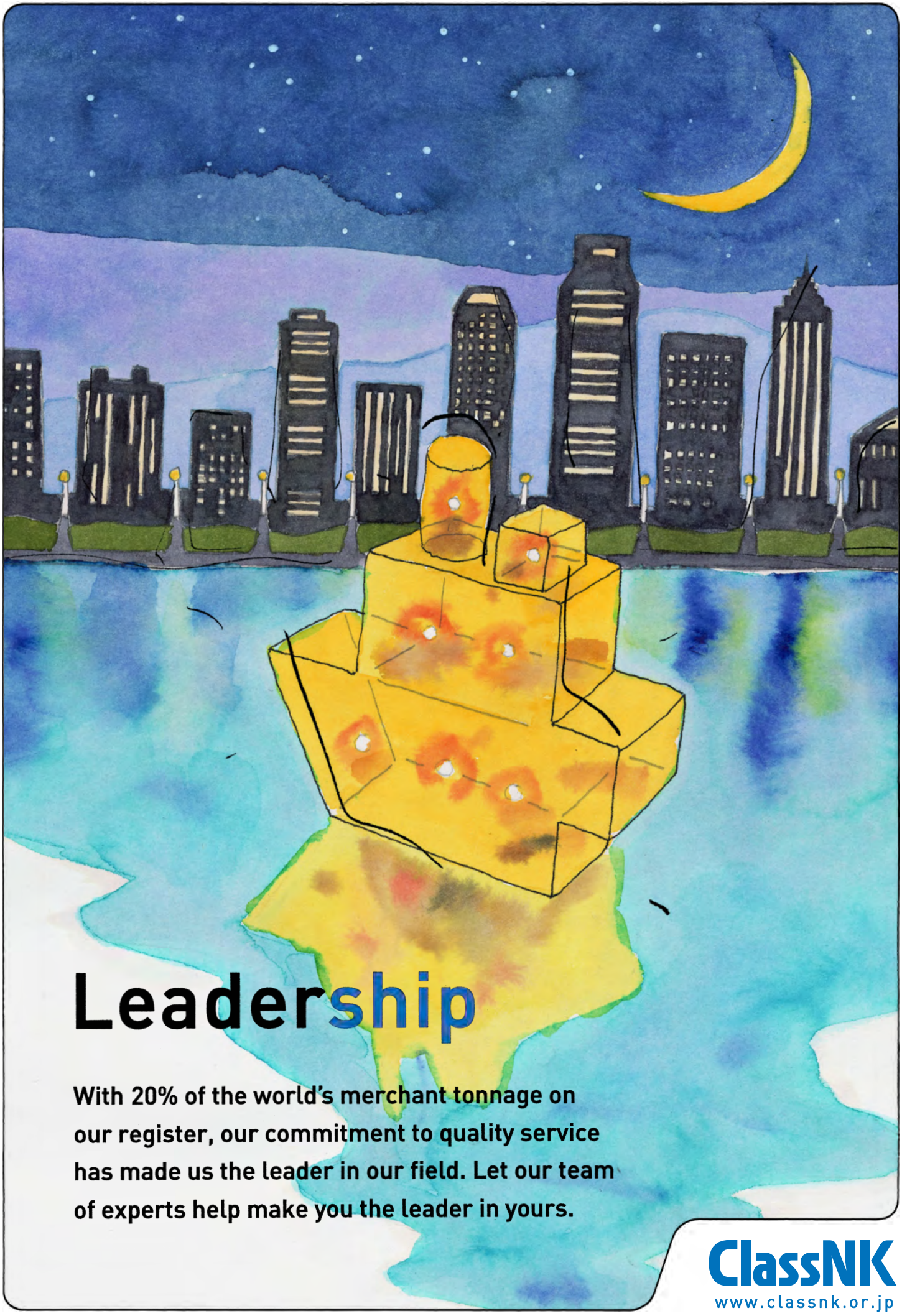
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