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Published by:  
 The Royal Institution of Naval Architects  
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 8-9 Northumberland Street  
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**E-mail subscriptions** subscriptions@rina.org.uk

Printed in Wales by Stephens & George Magazines.

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A 2015 subscription to *The Naval Architect* costs:

	12 Months	24 Months	36 Months
Inland	£177	£307	£444
Europe	£185	£324	£462
Overseas	£198	£347	£498

Average Net Circulation 10,933  
 1 January to December 2013  
 ISSN 0306 0209



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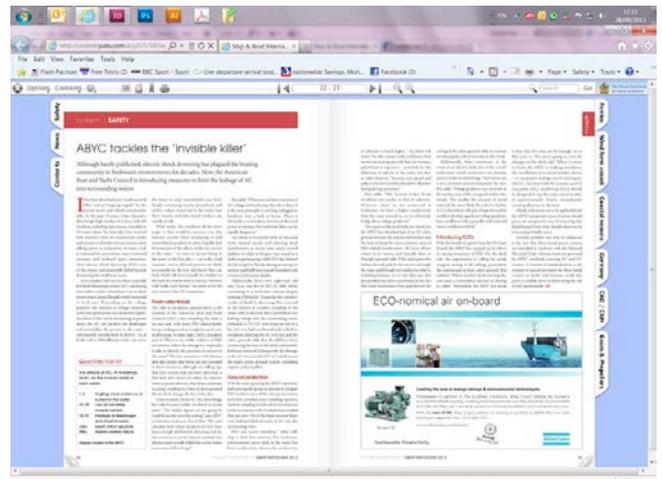
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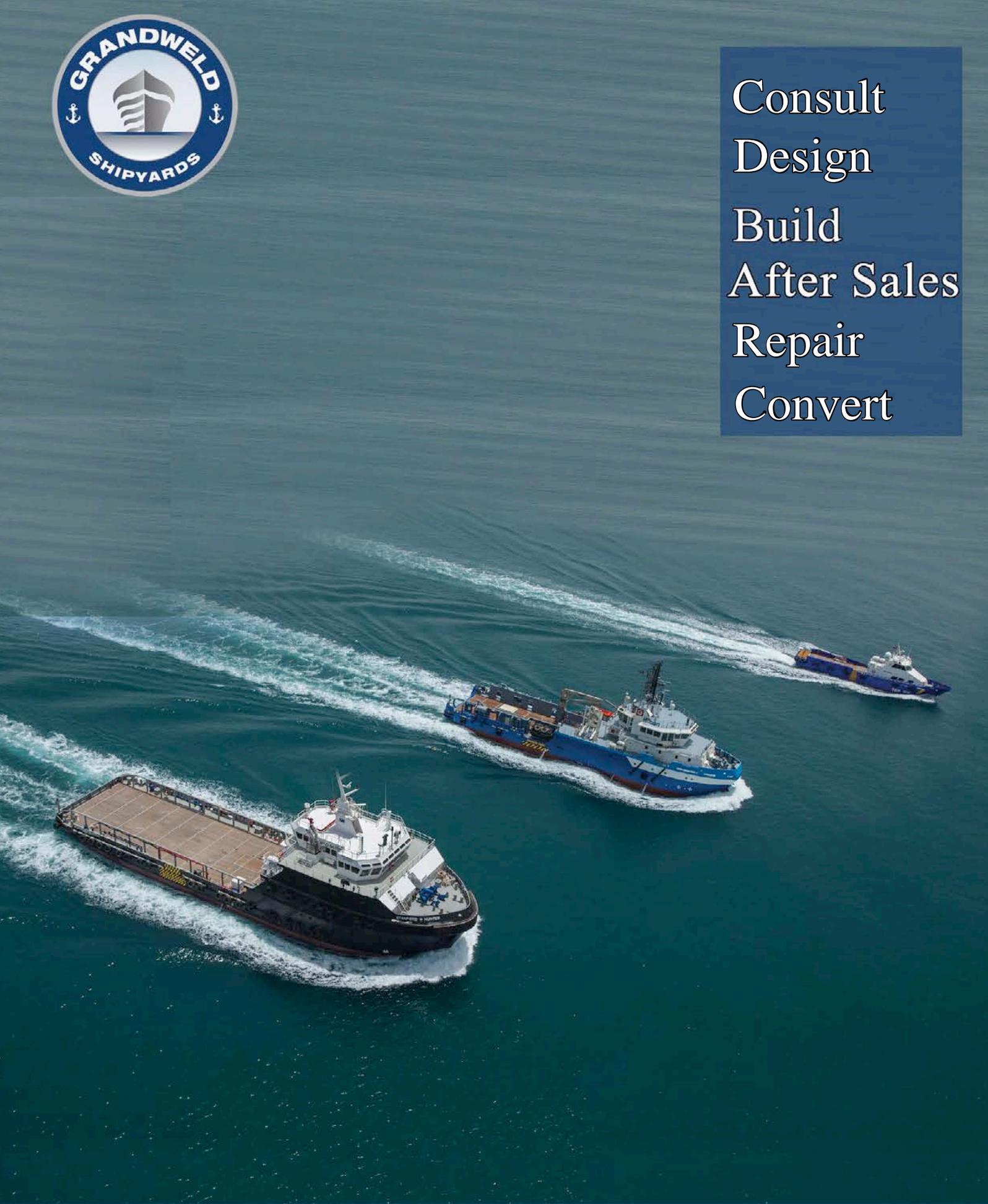
The Naval Architect is published in print and digital editions. The current and archived digital editions (from January 2004) may be read on PC, iPad or other touchpad.

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## The undermining of shipping's ECA system

Meeting with the SOx cap for ECA zones that comes into effect next year will put shipowners into a financial quandary over the abatement technology required

As the sulphur cap is about to become a reality this January it has become apparent that a number of owners who operate within the emission control areas (ECA) have taken note and a proliferation of new developments have emerged.

On the one hand some owners have opted for the most capital intensive option, building a new vessel with dual fuel capability, notably the ability to burn LNG, which does not emit NOx, SOx or particulates in any significant measure, while also reducing the carbon footprint. Nordic Hamburg, for example, has ordered LNG-powered feeder container ships.

Others have fitted scrubbers to clean the exhaust of SOx emissions, a far smaller capital outlay than the first option, which allows the operator to continue to burn the comparatively cheap HFO, compared to distillate fuel that is.

The third option is to burn distillate, which carries no capital cost concerns, but does currently retail at around US\$900/tonne. This is likely to be the preferred option in the immediate future.

According to the Trident Alliance, a group of shipowners that have banded together to make certain that regulatory authorities enforce the rules that they have imposed on the industry, thereby creating a fair environment for competition, the costs for ship operators will increase substantially, from 50% of the total operating costs to about 75%. Hence the owners' concerns that the rules are creating the sort of conditions that encourage non-compliance.

The fear is that some owners will not have the capacity to make major capital

investments that will allow them to carry on operating in the European and US ECA zones. Nor will they be able to afford the significant extra costs involved in operating on distillate fuel. In such cases some unscrupulous owners may decide that it is beneficial for their companies to simply fail to comply.

Should a significant number of owners reach this conclusion the entire ECA system could unravel.

Non-compliance will mean that some owners will have far lower costs compared to their competitors and will, therefore, be able to undercut prices set by ECA-compliant operators, thereby skewing the competition.

If this sounds far-fetched, then consider that a 2012 EU report agreed that only around one in every thousand vessels were tested for ECA compliance in the year before the report and that those found to be non-compliant were on occasions only fined paltry amounts of money, in the hundreds of dollars.

Consider also that some industry insiders claim that already owners are offering two different types of contract, one in compliance with IMO regulations and one that does not comply with the rules. If this turns out to be the case then the undermining of the IMO rules may already have begun.

There is a belief that the vast majority of shipowners and operators will want to remain in compliance, not least because some charterers, such as the oil majors, require compliance in the contracts that they exchange. In addition non-compliance could affect the validity of the insurance an owner has to cover his vessel and its operations.

It is then unlikely that the high end players in the shipping market would risk

non-compliance, but the budget players may be tempted as the costs of compliance soar, particularly if the returns on the shipping of goods remain slim.

An owner faced with competition from companies far larger and able to absorb cost increases may be more readily tempted to cut his costs by some US\$400-500/tonne in an effort to pick up a charter at a reduced rate. An owner could calculate that the savings on a comparatively small vessel that uses around 20 tonnes of fuel a day could be as much as US\$10,000/day.

Temptation of this magnitude could easily induce the kind of behaviour that would undermine the rules that will underpin the shipping industry in the future. Enforcement of the rules, however, may not be so simple with few reliable methods of measuring emissions from ships and the added complication in Europe of having many jurisdictions with differing commitments to enforcing the rules.

The EU recognises that in European waters it is the member states that decide the level of any penalties imposed and the level of commitment, in the form of resources to enforcing the regulation. Shipowners that are currently operating in the EU ECA zones have expressed a doubt that the EU member states have the kind of commitment to the sulphur regulations that is required to make them work in the current ECA zones. They believe that any extension of the sulphur cap, particularly an attempt to make the cap global, will be unenforceable under the current circumstances.

Such a failure could well threaten the entire ECA system. *NA*

MOL Comfort

## Comfort case court mulls class rules

Tokyo's District Court sat again in September to hear deliberations in the case between Mitsui OSK Lines (MOL) and Mitsubishi Heavy Industries (MHI) following the loss of the 8,000TEU *MOL Comfort* last year.

The Japanese operator is seeking damages of more than half a billion dollars following the loss of the vessel and the subsequent cargo claims. MOL believes that the ship had a design fault that contributed to the loss. However, MHI contends that the vessel was being operated beyond its design limitations.

In the latest hearing on 19 September the court has sought to clarify class rules regarding the global strength of the vessel and to clarify the Product Liability Act, which the carrier has invoked.

MHI's believes: "That the unilateral shifting of liabilities onto the shipbuilder by applying the PL Act [Product Liability Act] fails to be suitable for the established maritime framework/regime, which has been cooperatively developed by the class, shipbuilding, shipping and insurance industries, based on the common understanding that any ship may be at risk under the extreme loading conditions beyond the expectations of the class rules."

ClassNK's report on the accident, which is due to be published as *The Naval Architect* goes to press, has reportedly concluded that there are wide variations on the assumed loads acting on the vessel and the assumed strength in what is said to be a complex report that has again failed to conclude what the actual cause of the accident was, as was the case with the Interim Report published in English earlier this year by the Committee for Large Container Ship Safety (CLCSS).

The Ministry of Land, Infrastructure, Transport and Tourism led investigation into the accident, which produced the inconclusive Interim Report, is continuing

its investigation with monitoring of the MOL vessel's sister-ships to measure the loads on the structure of these ships under operational conditions. It is not due to report the results of this monitoring until next year.

Rules guiding the global strength of container ships, agreed by the International Association of Classification Societies (IACS), are expected to be updated by the end of this year and ClassNK's report on the *MOL Comfort* accident will inform the new guidelines issued by IACS.

Newbuildings

## Shale gas leads to ethane orders spin-off

The evolution of the shale gas industry in the US has led to an abundance of ethane which is a derivative of natural gas. There are expectations that much of this ethane will be shipped to Europe and the ships are now being ordered to meet that expected demand.

### TECHNICAL PARTICULARS

#### *ECO Star VLEC*

Length, overall: abt.....	231.60m
Length, bet. Perp.....	225.50m
Breadth max:.....	36.60m
Deadweight max. approx.....	50,000mt
Scantling draught:.....	12.30m

Sinopacific in China has profited from the development of US shale gas with a spate of new orders for ethane carriers. As well as the three 36,000m<sup>3</sup> vessels ordered by the Norwegian company Ocean Yield, due for delivery in 2016 the yard has secured orders for five ECO Star very large ethane carriers (VLEC) of 85,000m<sup>3</sup>.

The *ECO Star 85k* very large ethane carriers will be powered MAN quadruple fuel engines



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**VOS system provides**

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Venturi Injector



SGG(Stripping Gas Generator)

## **No use**

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## **No need**

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- Malta
- AMS of USCG



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All eight vessels will be operated by the Hartmann Group, but the ECO Star vessels will be owned by the Hartmann Group and its joint venture partner Jaccar Holdings, and operated under the banner of the joint venture company United Ethane Carriers which is based in Singapore.

“The cargo tanks of these five new [ECO Star] vessels,” DNV GL says, “include the use of the Star-Tri-Lobe tanks. These consist of three cylinders combined into one. Due to better utilisation of the space in the cargo holds, this results in higher efficiency and allows an increase in cargo capacity of nearly 30% over similarly sized vessels with conventional tanks, reducing shipping costs through greater economies of scale.”

The vessels will be fitted with MAN quadruple fuel engines, the vessels will use ethane as a fuel, but can also operate on HFO distillate and LNG if necessary.

Meanwhile, Samsung Heavy Industries (SHI) has won orders for a further six VLECs, the 87,000m<sup>3</sup> ships with options will be built at SHI’s Geoje yard.

French firm GTT (Gaztransport & Technigaz), which builds containment systems for gas carrying vessels has been selected to provide the containment system for the vessels that were ordered by an Asian owner.

GTT says the Mark III multi-gas containment system will allow the vessels to carry propane, butane and propylene as well as ethane.

Four of the vessels are expected to be delivered by the end of 2016 and two in 2017.

#### Propellers

## First plastic prop takes a spin

Nakashima Propellers of Japan has fitted the world’s first lightweight carbon fibre reinforced plastic (CFRP) propeller to the 499gt *Taiko Maru* owned by Sowa Kaiun.

According to ClassNK, which approved the design and part-funded the research into the CFRP propeller, the light weight of the screw means that there can be a smaller diameter propeller shaft with the combined weight saving of the shaft and propeller reducing the required horsepower by 9% compared to conventional aluminum-bronze propellers.

The owner had originally used CFRP propellers on the vessel’s bow thrusters and the successful operation of the thrusters led to the company transferring the technology to the main engine and drive.

ClassNK expects the use of CFRP propellers to become more widespread in the future due to their energy saving properties and the fact that the CFRP material is as strong, or stronger, than the aluminium-bronze units in current use.

#### Lube oil

## Testing times

French company GESERCO, which produces a digital oil testing unit has produced the latest version of its product, the Digital Rapid Oil Tester, which can evaluate the base number (BN) of a lube oil up to BN100, says the company.

The new tester is simpler to use offering accurate measurements of any BN depletion within three minutes and the unit can store up to 90 test results in its memory, but with the USB connection any results can be downloaded and saved.

#### Engines

## MAN reaches Tier III

Engine manufacturer MAN Diesel and Turbo has achieved Tier III accreditation for its 8L21/31 four-stroke engine fitted to the DFDS ro-ro ship *Petunia Seaways*.

The company says it achieved the standard, certified by DNV GL, by retro-fitting a selective catalytic reduction (SCR) system to the vessel. Without the SCR, the engine would already meet Tier II emission requirements, but the SCR also cleans the NOx emissions from the exhaust gases to a level acceptable for Tier III rules, more than 75% of NOx is removed when compared to current levels.

Testing on the vessel’s auxiliary engines, which have had the SCR fitted since 2012, have played a major part in proving the SCR technology, MAN accepted.

“For the last 8,800 hours, this particular auxiliary engine of the *Petunia Seaways* has consistently met Tier III NOx limits under real life operating conditions and in full accordance with the rules,” said Dr Daniel Struckmeier, senior project manager.

The MAN SCR uses urea in the exhaust gas with the mixture passed through a catalytic converter at up to 400°C causing a chemical reaction that reduces the NOx emissions.

MAN has also introduced electrical control systems that can auto-tune engines. Christian Ludwig at MAN explained: “MAN constantly monitors electrically controlled engines,” however, Ludwig said that crew are hesitant to adjust mechanically controlled engines. “Now mechanically controlled engines can be tuned, we often find that an engine is 10-15bar below what it should be.”

The monitor system measures the pressure in each cylinder which can then be adjusted manually, bringing savings of around 2-3% “simply by fine tuning engines,” he noted.

MAN accept that the monitor system, given that it operates on mechanically controlled engines, has a finite life as these engines will be phased out, however, MAN says that there are still 30,000 units in circulation. [NA](#)

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## IMO agrees gas code rules

A new draft code on gases and low flashpoint fuels has been agreed at the IMO Sub-Committee on Carriage of Cargoes and Containers (CCC 1), writes *Sandra Speares*.

The draft International Code of Safety for Ships using Gases or other low flashpoint fuels (IGF Code), along with proposed amendments to make the Code mandatory under SOLAS was agreed when CCC 1 met from 8-12 September.

The aim of the IGF Code is to provide mandatory provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using low flashpoint fuels, such as liquefied natural gas (LNG), to minimise the risk to the ship, its crew and the environment.

The code aims to cover all areas that need special consideration for the usage of low flashpoint fuels, based on a goal-based approach, with goals and functional requirements specified for each section forming the basis for the design, construction and operation of ships using this type of fuel, according to the IMO.

The code will apply to new ships and to existing ships converting from the use of conventional fuel oil to the use of gases or other low-flashpoint fuels, on or after its entry into force. It will not apply to cargo ships of less than 500gt.

The draft SOLAS amendments along with the draft IGF Code will be put to the Maritime Safety Committee in November. Draft amendments include a new Part G in SOLAS chapter II-1 (construction – subdivision and stability, machinery and electrical installations) related to ships using low-flashpoint fuels, requiring such ships to comply with the IGF Code; and related amendments to SOLAS chapter II-2 (fire protection, fire detection and fire extinction), covering to the use of fuel with a low flashpoint. Further draft amendments would update the form of safety certificates.

The draft code focuses in the first instance on the specific requirements for ships using LNG as fuel, but CCC 1 also agreed a work plan for the next phase of development of the code, to take account of the need to consider future proposals for the use of additional fuels for inclusion in it.

The IGF correspondence group will continue to develop guidelines for ships using ethyl or methyl alcohol as fuel; measures for fuel cells for inclusion in the code as and when appropriate;

develop measures for ships using low-flashpoint diesel oil for inclusion in the code as and when appropriate for submission to CCC 2 in September next year.

According to Alistair Hull, technical manager at the International Chamber of Shipping: “The development of the IGF Code is making good progress at IMO, based initially on implementation of requirements for LNG. However, there are still some key technical issues to be finalised, such as the requirements for fuel tank location.

“It is envisaged that subsequent to approval of the initial version of the Code, IMO will continue to work in this area so that the inclusion of other alternative fuels can be addressed in subsequent revisions.”

Dragos Rauta, technical director at independent tanker owners’ organisation Intertanko, said the association was positive about the development although there remained some issues to be sorted out, Adoption of the code would encourage the use of LNG and other alternative fuels as bunker fuel for ships, he said.

While the code is tailored for LNG at the moment, the intention is to expand it to other alternative fuels like methanol. He said Intertanko’s position has always been that, as far as the issue of emissions from ships is concerned, measures them should “start from the source”, that is the fuel itself. He also mentions the outstanding issue of the protective location of the bunker tanks.

He said he does not believe there are big differences of opinion on the issue and that it will be possible to finalise the draft in November. As far as the code is concerned, it initially concentrates on LNG because there was a view that if it was expanded to other alternative fuels, that might complicate its adoption, he says. Once it has been adopted for LNG, it can then be expanded to other fuels.

Commenting on the developments, John Dickinson of The Nautical Institute said: the discussions on the IGF Code were very technical and whilst we did not take part in the working group and the technical discussions we followed the debate in the plenary session closely. We will be able to further consider the code when the agreed draft is submitted to the parent body, The Maritime Safety Committee for approval and subsequent adoption and we look forward to the final approval of the IGF Code.” *NA*

# NUPAS

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XBow model courtesy of Ulstein Group ASA

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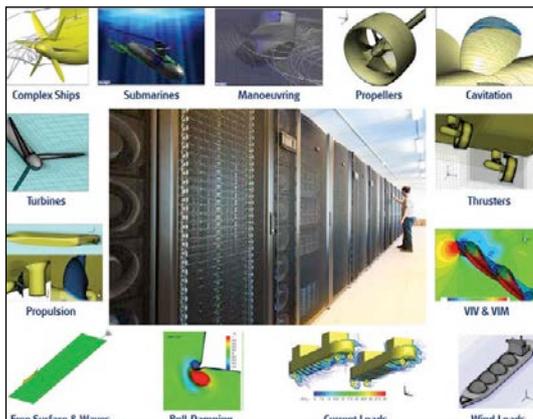
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CFD

## MARIN shares its wealth

MARIN, the Maritime Research Institute Netherlands, has announced the formal investment of €2 million (US\$2.5 million) in a large and fast Bull computer cluster (4000 computational cores). This supercomputer complements MARIN's extensive model basin, simulators and full-scale monitoring tools. MARIN has said that it wants to use this new facility to strengthen the cooperation with the maritime industry.

To stimulate interaction with naval architects and offshore engineers and invites its clients for the 'ReFresco-operation'. Participants in the ReFresco-operation are allowed to use the ReFresco code on their office computers without limitations in the number of users and cores. They also have the possibility to scale up calculations with the same input files to the MARIN medium cluster (1600 computational cores) without large investments. MARIN can also assist with calculations on the large cluster for independent verification or detailed analysis.



MARIN announces new super computer

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Accommodation & interiors

## Bolidt goes Quantum

Flooring solutions provider Bolidt has announced that it is to fit out the Quantum class vessels with its products.

Bolidt has been working closely with both Royal Caribbean International (RCI) and Meyer Werft on



Bolidt decks out the latest Quantum series being constructed at Meyer Werft

the latest 348m long, 4,905 guest capacity *Quantum of the Seas* and *Anthem of the Seas*, due for delivery in November 2014 and March 2015, respectively. Bolidt will be using its Future Teak for the stateroom balconies with Bolideck Select Soft used in public areas.

[www.bolidt.com](http://www.bolidt.com)

Deck equipment

## ACE Winches drives forward

Following significant Norwegian market growth, ACE Winches, deck machinery specialist, has launched its latest technology, Reel Drive Systems (RDS). The RDS ranges from 150Tonnes to 500Tonnes and will be able to deploy and recover subsea umbilicals, risers and flow lines (SURF), mooring wires and power cables for the global oil and gas sector.

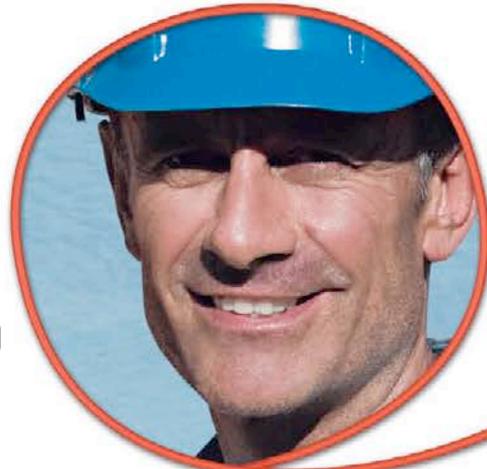
The ACE Winches RDS is Programmable Logic Controlled (PLC) and can be automatically adjusted to accommodate multiple reel sizes up to a 12m diameter whilst eliminating the requirement for manual handling, optimising the conditions for safe operations.

The modular systems will be located at ACE Winches' new Karmsund quayside facility, enabling clients to benefit from faster mobilisations and the ability to transport the RDS equipment in individual components to assemble onsite.

ACE Winches can mobilise, demobilise and conduct spooling and bollard pull test operations directly from the quayside. The new 2,000m<sup>2</sup> facility sits centrally in Karmsund, located conveniently for vessels passing between Bergen and Stavanger.

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## Ballast water treatment

## Ballasted by orders

Both Severn Trent De Nora and OceanSaver have said that they have received a rush of orders for ballast water treatment systems. The order for Severn Trent De Nora's systems will see fourteen IMO Type-Approved and USCG AMS-Certified BALPURE systems will be installed on crude oil tankers being constructed for BP by STX Offshore & Shipbuilding in Busan, South Korea.

The order includes 10 BALPURE BP 3000 systems, each with treatment capacities of 3,000m<sup>3</sup>/h, which will be installed on the 110,000dwt Aframax tankers, and four BALPURE BP 4000 systems, each with treatment capacities of 4,000m<sup>3</sup>/h, which will be installed on the 160,000dwt Suezmax tankers. The BALPURE units will be delivered to the STX shipyard for installation between February 2015 and March 2016.

Whereas, OceanSaver has said that it has won orders for over 40 systems in the space of the last six months, with some 21 units delivered so far this year.

The latest contracts, worth approximately US\$30 million, cover a diverse range of large tonnage, from a number of key international markets, with VLCCs, Aframax tankers, product tankers, and Cape size bulk carriers featuring strongly. A pair of Taiwanese-controlled VLCC's, currently under construction in Japan, are the latest assets in the orderbook.

[www.severntrentdenora.com](http://www.severntrentdenora.com)

[www.oceansaver.com](http://www.oceansaver.com)

## Ancillary equipment

## Uson Marine cleans up

Through cooperation with Marine Position AB, Uson Marine has joined forces with the Environmental Navigator for its new GPS Discharge Control system for food waste. Together, the systems will provide fail-safe control and monitoring of food waste discharge, the company has said.

The Uson food waste vacuum system, a one-way macerator system (OWMS) is designed for hygienic collection and treatment of food waste in compliance with IMO Marpol 73/78 Annex V, US Coast Guard and other relevant regulations and standards. Uson has said that the system is easy to install, with low water consumption and small pipe diameter that allows a flexible pipe routing.

The Uson GPS Discharge Control system is an embedded feature in Uson Marine's Food Waste control system. Utilising the Environmental Navigator's unique database of rules related to food waste (Annex V, etc.), combined with information from the ship's GPS, the system automatically controls and monitors all food waste discharge for full compliance



Uson launches latest GPS discharge control system

with the relevant regulations. The Uson GPS Discharge Control does not require an Environmental Navigator on the bridge for its functionality. A GPS signal is connected to the Food Waste control system and the functionality is achieved with software on an industrial PC and PLC within the control system cabinet.

[www.usonmarine.se](http://www.usonmarine.se)

## Fuel

## Frankfurt fuel tank testing

The Frankfurt laboratory of Exova Warringtonfire has extended its services and is now able to offer tests according to the norm 33 CFR. With this new test, Exova Warringtonfire Frankfurt says that it is able to further expand on its fuel tank testing abilities in response to customer demand in the maritime sector.

To test the fire resistance of a fuel tank, a fire bath which is located on a railway line set up is used. The fire is aimed directly underneath the tank which is fitted within a chassis to resemble an operational application. The test includes timed fire exposure within a number of conditions, including damaged and vulnerable structures, and offers a highly effective measurement of resistance.

This new capability further extends the facilities capabilities in fuel tank fire resistance testing for the automotive and marine sectors, the company added.

[www.exova.com](http://www.exova.com)

## Ballast water treatment

## Getting AMS approved

The recent trend in the ballast water market to meet with the US Coast Guard (USCG) alternate management system (AMS) acceptance has seen ballast

Creation: www.agencegalilee.com

# LNG Bunkering: GTT Solutions



In the short term, the release of polluting exhaust gases (SO<sub>x</sub>, NO<sub>x</sub>, CO<sub>2</sub>) will be restricted.

A set of new international regulations are coming progressively into force, which will impose the use of cleaner fuels.

LNG, being by far the cleanest and probably the cheapest of all fuels comes to mind as the most obvious alternative.

GTT, through its experience in the design of LNG handling and storage systems, both at sea, and on land, is ideally positioned as the preferred partner for the implementation of clean, efficient and reliable solutions at each step of the supply chain.

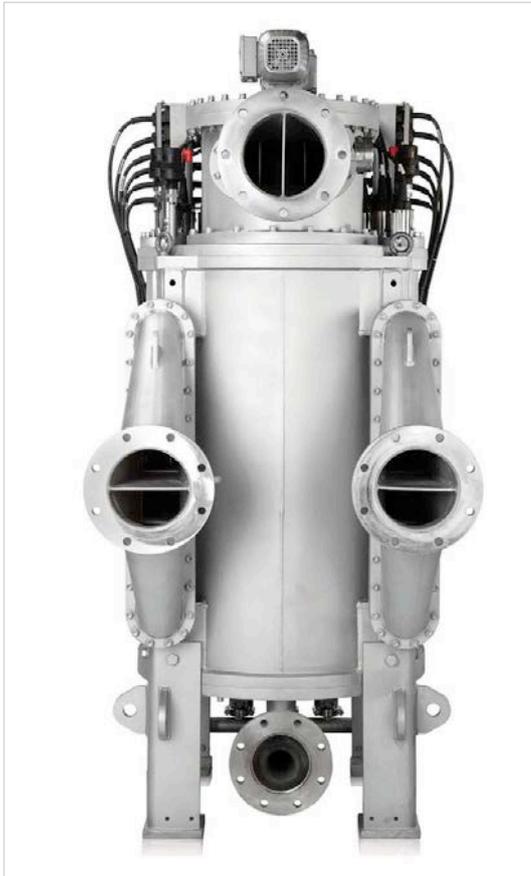
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water management systems surging towards testing. Two companies which have recently achieved approval are Evoqua Water Technologies' SeaCURE and Trojan Technologies Trojan Marinex system.

AMS is a temporary designation given to a ballast water treatment system approved by a foreign administration. Vessels operating in US waters may use an AMS-designated BWT system to manage their ballast water discharges in lieu of ballast water exchange – for a period of five years from a ship's compliance date – while that BWT treatment system undergoes USCG Type Approval testing. AMS certification neither guarantees nor implies that USCG Type Approval is likely, as the two programs are independent of each other.

[www.evoqua.com](http://www.evoqua.com)

[www.trojanmarinex.com](http://www.trojanmarinex.com)

Software

## Amarcon and Observator keep a weather eye open

Amarcon and Observator Instruments are set to develop a helideck monitoring and forecasting system to improve the safety of helicopter landings and take-offs from a vessel.

Amarcon, a part of the ABB group and Observator Instruments, a leading developer of sensors and

Trojan technologies gets AMS approval

services for meteorological and hydrological monitoring, today announced that the companies will jointly develop a helideck monitoring and forecasting system.

The company has said that the monitoring and forecasting system will improve the flight and passenger safety during helicopter landings and take offs. The new system, which will fully integrate with Amarcon's vessel advisory system OCTOPUS, monitors weather conditions and advises a vessel's crew whether to proceed with an intended helicopter operation (go/no-go) or wait. The system's analysis and recommendation is based in weather data from the past 20 minutes.

[www.amarcon.com](http://www.amarcon.com)

Power generation

## The Switch repeat order

The Switch, a supplier of megawatt-class permanent magnet (PM) generators and full-power converter packages, has received repeat PM shaft generator orders from WE Tech Solutions of Finland.

WE Tech Solutions placed another order for seven PM shaft generators that will be delivered to their end-customers Terntank Rederi AS of Denmark and Torvald Klaveness of Norway. To adapt to the various power requirements of the customers, The Switch will deliver the PMM 1000 shaft generators in two different lengths. Moreover, the orders comply with two different marine classification societies.

[www.theswitch.com](http://www.theswitch.com)

Trojan technologies gets AMS approval



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# Offshore vs maritime: the debate

The lure of the offshore sector is strong for naval architects with interesting projects and good money on offer. Offshore and maritime recruitment specialist Faststream looks at the key areas of demand and the pros and cons of making a move from maritime to offshore

**T**he business of offshore oil and gas exploration is getting tougher and tougher. Ever more marginal fields are being exploited, deeper and deeper waters are being drilled and activities are taking place in harsher environments than ever before.

From the oil majors down to the smaller consultancies, companies across the offshore sector need good naval architects to design, construct and maintain supply vessels, floating production facilities and drilling rigs. However, the current pool of naval architects with genuine offshore industry experience is limited. Over the past decade this has led to an opening up of a huge number of opportunities for naval architects from the maritime industry.

There are currently numerous large FPSO projects underway. These include BP's US\$5 billion Quad 204 project west of Shetland, Total's Kaombo in waters of up to 1,900m deep off Angola, the Kraken field in the North Sea as well as the recent announcement of the development of the Catcher field in the North Sea by Premier Oil. The FLNG market is also growing. Shell's Prelude project is the first of its kind and gaining attention from talented naval architects wanting to broaden their technical horizons. According to Shell, 600 people (not all naval architects) spent 1.6 million working hours designing this project.

Each of these projects has a lifespan of five or more years as far as naval architects are concerned. From the concept, FEED and detailed design, through to new construction and outfitting, not to mention the ongoing operation, all stages of the project requires specialist naval architecture skills.

All of these have excited naval architects looking to get involved with these huge and technically demanding ventures. Other hubs for offshore work include Norway, Italy and France where there is a constant demand for naval architects drawing people from across Europe.

But, these projects don't just require professionals on site, but draw in naval



Pay and prospects in the offshore sector are a draw, but the offshore design is not for everyone says Danni Devine marine manager at Faststream UK

architects working for consultancies, class societies and marine equipment manufacturers. The sector continues to grow and needs ever-increasing numbers of naval architects.

## Making the move

Some areas of the offshore sector are easier for a naval architect with a maritime background to move into than others.

According to Duncan Peace, managing director of Winchester (UK) headquartered oil and gas consultancy Crondall Energy, and an employer of naval architects, it is relatively easy for a naval architect with structural experience in the maritime sector to move across to work on offshore floating structures. However, he notes that finding people who "understand the challenges of mooring a vessel offshore" is far more difficult. A fast growing international consultancy with offices in the UK, Australia, Singapore and Houston, Crondall Energy employs around 50 and has taken on eight naval architects over the past

twelve months. About half the recruits already have offshore experience with class societies or offshore contractors, while the other half are either new graduates, or have come from the small craft and marine leisure sectors. People with expertise in the challenging area of hydrodynamics and offshore mooring design and analysis are few and far between and recruiting naval architects with these skills remains a challenge.

But, Duncan Peace thinks that the message that the oil and gas sector offers interesting, well paid careers has still not reached all young naval architects.

"Given how much of an opportunity the oil and gas industry represents to naval architects, I'm surprised at how little understanding there is of this sector amongst undergraduates and recent graduates" he says. "We would welcome the opportunity to work more closely with universities to support the development of a syllabus that would help provide the people and the skills that the oil and gas sector needs."

According to Faststream UK's marine manager, Danni Devine, there are three reasons that naval architects are lured from the maritime to the offshore segment: pay, exposure to new technology and stronger prospects.

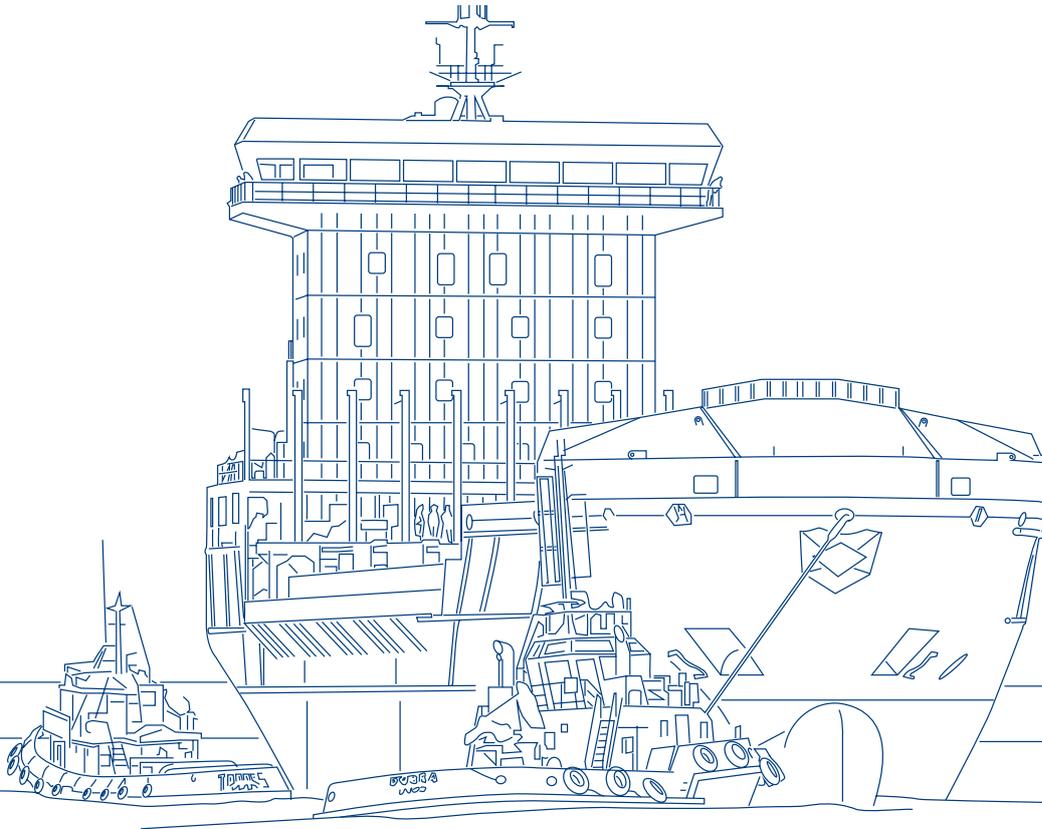
"The pay in the offshore sector can be 30% higher than in the ship-shape sector. A principal for an FPSO project might earn £100,000 (US\$165,000) for a consultancy, but £70,000 to £80,000 (US\$115,000-132,000) if working on a maritime project," she notes.

Turnover in the offshore sector is high with naval architects typically spending two to three years with an organisation before exploring the market for new opportunities. However, unlike the maritime sector there are more deals to be done around the employment of the candidates, with the right people enticed with good deals made available.

However, it is not just about the pay. Danni Devine reports that candidates are looking for opportunities to work with new and emerging technologies. Greater exposure to the latest



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technology and techniques can help junior and mid-level architects quickly accelerate their careers. She cites the example of cylindrically shaped FPSOs as one area that many naval architects are looking to get exposure to.

But, a move to the offshore sector is not for everyone. The biggest area of concern for more senior naval architects is the potential drop in status. Someone with no-offshore experience cannot expect to immediately take a position at exactly the same level. A senior naval architect from the marine sector used to managing a team of six might need to initially take a drop and become a mentor rather than a manager.

“Offshore experience is key,” says Danni Devine. “But this doesn’t mean that rapid advancement is impossible. One approval manager working for a class society recently made the transfer to an oil and gas consultancy, initially at principal level, but within a year was appointed deputy design manager.”

**Can maritime compete?**

Once a naval architect has made the move from the marine to the offshore sector, it is

very rare for them to return. How then can the marine sector compete at a time when the demand for naval architects’ services is in relatively strong demand?

Danni Devine believes that it is very tough for the marine sector to compete with the offshore sector, but she acknowledges that the move is not for everyone.

“The marine sector does offer much better retention rates. It feels more secure and more like a family to many naval architects. Many of the companies are smaller than the oil majors and can also offer research opportunities. In Britain the locations for marine work are spread across the country, whilst offshore opportunities are very much focused on London and Aberdeen.”

She also notes that it would be a mistake to think that the maritime sector does not offer exciting opportunities to work on new technologies or developments. The work currently underway developing dual-fuel and eco-efficient vessels certainly offers numerous challenges.

The past couple of years have seen plenty of work for naval architects thanks to relatively

high levels of newbuilding volumes in the dry bulk, tanker and container markets. The graduates of the 2014 pass-out certainly have typically found gainful professional employment. But, there are still plenty of vacancies for naval architectural positions with owners, class, shipyards and consultancies.

With a decreasing pool of experienced maritime naval architects to draw from in all the key hubs, companies are having to fill positions with people from across Europe. Polish and Romanian professionals are increasingly being considered for international positions. The need for maritime people has also had a knock-on effect on the defence sector which is struggling to fill vacant posts.

Given the current poor performance of an over-tonnaged freight market, whether or not there will be a continued short-term demand for naval architects in the maritime sector remains to be seen, but the long term picture of increasing offshore demand looks set to stay. Both sectors offer interesting opportunities, diverse projects and naval architecture continues to be a great career choice. **NA**



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# On-land shipbuilding works on new knowhow and equipment

On-land shipbuilding technology allows ship blocks to be moved on flat ground and launched without a gantry crane at a shipbuilding site. It also allows yards to lower investment by speeding up the shipbuilding cycle. Cheng Tian Zhu, former chief engineer at the China State Shipbuilding Corporation reports

The gantry crane, colossal and imposing, has been the symbol of modern shipyards. The crane, the berth and the dock are today essential facilities of a shipyard. Blocks of a vessel are lifted by the crane and assembled dockside into the main hull section, then integrated to form the completed body of the vessel.

This has been the 'traditional' method of building ships for the past 60 to 70 years and the lifting capacity of a shipbuilder's gantry crane has become an indication of the scale and capacity of the shipbuilder.

However, 'on-land shipbuilding' is right around the corner

As the continuous advancement of technologies takes place, however, traditional shipbuilding techniques are becoming obsolete. In the first instance hefty investment in facilities translates into a heavy financial burden for shipbuilders; and secondly, limited by the lifting capacity of the gantry crane, shipbuilders are restricted in boosting efficiency.

In addition the long shipbuilding cycle has made it difficult for shipbuilders to keep up with changes in the shipping market. Shipbuilding techniques involved in traditional shipbuilding are complex and time-consuming and have a bearing on the final product quality. It is not easy to meet the high standards and requirements in many aspects including safety, operational conditions, energy efficiency and environmental protection, among others.

In the last two to three decades, shipbuilding technicians have worked hard at revolutionising traditional shipbuilding techniques, giving birth to the 'on-land shipbuilding' concept and methods, followed by relevant craftsmanship and equipment. The new



The cloud transporter system in a shipyard

technology has since been adopted in individual countries and shipbuilders in China have also employed it in parts of their operation.

The perfect on-land shipbuilding technology entails moving ship blocks and the main hull section safely on level ground to a specified location in the shipbuilding area for precision assembly, then moving the completed vessel body also on level ground to be launched, without any lifting necessary by gantry crane.

The technology can revolutionise the production mode in shipyards and the way the hull is built.

## New knowhow and equipment make it possible

There are different installations and equipment for building ships on-land

available both inside and outside of China. Among them is the Hercules giant block moving and location equipment system invented and developed by shipbuilding experts including Fang Yue Hua in China, which has secured close to 20 national patents and owns the proprietary intellectual rights.

The system is comprised of a series of different equipment including a localiser, a rail transporter system, a giant block lifting device, a rudder pulp installer and a floating tank ship launching device.

Operating on the basic principle of an oil-pressure jack, the localiser can lift from several dozen to a few hundred tonnes. The cylinder head of a 3D-localiser can afford displacement on axis X, Y and Z in a 30, 50 and 100cm space. When several of them are used together, blocks from a few hundred to several thousand or tens of thousands

of tonnes can be lifted and be moved freely in a range of 6degs in a small area, making it possible for very precise positioning of heavy blocks. When it is not lifting weight a localiser can move around on the ground; when it is carrying weight, it can be placed on a rail transporter system and moved to the right place.

The transporter has a groove shaped rail with the two sides edged like a saw and on each side there is a tractor with a side-way hydraulic-driven lift-and-push gear that allows it to move along fitting in with the saw teeth on the rail and tow the localiser several metres every minute.

The blocks and main hull section on the localiser can be moved at several hundred metres an hour. When the blocks being moved close in on another block already located, the localiser can make fine adjustments for the blocks to join precisely, making assembly and welding easy. Because of the special design of the rail, the system is named the cloud transporter.

As for the giant block lifting device, it is used specifically for moving blocks of several hundred to several thousand tonnes or the assembled hull from high ground to low or vice versa. If a shipyard already has a dry dock which is not equipped with sufficient heavy lifting capacity, the giant block lifting device can

be of help there and make a shipbuilder's work more efficient.

The automatic rudder pulp installer, operating on the same principle as the localiser and the rail transporter, can simplify the complicated and intensive work processes of assembling the stern and dismantling the rudder shaft and blade, and propeller, hence assure that assembly works can be done highly efficiently and manage high quality delivery.

The floating tank ship launching device is used for launching a vessel from on ground into the water or taking a vessel in the water up onto shore. The vessel can sit on a number of the devices then be towed by the cloud transporter to be launched. And, it is used to move a vessel in the water onto land and to the right place in the shipyard for repair.

With the "Hercules" ballast water control software, the ballast water in the floating device can be adjusted and vessels can be launched or move out of the water at a safe and steady speed.

Shipbuilders who have equipped themselves with a semi-submersible barge or floating dock can use the software to adjust the ballast water in the barge or dock to align with the vessel on the cloud transporter onshore, allowing the vessel to be moved onto the barge or dock and be

launched, or vice versa for moving a vessel in the water onto the transporter on land.

### Obvious economic benefits

From the experience of shipbuilders who have used Hercules equipment, on-land shipbuilding obviously affords a lot of economic benefits. Using the new method and equipment, a shipbuilder is estimated to be able to boost efficiency of block assembly by more than 40% and also enjoy an improvement in other aspects of work such as safety and energy conservation.

Some smaller shipbuilders equipped with on-land shipbuilding gears are actually managing delivery of larger vessel models and with a higher quality and, the investment in a shipyard that intends to employ the Hercules system and equipment is going to be less than half that required for a traditional facility and the construction period will also be halved.

Traditional shipbuilding modes and techniques are expected to become obsolete and eventually be replaced by on-land shipbuilding. It will not take long for on-land shipbuilding to become the mainstream that can sway the development of shipbuilding methods in the future. And, it will also be an important technological area that commands the exertion of the shipbuilding industry in China and ultimately puts the industry among the best in the world. **NA**



A localiser (yellow) used in a shipyard



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# Designing for Arctic conditions

Arctic exploration is not only pushing into new territories, but also pushing the boundaries of vessel design. RS explains the challenges of designing modern ships that can not only withstand these harsh conditions, but can continuously operate within them

**T**he Russian Maritime Register of Shipping (RS) says that there are enough prerequisites to further the construction of up-to-date ships and facilities for the Arctic and other harsh climate regions. It also explains that ships built today are capable of performing tasks that might have been unbelievable just two decades ago.

Maxim Boyko, head of RS research department explains that the conditions for assigning each particular ice class notation comprises of a set of requirements for ship safety in harsh climates: hull strength, power plant output, winterisation and cold resistance properties of the materials used for the ship construction.

The correlation between two important aspects of ensuring ship safety in the Arctic is the ice class and winterisation notations. While availability of a particular ice class is a must for an Arctic vessel, the winterisation is an optional notation, implemented upon shipowner's request in order to increase the ship's safety and enhance the conditions for the crew working in a low temperature environment. However, with the adoption of the Polar Code, which contains certain provisions regarding winterisation, compliance with the requirements of this notation may become compulsory.

Boyko adds that if an owner is considering the assignment of a winterisation mark in the class notation, it is important to pay special attention to the choice of hull steel and the correct assignment of design ambient temperature (DAT) for the various areas of the hull.

RS also highlights some recent Arctic projects that it has been involved with such as the Arctic LNG carriers, the up-to-date offshore supply vessels and icebreaking rescue ships, and, of course, the next generation of nuclear icebreakers.

The RS competence on Arctic LNG carriers has substantially expanded, it says. RS carried out the Approval in Principle for GTT methodology to calculate global iceberg



*Baltika* is one of the latest developments in high ice-classed vessels



Designing high ice-classed ships are becoming more popular with developments such as the NSR

loads and for membrane cargo carriage systems for the Arc7 ship operations in the Russian Arctic and along the Northern Sea Route (NSR).

A project has also been carried out on bulbous bow gas carriers, where the bulb will enable fuel saving while moving in clear water. For this project RS in cooperation

with leading scientific centres has carried out calculations of ice loads on the bulb and calculations of the bulb strength criteria under ice loads.

Today, the technological development enables large ships to pass along the NSR, over 70% of transit cargoes in the Arctic are hydrocarbons carried by ships of over

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50,000dwt. The Yamal LNG project for LNG transportation from South Tambey gas condensate field on Yamal Peninsula via Sabetta port to Western Europe, the Americas and Asia Pacific region has been launched. The project foresees the construction of up to 16 innovative Arc7 gas carriers. The ships will be constructed at South Korean yards. "In this country we opened a Design and Newbuilding Support Centre, and carried out theoretical and practical training of our surveyors with due regards to the modern international experience," Boyko adds.

"The technical challenges that this project faced were mainly connected to the need for the vessels' high icebreaking capability (ice class category Arc7\*), to ensure 300m-long vessel manoeuvrability and its movement astern in heavy ice conditions (the double acting principle), to the uniqueness of the propulsion system (three sets of AZIPOD thrusters), to the response of cargo containment systems under ice induced vibration loads, as well as to the vessel's winterisation principles to cope with the harsh Arctic conditions (with

the DAT as low as  $-52^{\circ}\text{C}$ )", explains Pavel Shikhov, COO of RS.

Throughout 2013, technical discussions and clarification meetings with the potential builder, which has now been named as the Korean yard Daewoo Shipbuilding & Marine Engineering, continued and significant amount of time and effort devoted by RS to the project. The plan approval procedure started in early 2014, which still continues.

It is noteworthy that the membrane Cargo Containment System (CCS) No.96, developed by GTT, passed the RS Approval in Principle procedure for compliance with the Arc7 requirements well in advance, in December 2012. A wide range of research was performed under the procedure both by RS and GTT. As a result of joint research, that included vibration calculation in ice conditions, strength assessment of CCS under ice impact and ship motions in design wave conditions etc., the parties came to a conclusion that the membrane cargo containment system can be used on LNG carriers with ice category Arc7, including ships with possibility of moving in stern-first mode.

In addition to that, an analysis of the calculating methods for the dynamic interaction between LNG carriers and an iceberg was also done as part of the RS-GTT collaborative research.

"One particular technical challenge for the project worth mentioning here is winterisation of the ship and its equipment. For ships intended for operation at DAT below  $-50^{\circ}\text{C}$ , due to their uniqueness, there are no standard solutions to date and therefore the applicability of requirements for ship equipment to ensure long-term operation at low temperature is subject to special consideration", highlights Shikhov.

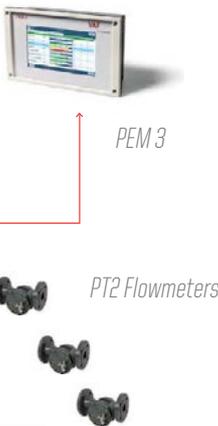
"Just by way of example: radio and navigational equipment operable at  $-52^{\circ}\text{C}$  is not available in the worldwide market meaning that manufacturers of this equipment would need to make post-production adjustments of the series-production equipment to ensure its operability at the lower temperature. This activity implies close cooperation between the yard, manufacturer of the equipment and Class", he adds. **NA**

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# HHI's moveable feast

Innovation in containership design is crucial as regulatory requirements become more stringent. Hyundai Heavy Industries has taken significant steps to meet the new rules by designing a vessel that optimises loading and significantly cuts costs by redistributing the weight of a mobile accommodation block

**H**yundai Heavy Industries (HHI) has developed a containership design with a moveable accommodation block, named SkyBench, which it says will help to utilise cargo space to the maximum possible capacity while allowing the crew to optimise the still water bending moment, allowing the vessel to operate at its most efficient set up.

Promotion of SkyBench began at this year's SMM exhibition and conference in Hamburg in early September and HHI says that a 14,000TEU ship will be able to load a further 350TEU while a 19,000TEU will increase its capacity by 450TEU by including SkyBench in its design.

According to HHI, the extra capacity can be seen as compensation for the loss of cargo loading space when fitting a LNG fuel system to a containership.

Calculations show that the vessel will have additional stability to add to the increased capacity, which will be achieved through the rearrangement of loading compartments. Global hull girder strength and a reduction in the still water bending moment and its relevant positive effects are all achievable offering a less stressful living environment to the crew, which in turn reduces their fatigue; SkyBench's design also dampens vibration and noise.

In addition, a new survival concept has also been developed with an automatic separation of the mobile section of the accommodation block from its supports in the event of an accident that sees the loss of the vessel.

However, one disadvantage may be a larger structural response in hatches and benches caused by torsional moments due to an additional hatch opening, which can be controlled within the permissible range through the design of side towers and lashing structures.

Space utilisation is one of the core elements in vessel design. This goes for the majority of industries. Space utilisation itself has a close relation to the production

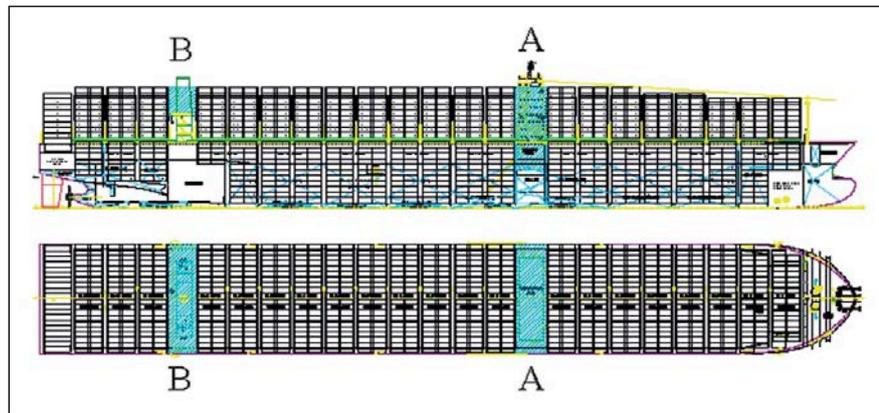


Figure 1: General Arrangement of a container carrier with z-island type

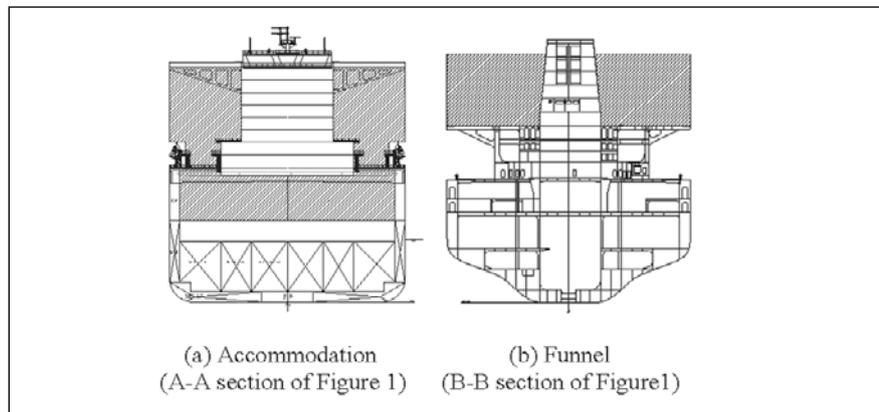


Figure 2: Section view in way of accommodation, funnel and space unused (shaded areas)

and operational costs and it could be a barometer of better design.

In container carriers, there are several ways to increase nominal capacity without changing the ship's dimensions such as changing the location of the deckhouse along the ship's length and raising the deckhouse height and the tiers of lashing bridges, for example:

- Stowage using cell guide support structures instead of the lashing bridges in the aftermost bay above the mooring deck.
- Blind sector stowage using rules for the navigation field of vision which

specifies a blind area of 5degrees viewing from the coning position of the wheelhouse is allowed for facilities on the uppermost deck used for the ship's operations.

Despite efforts to increase the numbers of nominal and loadable containers in a container carrier, there are limits to these increases due to the restricted space and the way the space is utilised in conventional designs.

SkyBench, which has been developed by HHI and Pusan National University,

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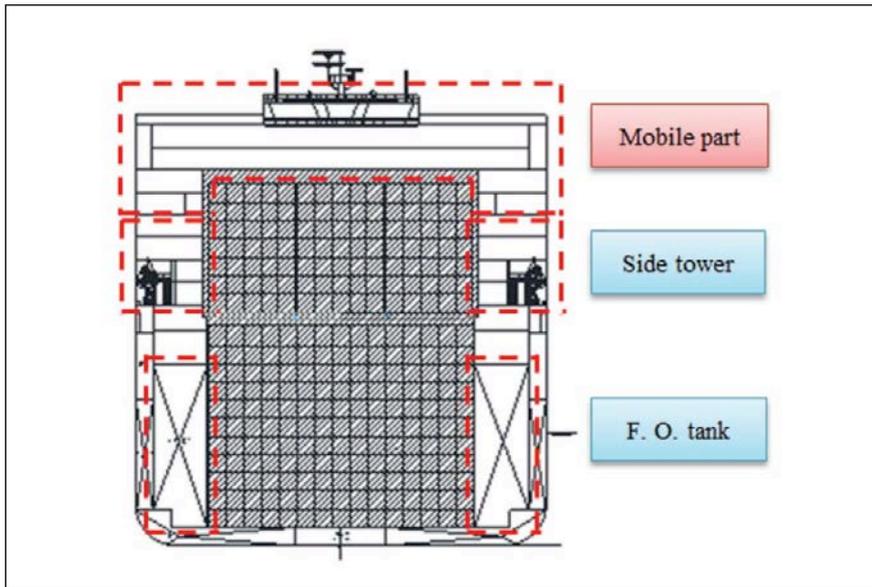


Figure 3: Section view of SkyBench and area for additional container stowage

overcomes the limitations of space utilisation to provide shipowners with maximum cargo stowage space, it can extend capacity by around 300-450TEU for 14,000-18,000TEU container carriers.

Traditional containership designs offer a two-island solution, as shown in Figure 1, with two superstructures where a designer can secure extra spaces for loading cargo keeping the traditional arrangement of compartments and systems with no big changes.

The spaces around the accommodation block shown in Figure 2(a), the shaded areas within the range between the upper deck and bridge wings, are available for extra loading. The space under the upper

deck, except that taken by the fuel tanks and the machinery and facilities is also available for additional loading.

On the other hand, the shaded areas around the funnel shown in Figure 2(b) are considered relatively tricky and have a lower profitability due to the limitations of the stowage level because maintaining enough space for securing working areas for the operation of a monorail crane under the funnel bridges is necessary.

In addition, to secure extra spaces for stowage above the funnel bridges, lashing at relatively high positions may require additional structures or supporting structures. Loading and unloading should be possible with a safe approach

to the ship's stack areas regardless of whether they are accessed from the port or starboard-side by the gantry crane.

To arrange cargo space for one more 40ft-bay inside the hull structure, fuel oil tanks which are located under the accommodation are about 40ft in length and are rearranged into two parts. Each of the tanks has two 40ft-bays in length and a higher height compared to the traditional design for ensuring the equivalent tank volume. If a designer wants to increase the tank capacity bench structures can be arranged from the inner bottom upward or some part of transverse bulkheads using closed type sections can also be used.

In Figure 3, the enclosed area within the uppermost dotted lines indicates a mobile part of the accommodation. The two side tower structures located on either side of the vessel support the mobile section.

Figure 5 shows an example of the procedure for loading cargo where the SkyBench system is applied, looking from starboard to port. The mobile part moves over the span of two 40ft-bays. The final position of the mobile part is at the fore end of the span when the cargo loading is completed. Subsequently the sea-fixing process stabilises the mobile section before a voyage can take place.

The final position has been decided by the crew taking into account the cargo weight and visibility; more cargoes can be loaded when the deckhouse is located in a forward position.

The following are the details of the procedure referring to the Figure 5. (a) Mobile part is located in the aft bay of the two bays equivalent to the span and containers are loaded into the cargo hold of the fore bay; (b) Loading on deck of the fore bay; (c) ~ (d) mobile section moves forward and sea-fixing takes place; (e) loading into the cargo hold of aft bay;

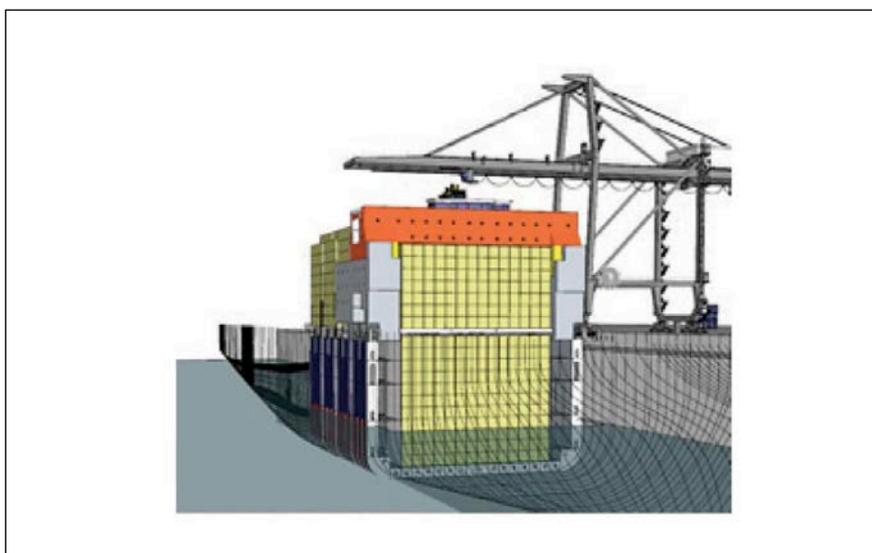


Figure 4 shows a 3-dimensional view of a 14,000TEU class container carrier with SkyBench. The scene shows a loading or unloading scenario in a terminal

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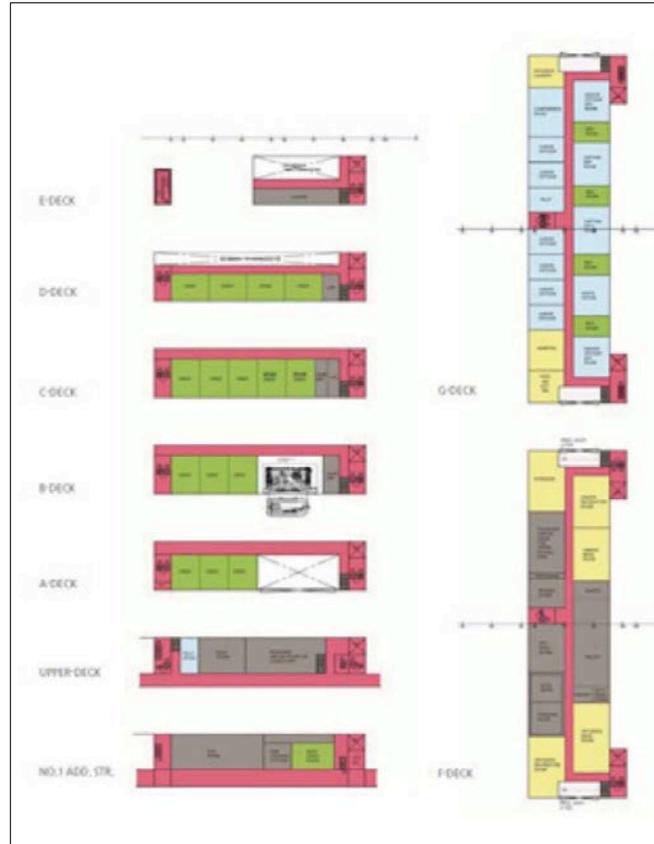
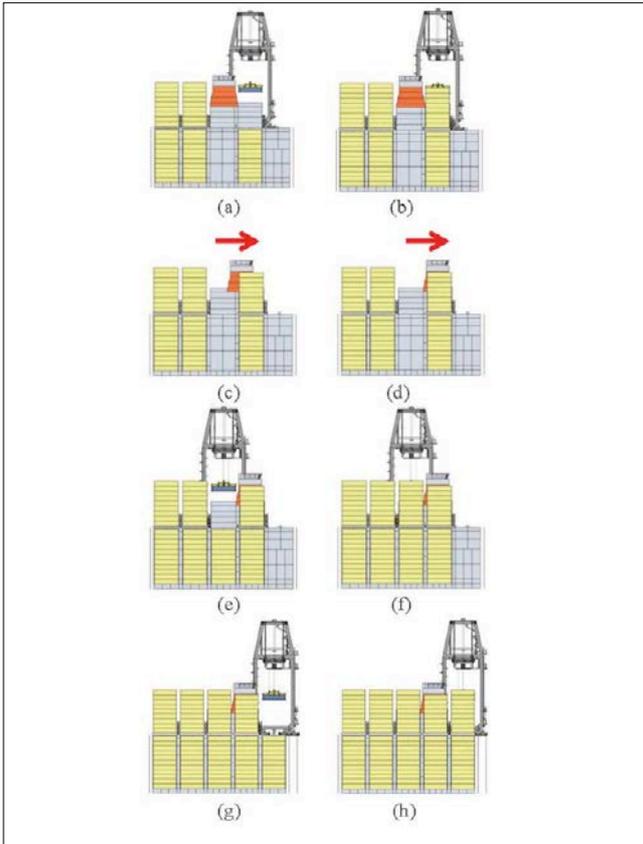


Figure 5: Loading procedure of SkyBench

Figure 6: An example of accommodation layout

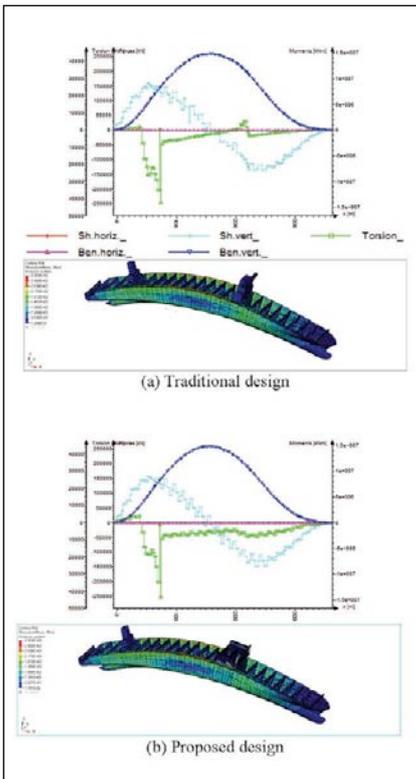


Figure 7: Comparison of stress distribution with deformed shape caused by the maximum vertical bending moment in maximum hogging condition

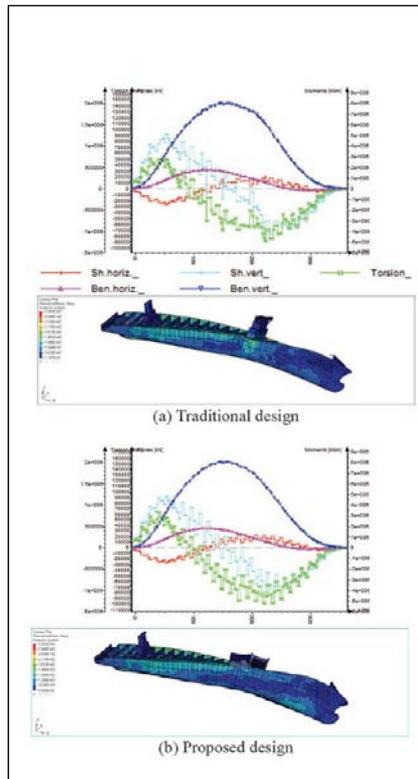


Figure 8: Comparison of stress distribution with deformed shape caused by the maximum torsional moment in maximum hogging condition

(f) loading on the deck of the aft bay; (g) ~ (h) loading into the remaining bays. Similar procedures can be applied for unloading.

Figure 6 shows an example of the accommodation layout on SkyBench composed of the mobile part and side towers. Being separated into two parts, the following should be considered in the design of layout to minimise the inconvenience to crews.

- Minimisation of the crew's traffic flow
- Grouping of the spaces according to their functions
- Minimisation of the space loss in way of moving and sea-fixing systems.

The installation position of the provision crane should also be decided facturing in the above design elements.

Since the mobile section uses the moving and sea-fixing system similar to an offshore gantry crane, the emphasis should be on the following elements for its durability and reliability:

- Driving power considering trim and heel in port
- Safe speed of moving
- Redundancy of driving power considering emergency situations.

The energy efficiency design index (EEDI) is mainly concerned with main engine power. However, if there is a considerable reduction in lightship weight (lwt) increasing deadweight, it is a different matter since the capacity, one of the variables in the denominator of the EEDI formula, takes 70% of the full dwt in the calculation for a container carrier.

In this regard, when the SkyBench system is adopted, a considerable reduction in lwt, strictly speaking steel weight, could be possible. This can be achieved through the reduction of the still water bending moment and minimisation of the structural members required to support the main structures on non-used spaces.

The still water bending moment depends mainly on the loading pattern; when the SkyBench system is applied, a relatively higher mass distribution of cargoes around the midship is possible and it is expected that the still water bending moment can

be reduced by around 5~10% for container carriers over 13,000TEU.

This has a direct connection to the reduction in lwt and also higher structural safety margins can be achieved even if the still water bending moment remains the same as in the traditional design.

Optimising the SkyBench system requires a basic structural integrity in the traditional design and the rearrangement of compartments, including tanks and machinery spaces, to below the under accommodation block. In addition, structures such as bridge wings can be removed if the mobile section crosses the full beam. Moreover, this offers better intact stability and increases the capacity for loadable containers.

In general, the dominant loading conditions for global hull girder strength of the container carrier are the total maximum vertical bending moment and maximum torsional moment

accompanying the horizontal bending in a maximum hogging condition.

Container carriers adopting the SkyBench system can provide more strength against a vertical shear force and bending moment. If the focus is on the parts where the side towers connect and side hatch coamings, longitudinal strength can be improved in principle. The longitudinal structural members of the side towers form outer walls and are aligned with side hatch coamings of the cargo holds between the upper deck and the first deck above the upper deck, traditionally an accommodation area.

The closed type upper deck under the accommodation in traditional designs offers resistance against global warping deformations. However, in the HHI design this is changed to an open type with a hatch opening offering one more 40ft-bay.

Figure 7 shows forces and moments acting on the hull girder and the distribution of stresses on a 14,000TEU



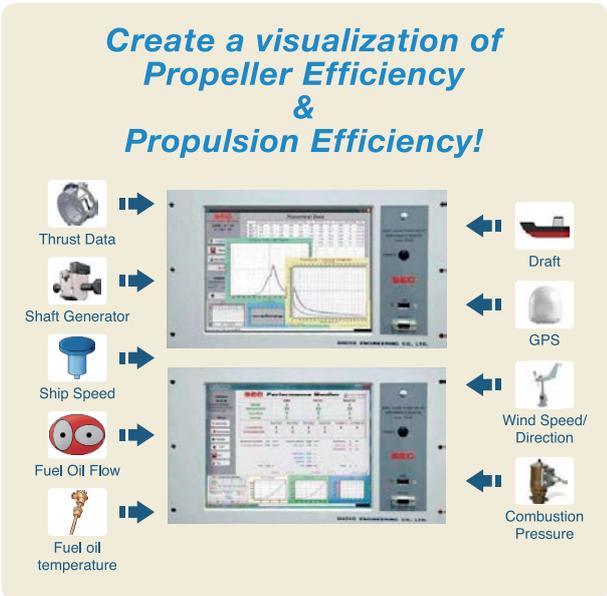
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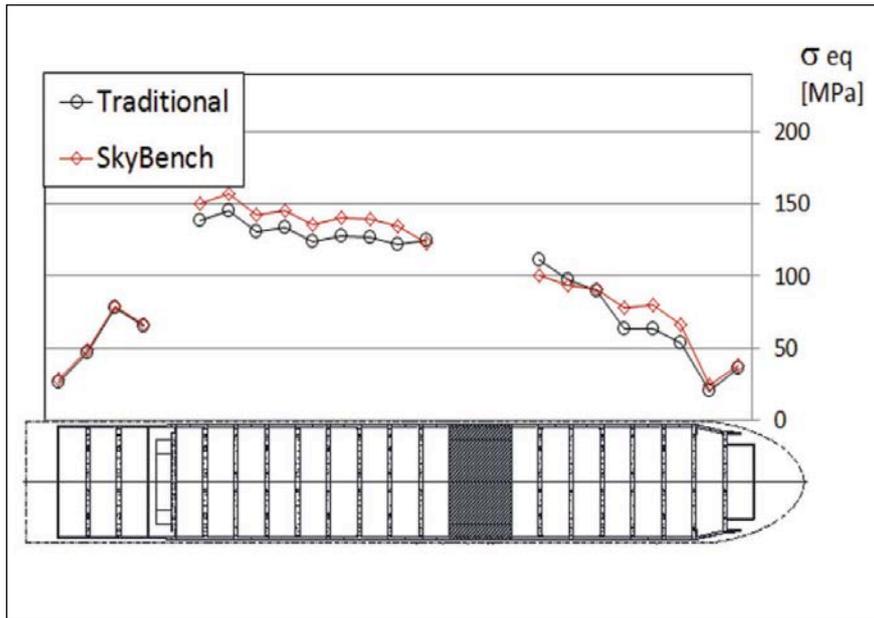


Figure 9: Equivalent stress distribution at hatch corners in case of maximum torsion condition

container carrier for both traditional, designs and the design adopting the SkyBench option, subject to the maximum vertical bending moment in maximum hogging condition. Figure 8 shows those subject to the maximum torsional moment.

For a relative comparison of traditional designs and the proposed design, the decrease in the vertical bending moment, mentioned earlier, is not considered i.e. both are in the same condition of force and moment.

To summarise the results of global hull girder strength analysis, stresses at hatch corners in the condition of maximum torsion are compared in Figure 9. Looking into the result, the equivalent stress at forward parts of the engine room bulkhead of the proposed design is higher than those of the traditional ship, but its increase is below 9%. However, the stress is lower than yield criteria with enough margin. It may be necessary to reinforce the corners of hatch and bench

structures with insert plates to improve fatigue strength.

Ship structure designers normally provide a hatch cover maker with the information on hatch deformations at the beginning of the detailed design stage. The information contains the relative deformation of hatch openings at the positions of all hatch cover panels. The upper limit of maximum hatch diagonal deformations based on design experiences is approximately 110mm.

Table 1 shows the analysis results on maximum absolute values of hatch diagonal deformations in 14,000TEU containerships designed by traditional and proposed methods. The results confirm that the maximum deformation in the proposed design is below the allowable deformation, although it is larger than that of traditional design.

The characteristics of SkyBench from the vibration and noise point of view are quite different from traditional designs, particularly for vibration.

Figure 10 presents the typical dominant vibration modes for the accommodation in a traditional design. This is for large container carriers of the two-island type such as in the 13,000 ~ 18,000TEU class.

The fundamental natural frequency range of accommodation in traditional design is 3 ~ 4Hz in longitudinal mode and 7 ~ 8Hz in torsional mode, in other words, out-of-phase mode of the bridge wings. Horizontal mode is found in the range of around 9Hz and higher.

The recent trend toward the slow steaming of ships for the purpose of energy saving leads the changes in main propulsion systems. The main engines with 11 or 12 cylinders, bigger than 95cm bore and higher than 90rpm at normal continuous rating and a propeller with six blades, are being changed to below nine or 10 cylinders, smaller than 90cm bore and lower than 70rpm at normal continuous rating and five-bladed propellers.

Reviewing the probabilities of resonance with vibration sources taking account of aforementioned characteristics, the trend of lower excitation frequency could make it go into the resonance range of dominant

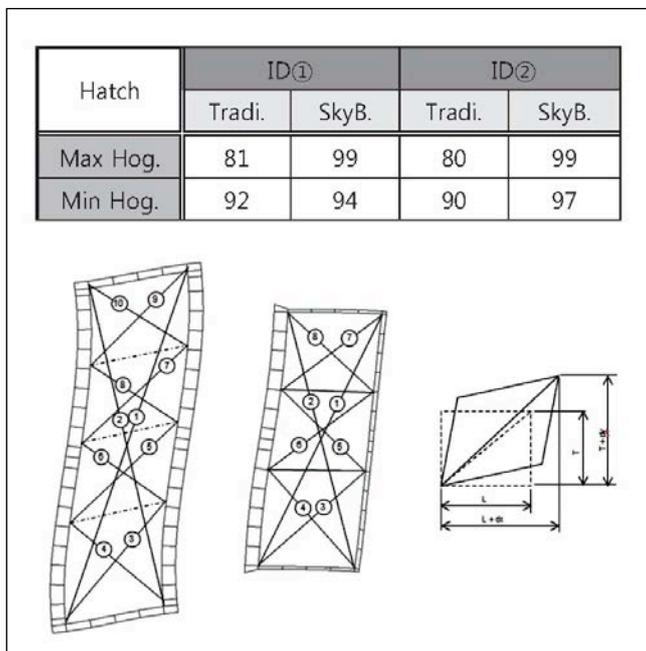


Table 1: Maximum deformations of hatch diagonals in a 14,000TEU containership (mm)

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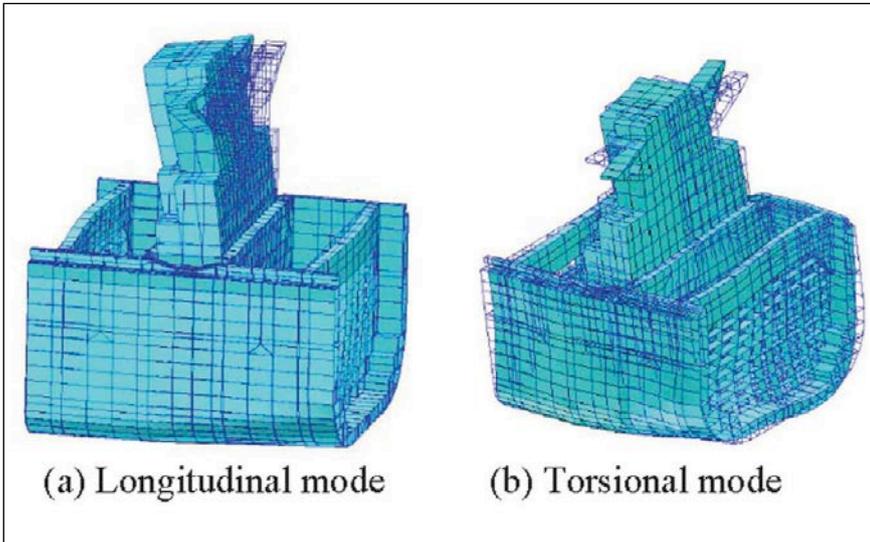


Figure 10: Dominant vibration modes in a traditional design

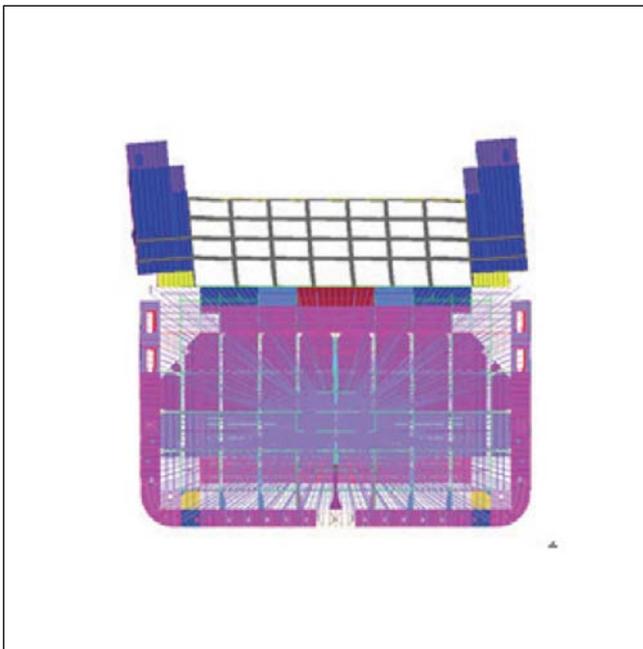
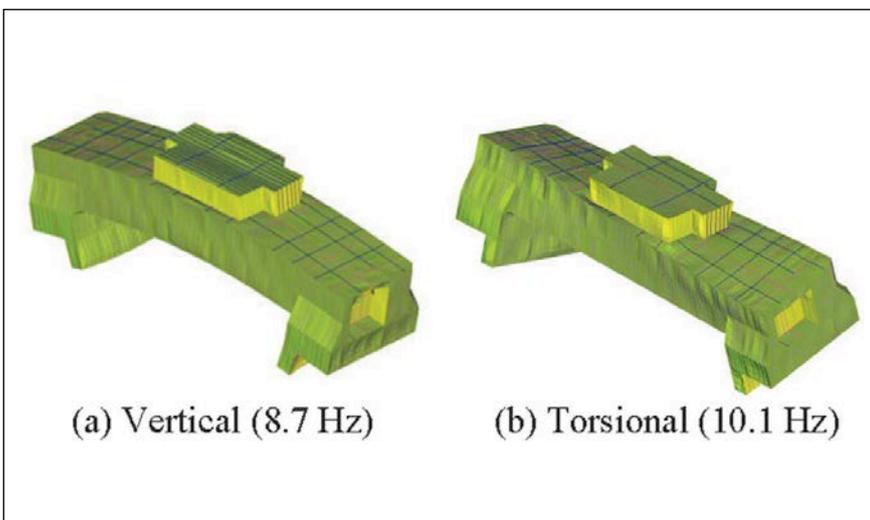


Figure 11: The 1st horizontal mode of side towers in SkyBenchTM (4.2 Hz)



vibration modes of accommodation in traditional designs.

On the other hand, the vibration characteristic of SkyBench is totally different from the traditional. The side towers are an assembly of hull structures welded on the upper deck. The dominant vibration mode of the side towers is horizontal and its natural frequency is expected to be around 4Hz, as shown in Figure 11 for a 14,000TEU container carrier. In the longitudinal mode, its natural modes have not been found to be in the range of up to 13Hz, which could be expected from its geometry with a longer length and lower height.

The vibration characteristics of the mobile part in SkyBench depend mainly on the following:

- Moving method and mechanism
- Sea-fixing method and devices

Considering these aspects, vibration analysis of the mobile part has only been done with both free boundary and simple boundary conditions at certain locations. For example, Figure 12 presents the dominant vertical and torsional modes of the mobile part in free boundary condition. From the numerical analysis, it is expected that the lowest natural frequency of vertical mode is around 8 ~ 9Hz and that of torsional mode is around 10Hz. However, these results can be changed according to the sea-fixing method of the mobile part.

In the case of noise, design criteria for crew cabins calls for a reading below 55dB(A) and, in a traditional two-island container carrier, noise levels of the accommodation area are easily kept below 55dB(A) as it is separated from the major excitation sources such as the propeller, main diesel engine, generator and so on.

SkyBench is quite similar to the traditional design in this aspect. But if the mobile section is well designed with a low noise transmission mechanism

Figure 12: The claimant vertical and torsional modes of the mobile part in free boundary condition

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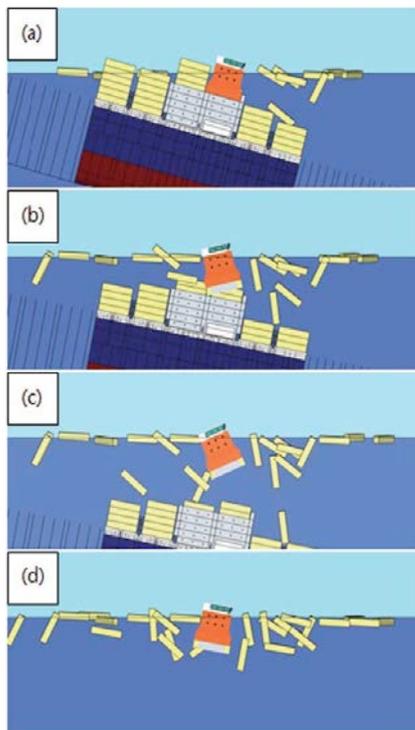


Figure 13: A new survival concept in ALS condition

- towers is kept by several groups of pipes and electrical wires. The pipes and wires resist all tensile loads which are the same as the buoyancy of the mobile part
- (c) The second stage is the fracture of the pipes and wires caused by over-tension induced by buoyancy exceeding a design value. The next is a complete separation of the mobile section from the side towers
- (d) Finally the mobile part floats with a designated draught on the surface stabilised with a certain degree of trim. The stability can be decided at the design stage. This can be realised if the horseshoe-shaped mobile part has non-watertight compartments in both sides of the lower part. When it floats, self-weight of the non-watertight compartment makes the mobile section straighten up and remain stable.

from the sea-fixing mechanism and side towers to the mobile section it could be relatively quieter, keeping the noise levels below 50dB could be achievable in the mobile part even when considering the independent heating, ventilation and air conditioning system.

### Saving grace

Perhaps one of SkyBench's greatest achievements is the possibility to introduce a new survival concept for an accidental limit state (ALS) condition.

Figure 13 explains an example, assuming the vessel is sinking. The following explains the survival concept:

- (a) Watertight design is applied to the structures above a certain level of the mobile section including portholes. When the ship sinks, the mobile part moves into deep sea together with the hull and starts to get sea pressure at the watertight level. The buoyancy increases as the water level rises
- (b) The first stage of separation from the side towers then starts. The sea-fixing parts fail due to an overload beyond the design limit and are separated from the side towers. The connection between the mobile part and the side

To adopt this concept, the designer should set the following as one of the core design factors:

- Limit of trim and heel in sinking scenario
- Strength of sea-fixing devices and its braking force
- Total sum of tensile strength of pipes and electric wires.

In addition to the above, the designer should take a scenario with relatively low probability in accidental situations into consideration to increase the probability of survival.

The SkyBench containership design has been applied to increase space utilisation using the concept of a mobile accommodation area. It can provide owners with maximised utilisation of space through loading more cargoes compared with a similar size of conventional design.

HHI's design can provide better intact stability and the cargo capacity of container carriers adopting SkyBench can be enlarged if the length-breadth ratio of the ship's dimensions becomes

smaller i.e. breadth is relatively bigger than length.

Global hull girder strength can reduce the still water bending moment by 5 ~ 10% compared with traditional designs. As a result, the reduction of lwt and relatively higher structural safety margins can be achieved. However, the proposed design may induce larger warping deformations of the hull girder and stress in hatch corners, but these adverse effects can be controlled by precise structure analysis and reinforcement around hatch and bench corners.

Vibration and noise characteristics of the SkyBench accommodation block will depend on the sea-fixing system of the mobile section and can be improved by an additional isolation mechanism of the sea-fixing devices compared with the traditional design.

Finally, a new survival concept is included with the SkyBench system automatically separating the mobile part from its supporting structures. **NA**

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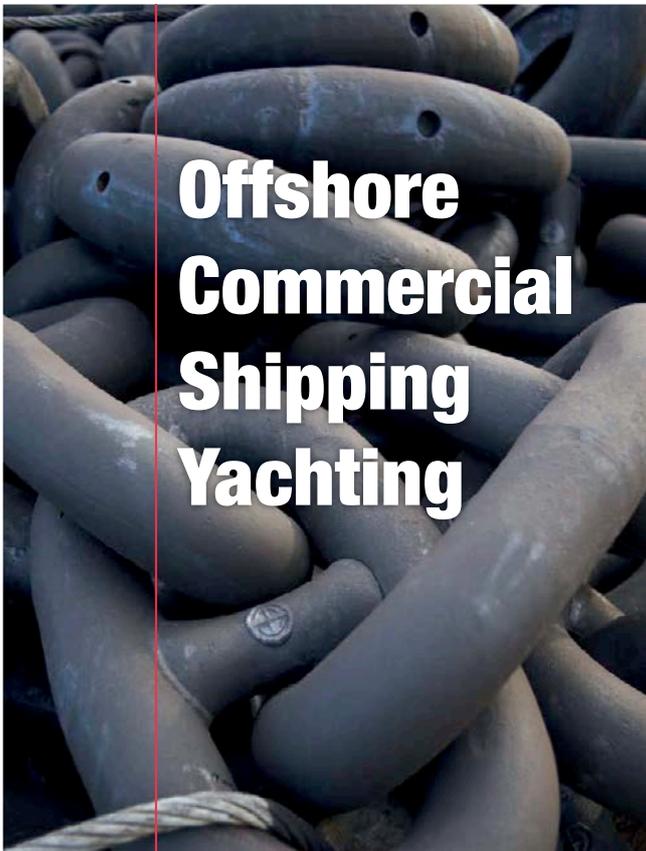
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# Super SAVER paves the way to cleaner shipping

Highly efficient ships are de rigueur for the modern day shipowner. But, for owners that charter out ships, designing a vessel to fit all eventualities becomes a tall order. Leading container ship owner Seaspan tells *The Naval Architect* how it went about building its latest vessel, the SAVER 10000

Designing a container vessel for an owner that charters vessels rather than operating them directly can be a more complex affair, not least because the ship may have to operate in a number of different trades and conditions.

Optimisation for such vessels is, therefore, significantly tougher and so the trend towards designing vessels for actual operational conditions, rather than to a single design point such as speed and design draught, can help to make certain a new vessel design remains competitive throughout its working life. Seaspan's latest series of 10,000TEU ships are

currently under construction at Jiangsu Yangzi Xinfu Shipbuilding.

Seaspan chief operating officer Peter Curtis told *The Naval Architect*: "These vessels have been specifically designed for Seaspan with our SAVER (Seaspan's Action on Vessel Energy Reduction) principals in mind. The motivation of the SAVER design is to reduce fuel consumption and increase the number of TEU carried while maintaining operational flexibility."

Designed by the Marine Design and Research Institute of China (MARIC) with model tests being conducted by the Maritime Research Institute Netherlands (MARIN), "The main challenge was ensuring a holistic approach to the entire design to ensure the proper balance between the selection of the hull form, structural strength, cargo arrangement and propulsion system," says Curtis.

According to Seaspan, the company worked closely with the yard, designers and testing facility throughout the design and construction of the vessels optimising the vessel's structural design, hull form, propeller and rudder and the main engines to provide the optimum match for all the variables.

"The main challenge was ensuring a holistic approach to the entire design to ensure the proper balance between the selection of the hull form, structural strength, cargo arrangement and propulsion system," explains Curtis. He goes on to say: "The SAVER vessels have been designed for a range of draughts



Peter Curtis, chief operating officer explains the development of the saver 10000

and speeds over which they are predicted to actually operate (these speeds and drafts were taken from operational data of existing vessels and discussions with the future charterers of the ships)."

As such the SAVER 10000 vessels are something of a compromise admits Curtis where the designers and builders needed to find "the correct balance" between hull and propulsion efficiency and cargo capacity.

"Maximising the propulsion efficiency of the propeller leads to high loading of the propeller tips which result in high induced pressure pulses which, in turn, results in high levels of vibration, which are objectionable to the ship's staff and detrimental to hull structures and machinery," Curtis explains.

TECHNICAL PARTICULARS	
MOL Bravo	
Length oa:	337m
Length bp:	320m
Breadth moulded:	48.2m
Draught	
design:	13m
Gross Tonnes:	112,083 MT
Deadweight:	86,000dwt
Daily fuel consumption (tonnes/day)	
Main engine only:	179.2 MT/day (NCR)
Main engine:	MAN B&W 10S90MEC9.2
Manufacturer:	CSSC-MES Diesel Co Ltd
Propeller(s)	
Material:	Nickel, Aluminium, Bronze
Designer/Manufacturer:	Nakashima
Number:	1
Fixed/Controllable pitch:	Fixed pitch
Diameter:	9.5m
Speed:	84 rpm (maximum continuous output)
Special adaptations:	Propeller Boss Cap Fin
Containers:	
Total TEU capacity:	10,010
On deck:	5,510
In holds:	4,500
Reefer plugs:	1,000 (FEU)

MOL Bravo the first of the super saver design



However, he also points out that: “Maximising the cargo capacity without building in extra unusable capacity requires a balance between the ship’s stability, hull strength, and strength of the cargo securing system. There is no point to increase the longitudinal strength of the hull if the ship stability or the strength of the cargo securing system will limit loadability before the extra hull strength and can be utilised. Likewise there is no use adding extra tiers of lashing bridges if loadability will be limited by hull strength or ship stability.”

Eating a pudding is, proverbially, the ultimate test of the chef’s art and the proof of this particular pudding will necessarily need to wait until the first vessel, *MOL Bravo*, is delivered later this year. However, comparisons of how the industry has developed since the banking crisis in 2008 are instructive.

Chinese operator COSCO took delivery of its 9,500TEU vessel, *Guangzhou*, in 2006 and, although this is a slightly smaller vessel, 109,000gt compared to 112,000gt



*MOL Bravo* features optimised capacity through the balance of stability and hull strength

for *MOL Bravo*, the comparisons are interesting. The 350-long *Guangzhou* has a design draught of 13m and a service speed of 25.4knots, burning 271tonnes of HFO per day.

The NCR for the *MOL Bravo* is rated at 179.2 tonnes per day at 15% sea margins; today’s vessels are operating on substantially less fuel, as Curtis points out a 9,600TEU

ship operated by Seaspan, at 20knots with a draught of 13m, consumes 98tonnes of fuel per day compared to the SAVER10000 which at the same speed and draught consumes 89tonnes per day.

“This is more impressive when you note that the SAVER 10000 has a deadweight of 86,000tonnes compared to the 83,330tonnes of the 9600TEU ship,” says Curtis. *NA*

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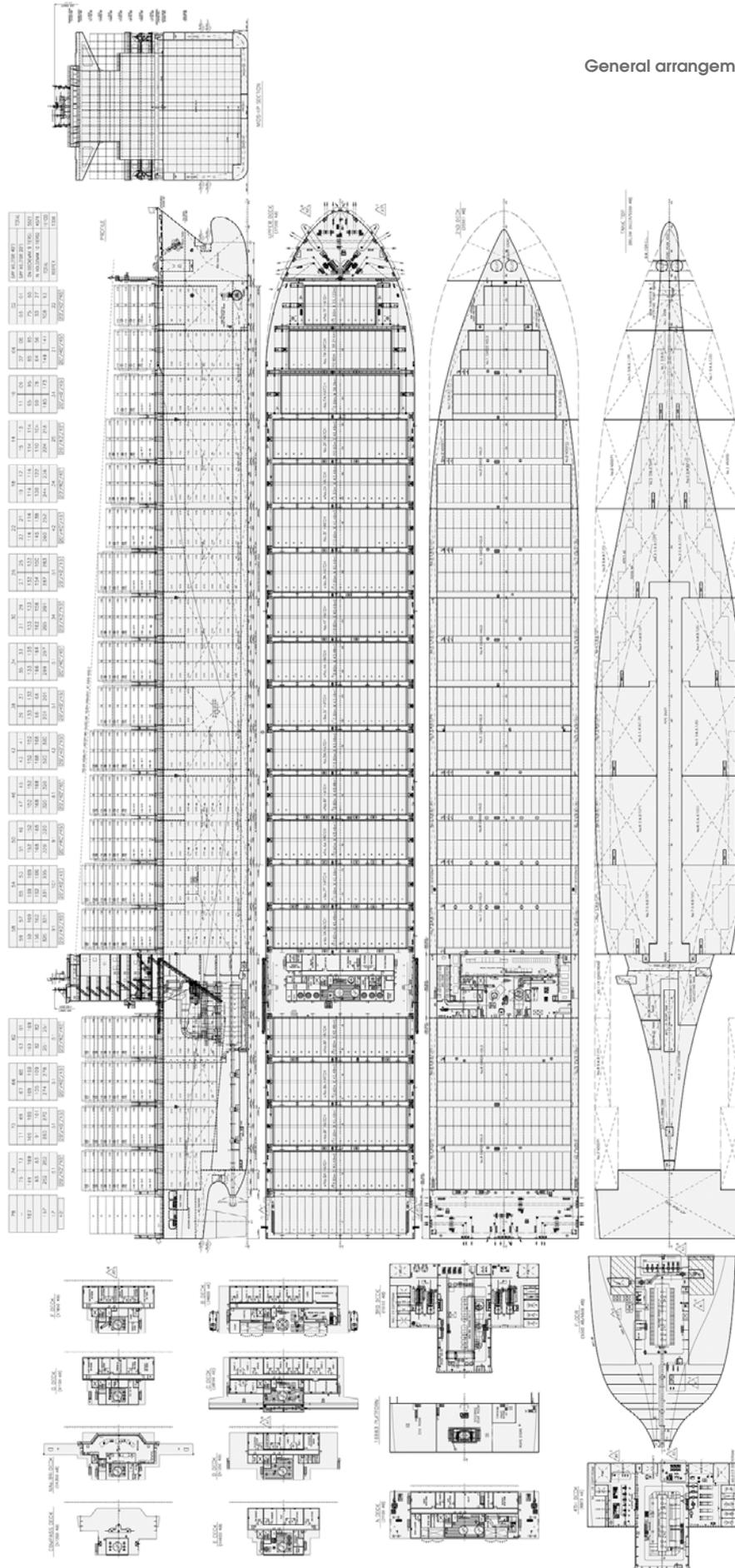
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# The TRIDENT method

Roberto Bencic, IT design & development engineer, USCS explains the development of TRIDENT a modular CAD system that is flexible in how it works with other systems

Since 1985, Uljanik Shipbuilding Computer Systems in collaboration with Uljanik Shipyard, has been developing its own CAD system (based on PTC CADD5i modelling foundation) named CADD5/TRIDENT. Special attention has always been given to the idea of product development through a precisely defined and well integrated shipyard information system and consequently, the integration of the CAD system with the surrounding systems (PDM, ERP, visualisation, document generation & distribution, etc.).

The experience gained in years of development of 3D modelling and documentation production tools, along with the use of various off-the-shelf visualisation tools, have shown limitations in developing and customising third-party products and subsequently led to the idea of developing of a new modular system planned and realised from scratch according to contemporary hardware and software platforms and user demands.

The result is the TRIDENT ShipExplorer suite, designed to complement the CAD system by using the 3D model data for production purposes. The modules (Figure 1) are technically and functionally adapted to the CADD5/TRIDENT system, they operate on various operating systems, and also provide the possibility to exchange data with other CAD systems and the integration with ERP, PDM and other systems. For the user, the suite represents a real collaboration platform supporting the development of complex products such as ships.

The first production version of the TRIDENT ShipExplorer suite was introduced in 2011 in all departments of Uljanik Shipyard (in the preparation and production phase) and since then more than 150 employees, with different qualifications and roles, have been trained to work with different parts of the suite. Since 2014 the use of the ShipExplorer suite has been extended



Figure 1: ShipExplorer: a new generation of TRIDENT modules

to the whole Uljanik Group (including 3. Maj Shipyard – Rijeka).

TRIDENT ShipExplorer development is based on the technologies that have proved particularly successful in the areas in which most important user requirements were stated.

## Graphical and non-graphical data

The transfer of the 3D model from CADD5/TRIDENT was made by means of the XML language by development of a XML schema which contains the complete model description (both graphical and non-graphical data and their hierarchical connections). The xsd programming tool for generating the XSD schema, which is basic to the source code generation, was adopted to handle the XML format.

## 3D graphics and interface

OpenGL library was used for the graphical presentation of the geometry, while the design of the user interface was done using the wxWidgets library.

The characteristic of these technologies is that they both efficiently perform in a multi-platform environment, which was one of the project requirements. The application itself was designed by using the C++ programming language, whose tools allow the complete control of the memory resources and, consequently, the creation of an effective programme code which maximises the processing speed.

## Connection with the ERP system

Since important pieces of information regarding the materials and equipment, their production statuses, technological process flow etc., are not part of the CAD system, the procedure for preparing the product structure is connected with the ERP system. In this way, all the 3D models data besides being saved in the XML files on the user server are also saved in the SHIPEX Oracle database scheme, which permits to add additional attributes to the structure nodes, not resulting from the CAD model, and to search the

whole product structure, without having to preload the XML structures of the individual hull blocks or outfitting spaces.

### System operating principles

The decomposition of the CAD models from the PDM or CAMU servers, the product structure generation and its publishing to the ShipExplorer user server for yards in production is done daily. Besides, users currently editing 3D models can initiate the creation of the local XML model and then visualise it. If the change in 3D model is of global importance, they can also initiate the publication of the new 3D model version on the server.

In order to interact with external users that are using different CAD tools, the important feature of the TRIDENT ShipExplorer suite is the possibility of 2D/3D data exchange via standard CAD formats (dwg, dxf, dgn, vrm, stl, blend, ...), or using the data defined with XML schema (e.g. Intergraph SmartMarine 3D, TRIBON Basic Design).

TRIDENT ShipExplorer suite currently consists of Visualisator, Drafting, Painting, Nesting, Welding, Measure and Pipe Production module.

The TRIDENT ShipExplorer Visualisator is used for exploring hull structure and outfitting models from initial design up to workshop models. The ship's hull structure and outfitting models can be opened from the user server or imported from local disk. Afterwards, a part of the model can be selected and transferred to TRIDENT Drafting, Welding, Pipe Production or other modules in which a specific action has to be performed.

ShipExplorer Visualisator contains all functionalities necessary for efficient exploring of the models and product structures: displaying single elements or branches of the structure, intelligent view manipulation, shaded or wireframe display, transparency levels, display non-graphical attributes (from CAD, PDM and ERP systems), perspective view, fly-through mode, etc.

Besides, ShipExplorer Visualisator has also advanced functionalities, e.g. hiding model parts by an arbitrary number of user defined cut planes, distance measurement in 3D space, mass and centre of gravity calculation for the selected elements, as well as a sketching tool.

“a part of the model can be selected and transferred to TRIDENT Drafting, Welding, Pipe Production or other modules in which a specific action has to be performed”

### TRIDENT ShipExplorer Drafting

The TRIDENT ShipExplorer Drafting module is used to create shipbuilding documentation (both hull and outfitting) from the underlying CAD models. It consists of a work area with a twofold function: a model window and a drawing window. The drawing view has the functionality for drawing definition and manipulation (also with the hierarchical structure), for adding model views (from the selected geometry or using cross-sections), for rotating and scaling views, adding details, labels, dimensions, etc.

The drawing description can be done with the standard tools for dimensioning,

text input, symbols, labels, but a number of more advanced functionalities have also been implemented: for example, attributes such as workshop labels, thickness, are dynamically updated, etc.

TRIDENT ShipExplorer Painting module is used for spaces definition and estimation of paint quantities. The Nesting module is used for nesting of shipbuilding plates and profiles, giving a broad palette of functionalities for nesting and cutting process definition. The Welding module is used for automatic (rule based) or manual welds definition. The Measure module is used for definition of measuring requirements and data for the selected hull structure and export of the measuring points to the measuring device. The Pipe Production module is used for pipe spools definition, generation of pipe spools sketches, reporting, changes control and data preparation for pipe cutting and bending machines.

### Further development

At the present time, the development of the TRIDENT ShipExplorer application is advancing on a number of levels:

- The development of the user interface – includes the production of the complete user interface using OpenGL technology, customisable user preferences etc.
- The development of modules intended to function as tools within the application – includes, for instance, the

Figure 2: ShipExplorer Visualisator user interface

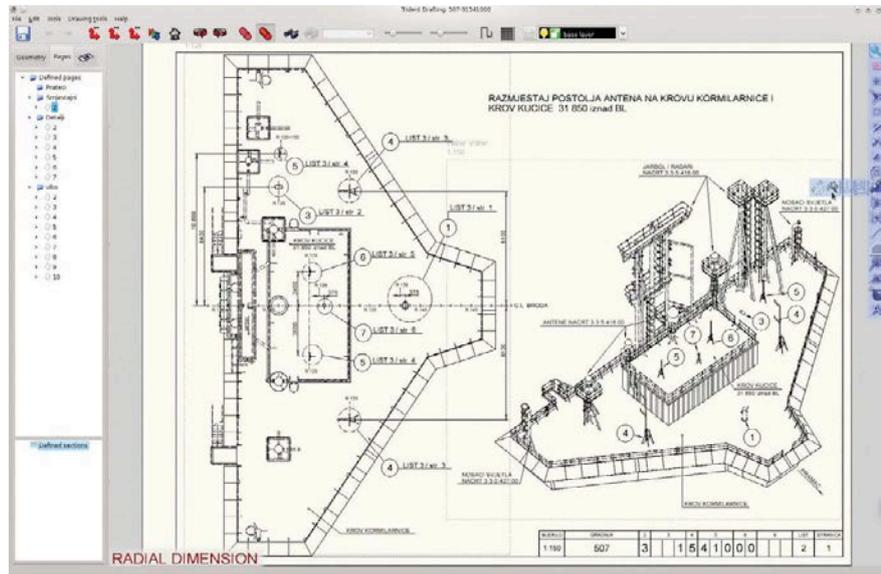


Figure 3: ShipExplorer Drafting user interface

development of different specialised modules, for example, for mass distribution analysis, etc.

- The development of visualisation techniques – includes the development of the walk-through mode which could result in the development of a real stereo 3D display (using active or passive 3D technology).

The long-term plan is to develop a simplified version of ShipExplorer by means of HTML 5 standard with extensive usage of WebGL, which would extend the use of visualisation tool (corporation web portal, various Internet services, etc.). The development of a mobile version of the application is being considered too (Android, iOS),



which would make it available to the full range of technologies like augmented reality and others could be exploited. NA



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# Modern interfacing from SARC

The beta-testing days are over for the new user interfaces of SARC's latest PIAS (naval architectural calculations), LOCOPIAS (loading computer software) and Fairway (hull design, transformations and fairing)

The latest development from the Dutch-based software developer now sees a new interface that has been made available to all existing users and new users, who will no longer see the old interface. SARC has gradually introduced the new interface to existing users, allowing both versions to be used.

Bart Soede, naval architect at SARC, explains that: "Though some first-day users have to get used to the new interfaces (sometimes after having used the old ones for over 25 years), the learning curve has been shortened and flattened for new users."

Positive reactions from prospective clients at the recent SMM exhibition in Hamburg following some live demonstrations have confirmed that SARC has made the right choices for the new interfaces: multiple separate modules were combined, the software now provides better and more graphic feedback, the help function has been made context sensitive.

Some final changes to the interfaces will be made over the next year or so with additional separate modules that will be integrated in the new-combined-modules, and the current backward compatibility (allowing the alternative use of old and new interfaces) will be dropped. Forward compatibility will ensure that the new software will still work with older files (after automatic conversions of files if so required).

SARC has said that it has listened to market demands and interoperability is one of the buzzwords.

PIAS and Fairway now provide for multiple open interfaces to external software to retrieve information from the defined model, for instance for construction modelling software. In addition, the open interface allows modifications to the subdivision as defined in PIAS. With the proper client application in place, the construction engineer may move (or add) a bulkhead in his construction model and the PIAS model will be altered on the fly via this open interface.



SARC introduces its new look to customers

Soede also explains that an industry project sponsored by the Dutch government has established firm 'proof of concept'. The interoperability implemented by means of SARC's hull (external and internal) geometry server allows users of different types and makes of software to jointly work on the same model, as if they were using the same system. Thus, a 'virtual system' is constructed where all are using their own preferred software, meaning engineers can cooperate as never before. If one changes a bulkhead position definition, this modification is available directly (in real time) to others sharing the same underlying model, regardless of the software they use to access it.

Similar interoperability between all PIAS modules is also offered, SARC named this the 'local cloud': changes to the hull model will be directly reflected in compartments,

resistance predictions, stability calculations, etc. all of the required models can be active at the same time and sharing the data, not via file operations, but via a shared 'local cloud'. Note that the 'local' aspect of this cloud simply means that the data are all available on a single system. This system is prepared for interoperability between separate systems connected via the internet.

Finally, SARC has reworked, cleaned up and expanded their extensive libraries of hydrostatic calculations, modelling tools, numerical methods, etc. to get rid of outdated and obsolete code and previous problems from the past (such as lack of memory). Soede adds that: "At this point in time, the average user would not notice the difference, but the expansions allow exciting new features, to be developed in the (near) future." **NA**

# 2D in a 3D world

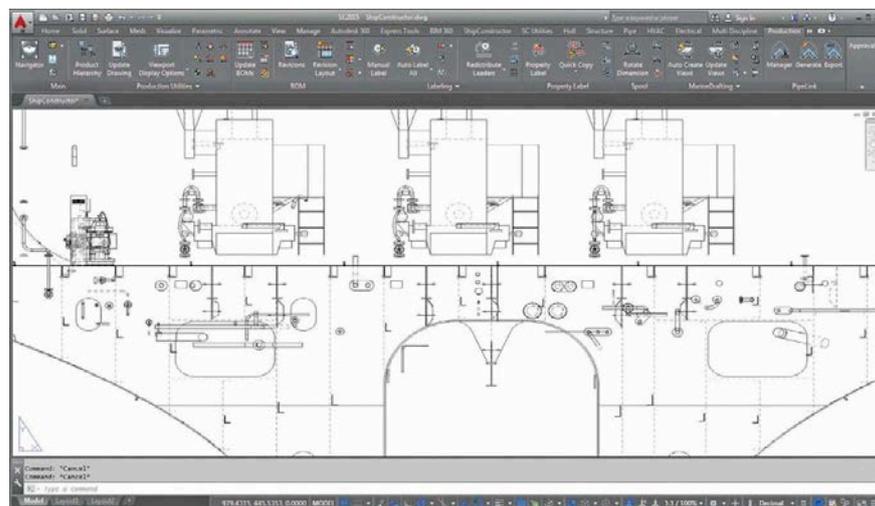
Mark Waldie, Darren Larkins and Denis Morais, SSI, Canada explain how 3D technologies can enhance 2D approval workshop drawings

In an industry that has adopted 3D technologies in almost every aspect of the shipbuilding process; 2D approval workshop drawings still play a critical role. Therefore, methods have to be found to handle both approaches.

Initial design software is used to create the surface model of a hull which is utilised, among other things, to perform a range of hydrostatic and hydrodynamic analysis. That hull form, along with other information like general arrangements, is used as the foundation for the basic design. As part of the basic design process, 2D approval drawings are created for inclusion in the package of drawings sent to the appropriate classification society. Typical examples of these classification approval drawings are those that detail the layout of typical planar sections (frames, decks, and longitudinals). These drawings get reviewed and theoretically, a shipyard should wait until approval to do further work. However, the reality today is that even before this happens, work is being done on the design and engineering model and nowadays, that is typically done in 3D.

## 2D Vs 3D (why not standardise?)

To unify the process, one might logically ask why all work is not done in 3D or conversely why it is not all done in 2D. After all, both methods could theoretically handle most of the key requirements of the design and engineering process. For instance, to the trained eye, a properly executed set of 2D class approval drawings provide a decent enough 3D picture of the vessel being designed. This is accomplished through the use of an incredible amount of symbolic detail that is laboriously added to a drawing. The detail ranges from specific line styles (thickness, continuity, colour, etc.) used to communicate additional information,



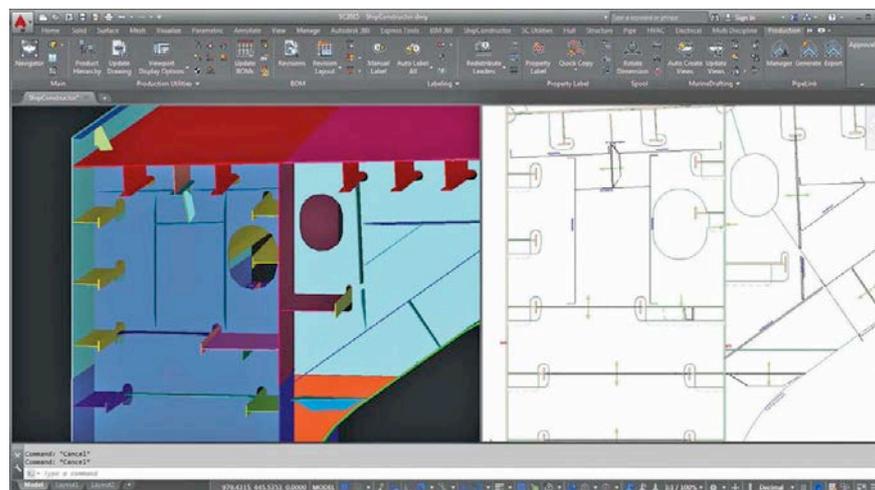
2D Drawing Created by ShipConstructor MarineDrafting

such as the side of the plate to which a stiffener is attached, to specific symbol standards used to represent various items such as flanges, profiles, types of welds, etc.

But, there is a problem. Due to the depth of information that is included in these drawings in this fashion, they are perhaps one of the most difficult drawings to create and read. Accurately detailing and interpreting 2D approval drawings in the marine industry continues to require extensive specialised knowledge and skill. And even then, to be blunt, 3D is better

(and even necessary) for many tasks such as visualisation, analysis, simulation and checking the design.

So why not do everything in 3D? The answer is that it would require a degree of standardisation and interoperability between each of the multitude of 3D CAD systems that does not currently exist. Classification societies simply cannot be expected to maintain a library of 3D software applications and the trained people to use them. By contrast, 2D drawings can be sent in industry standard CAD formats such as DWG, or



Profiles attached to plates - from 3D model (left) to 2D drawing (right)

simply in PDF, without the requirement for any application-specific intelligence or conversion, 2D drawings therefore remain the deliverable of choice.

Nowadays there is a mix of 3D and 2D software that is utilised. Classification drawings are typically developed in 2D software (e.g. AutoCAD) but, separate applications are often used for the development of a 3D design and engineering model. That approach solves the problem listed above but, unfortunately results in duplicate effort, rework and error. To try to solve this new problem, several shipbuilding specific software packages can now generate class approval drawings from the 3D model. Once again, there is a weakness. These programmes lack the detailing capabilities offered by AutoCAD so in practice, AutoCAD is still used as well. Thus, the problem with duplicate effort remains and is compounded as changes occur because the drawings are disconnected from the 3D model.

### MarineDrafting

To overcome that issue, SSI has released an application called “MarineDrafting” as part of its ShipConstructor software toolset. SSI’s MarineDrafting allows standard 2D AutoCAD drawings to be automatically generated from the 3D ShipConstructor model according to specific class rules and shipyard standards while remaining linked to the 3D model as changes occur.

The reason that this is possible is due to the underlying technology at the heart of SSI’s ShipConstructor software.

ShipConstructor sits on top of AutoCAD foundation, which gives it the ability to utilise built-in AutoCAD capabilities such as hidden line removal (HLR) and AutoCAD drafting standards, plus the ship specific information stored in the ShipConstructor model, to ensure that the 2D drawings generated from MarineDrafting are of the highest fidelity and can be easily detailed to suit specific needs.

Secondly, ShipConstructor stores information in a 3D model that is defined by relationships between the individual geometric elements as well as by the complex logical relationships that exist in a real ship. Stiffeners attached to either side of a plate as part of a panel, or the cutout caused by a shell stringer passing through a transverse plate are examples of this type of relationship. The ability to easily extract both types of information from the model, during the generation of drawings or while manually detailing afterwards is of critical importance to this approach.

### How it works

Unlike historic approaches, and the products that follow them, the process followed by MarineDrafting requires a 3D model to be developed from which 2D drawings such as Class Approval drawings can be extracted. Clients begin by developing libraries of symbolic geometry and rules. Libraries packaged with the product, or employed on previous projects, are configured for the particular class rules or production processes to be used on the current project. Once a 3D model has been sufficiently

developed, sections through the model are defined either automatically by the software for major groups, or dynamically by the user. These sections, in conjunction with the rules and symbols defined earlier and are used to automatically generate the 2D drawings.

In order to align with the skills and tools typically employed in the creation of this type of drawing, all output from MarineDrafting is generated in the DWG format using only native AutoCAD geometry and can be edited using available AutoCAD commands and tools. This gives the proverbial “best of both worlds”. The engineering work can be done in 3D while the classification drawings can be detailed in 2D using AutoCAD’s drafting toolset. Most importantly, with MarineDrafting the 2D drawings and all native AutoCAD geometry in them remain associatively linked to the 3D model.

This last point is key because in shipbuilding, there are always changes required, especially when you note the fact that engineering work is being done even before classification societies have given official approval. Fortunately, with MarineDrafting accommodating change is easy and errors are prevented due to the connectivity between the 2D drawings and the underlying 3D model. Using SSI’s Associative DWG technology, any drawings that have been generated can be updated as the model changes without losing any additional detailing work that has been performed.

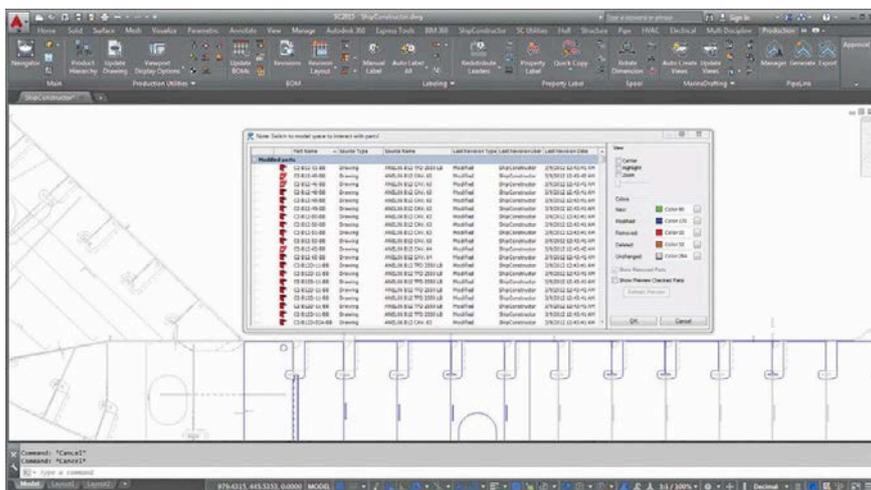
### Conclusion

Both 2D and 3D are necessary in shipbuilding. It is critical to tightly connect both approaches so that there is no wasted effort or processes that could create errors when changes to designs inevitably occur. The MarineDrafting product as part of the ShipConstructor software portfolio from SSI is a solution to that challenge. From an intuitive 3D model, it generates 2D drawings in the popular DWG based format while maintaining a constant associative linkage. **NA**

### Authors’

Mark Waldie is the PR Coordinator for SSI.  
Darren Larkins is the CEO of SSI.  
Denis Morais is Chief Technology Officer

Change management within approval drawing



# SENER expands creative range

SENER has announced the development of its FORAN V70R3.0, which will bring new capabilities for more complex projects

**S**ENER announced at its bi-annual forum earlier this year that it would be launching the latest version of its FORAN software that would see many improved features. (See: *The Naval Architect*, July/August, pg 26-28)

The latest release includes an FGA module for the generation of the general arrangement that will allow the quick definition of compartments and spaces in 3D. This module incorporates new functionality for the early positioning of equipment in the 3D model that can be linked to the spaces of the ship and will be integrated with the rest of the outfitting solutions in later design stages.

A new module, FABASIC, groups all the former applications related with the naval architecture calculations, storing the information in the FORAN database and allowing it to organise the concepts in a hierarchical tree. New enhancements are the

interactive definition of loading conditions and user-defined stability criteria, are all integrated with the spaces and volumes defined in the FGA module of FORAN. SENER says that FBASIC will be finished in December 2014, with the incorporation of the deterministic stability module (FLOOD), probabilistic method (FSUBD) and the module for the launching (LAUNCH).

The latest release also sees improvements the structure model definition with fast generation of fabrication outputs. Another noticeable feature for users is the structural parts by BREP and new enhancements in the generation of a simplified model to be exported to FEM tools, reducing dramatically the time during the analysis process.

The re-developed solution FSYSYD for the diagrams definition adds functionality, such as new instrumentation lines according with ANSI/ISA-S5-1-1984/1992 regulation. The communications with other systems

has been improved and it is now possible to export multiple diagrams in PDF format. Other options are the automatic labelling and improvements to check the diagram integrity. Some of the upgrades are improvements to FDESIGN and have been made to optimise the labelling, the possibility of having drawings of sections defined in different planes and more properties for distributors containing different heights referred to decks.

For piping some other aspects that have been added to the FPIPE module include a new entity for equipment assembly, the replacement tool for straight fittings in pipelines and other functionality in auxiliary structures and supports. Within the electrical design in FORAN, FCABLE reduces the wasted gaps in the cable filling and allows the user to export cable transits to Hawke's HDS. Whilst, the module FREPG for reports generation allows users to define labels including a QR code. *NA*

## RINA-QinetiQ Maritime Innovation Award

Innovation is key to success in all sectors of the maritime industry, and such innovation will stem from the development of research carried out by engineers and scientists in universities and industry, pushing forward the boundaries of design, construction and operation of marine vessels and structures.

The Royal Institution of Naval Architects – QinetiQ Maritime Innovation Award seeks to encourage such innovation by recognising outstanding scientific or technological research in the areas of hydrodynamics, propulsion, structures and material which has the potential to make a significant improvement in the design, construction and operation of marine vessels and structures.

The Award is made annually to either an individual or an organisation, in any Country. Nominations for the Award may be made by any member of the global maritime community, and are judged by a panel of members of the Institution and QinetiQ. The Award will be announced at the Institution's Annual Dinner (tbc).

Nominations are now invited for the 2014 Maritime Innovation Award. Individuals may not nominate themselves, although employees may nominate their company or organisation.



**QinetiQ**

- Nominations may be up to **750 words** and should describe the research and its potential contribution to improving the design, construction and operation of maritime vessels and structures.
- Nominations may be forwarded online at [www.rina.org.uk/MaritimeInnovationAward](http://www.rina.org.uk/MaritimeInnovationAward) or by email to [MaritimeInnovationAward@rina.org.uk](mailto:MaritimeInnovationAward@rina.org.uk)
- Nominations should arrive at RINA Headquarters by **31 December 2014**
- Queries about the award should be forwarded to the Chief Executive at [hq@rina.org.uk](mailto:hq@rina.org.uk)

# The quest for a safe use of FRP in shipbuilding

Tommy Hertzberg, Franz Evegren, SP Fire Research, SP Technical Research Institute of Sweden explain the advantages of using fibre reinforced plastic composites for shipbuilding

**E**nvironmental and economic advantages from using FRP (fibre reinforced plastic) composites in shipbuilding are well recognised from numerous studies [1, 2, 3, 4, 5]. In particular due to the appearance in 2002 of a performance-based regulation in the SOLAS fire safety chapter, the last decade has seen many investigations on various lightweight ship designs.

In spite of all declared advantages, a commercial breakthrough for FRP in shipbuilding is still pending. The main obstacle has been, and still is, knowledge on how to manage fire safety when a combustible material is used instead of steel.

A major hindrance is also the inherent conservatism in a business where novel designs imply high financial risk-taking and where steel behaviour and characteristics are built-in to existing regulations and minds. For a couple of years now, discussions have been ongoing within the IMO on how to handle the commercial interest in FRP and in particular on how to support national authorities in their safety evaluations of ships with FRP structures. This article gives short descriptions of the status within the IMO FRP correspondence group and of the on-going development towards lightweight shipbuilding.

In 2002 a new SOLAS regulation in the fire safety chapter, regulation 17 "Alternative design and arrangements", opened the way for new and unconventional ship design; it allows an alternative to compliance with the prescriptive SOLAS regulations to be adopted if, and only if, it can be proven that the safety level given by the prescriptive code is not adversely affected.

The interaction between a performance-based approach and a world accustomed to a prescriptive methodology is problematic. Particularly



Figure 1. Test performed at SP Fire Research within EU project "BESST" (5, 11) in accordance to SP Fire 105 (8). Unprotected panel test with sprinkler activated, 3mm/min, at 12:38 (upper right photography). At 12:43 (lower left) only the pool fire is burning

the lack of experience in judging whether a new design is good enough to be approved is often an obstacle. A relatively well-defined path founded on well-known prescriptive requirements is a much less complex approval procedure than to evaluate how objectives and functional requirements are achieved in a performance-based design.

SOLAS chapter II-2 regulation 17 provides a schematic procedure for how to perform an assessment that demonstrates that (at least) an equivalent level of fire safety is attained by an alternative design. Small deviations from prescriptive requirements are quite easy to manage by this procedure. However, for a larger project, such as a ro-pax superstructure

in FRP composite, the assessment might become dense by reports of experimental data, simulations, event trees and risk calculations.

Obviously, if the approval process is unfamiliar and the material is fairly unknown to the authority, which is often the case, the evaluation will take time and be costly. Recognising this, the IMO Fire Protection subcommittee designated a Correspondence Group in 2013 to develop guidelines for use of FRP composite structures on SOLAS vessels in conjunction with the performance-based regulation in SOLAS II-2/17. Hence, the regulation is valid and will not be changed but guidelines are developed to support the particular area of FRP composites in shipbuilding. The Swedish Transport Agency is leading the Correspondence Group, consisting of 12 country representatives and some NGOs. A first draft [6] was presented to the IMO SDC1 (subcommittee on Ship Design and Construction) meeting in January 2014 and a next version will be presented at SDC2 in February 2015.

## FRP composite and fire performance

The use of FRP for ship structures improves flexibility in design and allows for weight savings, improved stability and further provides thermal and sound insulation. The non-corrosive nature and good fatigue properties of the material help to ensure that characteristics remain more constant over the lifetime of the vessel.

From a fire hazard perspective, the material can potentially provide energy to a fire, even though the main hazard might be a structural collapse due to the heating of the polymer. However, from a fire containment perspective, the material is actually better than metallic structures since the heat

evolved will be better contained in the fire room due to the high insulating quality of FRP composites. It implies a lowered risk for fire spread through the enclosure boundaries.

In general terms, fire safety engineering strategies for using FRP composites in shipbuilding are fairly straightforward and easy to understand. In order to avoid a heat induced structural collapse of load-bearing FRP structures, cooling by water (see figure 1) or use of insulation or astute structural design are proven remedies. The first two options mentioned are also valid to mitigate other relevant fire hazards, such as fire spread and fire growth. To prevent fire involvement of FRP, much research has been put into finding polymers and fire retardants (see figure 2) that will make the FRP composite more prone to resist fire exposure (e.g. in the EU project "Fire Resist" [5]). Several good systems also exist on the market today.

### Critical players and stakeholders

E-LASS, the European Network for Lightweight Applications at Sea was founded in June 2013 [1]. The network consists of stakeholders from the entire maritime industry. Presently, 200 persons from 140 organisations and 24 countries are registered members of E-LASS, which clearly demonstrates the level of interest for lightweight materials in the marine business.

At the kick-off meeting in Borås, September 2013, many previous and ongoing research projects were described in a seminar (presentations can be found at [1]). Both civil and military experiences were presented, including management of regulations and results from fire experiments (see e.g. figures 1 and 2).

Shipping business might, schematically, be divided into users, producers and authorities. No ships with FRP composite will be built unless shipowners demand the material; yards must know how to build in FRP and the authority must provide guides for approval.

Not all shipowners have the technical capability to develop new and innovative designs, but some certainly do. The authorities (flag, class) are mostly reactive to market demands but also to political

strategies, which might have significant impacts [9]. Perhaps the most critical stakeholder for the development towards FRP composites in shipbuilding is the ship yard. The yard must guarantee flag approval of the design and must judge whether the design is competitive or not on the market. If the ship yard is willing to invest in development of internal know-how and also to take the economic risks, the market will certainly open up. Kockums ship yard in Karlskrona, Sweden, has played a key role in the development of the Swedish fully composite 73m long Visby class stealth corvettes. The product has been followed by two Indian corvette (P28) superstructures in FRP composites and recently also by an order for superstructures in FRP composite to the Singapore navy.

Two interesting civil applications were described at the second E-Lass meeting in Papenburg, March 2014; a river cruiser sun deck in FRP composite was shown by the Meyer-Werft ship yard and the cleverly designed FRP hatch covers for a large ship from the Oshima shipyard, in Japan, were presented at the seminar [10]. The fact that two such globally important ship yards are showing strong interest in FRP composites is indeed a good sign for what might be a general acceptance of the material in shipbuilding. [NA](#)

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Figure 2. Test as in fig 1, however no sprinkler was used. Intumescent surface coat and flame inhibitors in the polymer matrix. Flaming seen on the photos are from the pool fire beneath the panel. Virtually no energy contribution at all from the panel during the fire test



## Hi-Fog gets a revamp

Marioff, now part of the United Technologies group of companies, has revealed that it will be launching the next generation of its HI-FOG high pressure water mist nozzle series by end of 2014

The latest HI-FOG 3000 series will have a very robust design and is developed to give even better coverage than existing sprinkler heads, which can be adapted to individual areas with an optimised pump size. The further development of the high-pressure sprinkler mist system has included comprehensive fire tests with the focus on accommodation areas as well as public and service spaces onboard ships, all in accordance with the latest IMO regulations.

The current HI-FOG offering by Marioff also incorporates a dry pipe system with spray-heads especially designed for machinery spaces, which means that the pipes will remain empty of water until the system is activated, either automatically by the fire detection system in case of local protection, or by manual release in case of so called total flooding, which covers the entire engine room including bilges.

“The machinery system activation is done by our remote-controlled HI-FOG section valves, which also gives you the advantage of activating specific areas separately, or all together, if so desired,” explains John Hemgård, director of marine business at Marioff. “Our HI-FOG total flooding system provides high-pressure water mist into all compartments of the engine room including bilges.”

In addition to the automatically released HI-FOG local engine protection, the total flooding shall always be manually released from the engine control room when so decided by the crew, into all machinery sections and bilges in the entire machine room, in case of an extensive fire.

Hemgård says that the advantage of having a high-pressure water mist system as opposed to CO<sub>2</sub> systems is that of crew safety. “With HI-FOG you do not have to evacuate the area first and neither do you need to close off the entire engine room and if the HI-FOG system is activated accidentally there is no danger to those crew. The low water consumption of our water mist system does no harm to machinery either as HI-FOG works well with machinery components which have IP44 class protection,” he adds.

Marioff’s HI-FOG total flooding system is readily available and has been type approved



The next generation HI-FOG 3000 is expected to deliver better coverage

by Lloyd’s Register (LR) and other major classification societies as a primary fire protection system of machinery spaces, whereas CO<sub>2</sub> can be used as secondary redundant back-up.

Hemgård further reveals that after the soon-released HI-FOG 3000 sprinklers for accommodation and service spaces, Marioff is next year expecting to launch its next generation HI-FOG pumps to the maritime market.

United Technologies Building & Industrial Systems (UTC BIS) amalgamated its climate and controls side of its business last year; among the companies that were brought into under the UTC BIS banner were Otis, Carrier, Autronica and Marioff. By coordinating the activities under one “marine umbrella” UTC enables utilisation of its latest technology for its portfolio offering of marine solutions, services and expertise to shipbuilders and owners, explains Hemgård. [NA](#)

### Autronica takes control

Behind modern fire extinguishing systems lie’s a control system, which “knows” when to trigger the sprinklers or other systems required. Autronica developed its Integrated Safety and Emergency Management System (ISEMS), Autromaster ISEMS, which manages several systems onboard. Frode Lund, managing director, Autronica explains that the system is still evolving as new technology comes on to the market. The Autromaster ISEMS monitors the total fire detection system and provides heat and smoke detectors that have seven indication levels of smoke density plus two levels of heat readings even after alarm. This allows the system to graphically display smoke and heat spread in real time on the safety centre. The system senses the danger, controls the valves to release the water into the pipes.

Autronica ISEMS covers SMS, fire dynamics simulator (FDS), emergency shutdown (ESD), DSS and interfaces for control and monitoring of the CCTV, LLL, High Voltage, Dangerous Goods, Safety Plan, Fire Doors, WT Doors, VDR, Elevators, Fire Dampers, Smoke Extraction Fans and several other systems on board. ISEMS also provides an Electronic Plotting Table and provides the crew with training modes and replay / storage functionality to make sure the crew can learn by using the system on a daily basis.

Lund also highlights some of the current challenges that the technology is facing when it comes to regulation and safety standards. “We see that with safety standards, sometimes the industry finds them difficult to implement, so the regulations change to suit,” he says. However, Lund urges shipowners that are looking to invest in the latest fire safety equipment that they need to look at the lifecycle cost and not just the purchasing cost of the system.

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# Fighting fires effectively and efficiently

Water mist is a proven fire-fighting solution onboard ship and owners are increasingly aware of the advantages of low pressure systems, writes Stein Lovskar, commercial development manager, Wilhelmsen Technical Solutions

**F**or a fire to survive, it must rely on the presence of the three elements of the ‘fire triangle’: oxygen, heat and combustible material. The removal of any one of these elements is enough to suppress or extinguish a fire.

While traditional water sprinkler systems remove only the heat element of the triangle, water mist systems remove both the heat and oxygen elements by dispersing water through specially-designed nozzles.

The smaller a water droplet’s size, the larger its relative surface area becomes and thus the more effective the system is in rapidly reducing the temperature of a fire. To put it another way, when water is converted to steam – which is what happens to the water droplets in water mist – then a large amount of energy is taken from the fire, which results in rapid cooling whilst the formed steam displaces the oxygen.

The development of the water mist system over the recent years has been able to offer customers a more flexible solution that has a wider application. After the ban of Halon gas fire extinguishing products in 1996 most ships then went back to CO<sub>2</sub> systems and then the development of foam, water and other chemical fire suppressants were developed. Although CO<sub>2</sub> is still a popular extinguishing product, a water mist system can cater for areas of 5-10,000m<sup>3</sup> and can be applied to all areas of the vessel.

## Low pressure vs high pressure

As a result of their proven effectiveness in fighting fires, water mist systems have become increasingly popular in shipboard applications. First to the market were high pressure water mist solutions, but low pressure systems are increasingly preferred by owners and yards. The key



Stein Lovskar, commercial development manager, Wilhelmsen Technical Solutions explains the advantages of water mist systems

reasons for this are their easier and less costly installation and maintenance.

In addition, low pressure systems have simpler piping requirements and less risk of clogging. Using a common pump unit and control system makes it simpler to operate and maintain. Furthermore, low pressure systems have lower power

requirements than high pressure ones, providing a further potential saving in emergency generator costs.

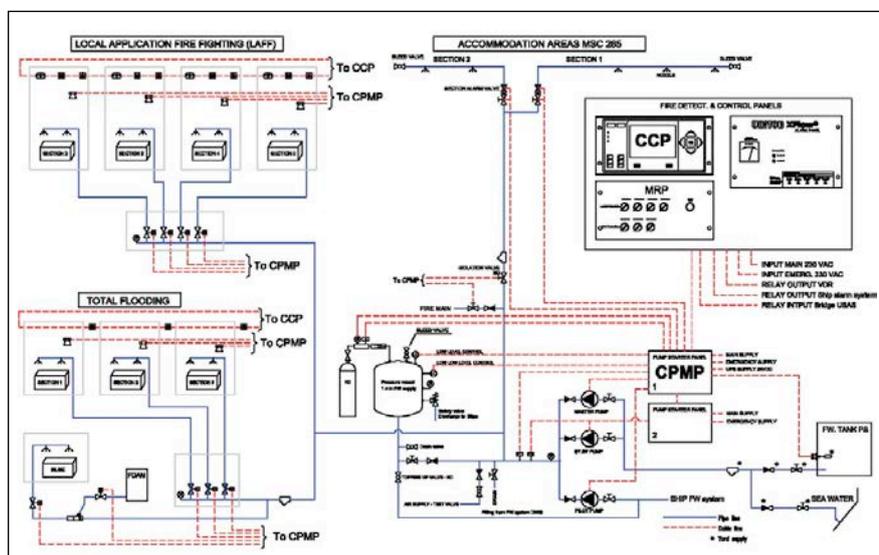
All water mist systems must pass the same performance-based tests according to IMO requirements. As a result there can be no difference in the extinguishing efficiency between low pressure and high pressure systems.

However, there remains a misperception that low pressure water mist systems use more water than high pressure systems. But, approval data published in DNV EXCHANGE demonstrates that there is very small difference between the systems and that low pressure systems can even use less water on occasions.

## Fire-fighting in sensitive spaces

Owners naturally have concerns when it comes to the combination of water and electrical equipment. However, a review by Liu and Kim[1] of water mist fire suppression cites several studies showing that water mist is effective in electronic equipment applications and does not cause short circuits or other damage.

Water mist may in fact have some advantages over gas-



Unitor XFlow water mist arrangement

based fire suppressants due to its heat removal mechanism, which may help to prevent melting of wire insulation and other materials, and due to its non-toxic quality, which may allow uninterrupted human occupation of the compartment. Water mist can be used in a room where equipment with an Ingress Protection (IP) rating better than IP22 is located.

Another misperception is that low pressure systems can cause more damage to electric and electronic equipment than high pressure systems. In fact, cabinets and cables may be better cooled by the larger water mist droplets.

### Unitor XFlow

Since 2012, Wilhelmsen Technical Solutions (WTS) has supplied the Unitor XFlow water mist fire-fighting system alongside its other solutions. Unitor XFlow is a low pressure water mist system with a combination of very fine and larger droplets. Using the patented XFlow nozzle technology, this

low pressure system can provide protection volume up to 5,000m<sup>3</sup>; a volume which traditionally has required a high pressure system.

The system is performance-based, meaning that its operation is verified at an independent test facility to an IMO performance standard. In addition to machinery spaces, water mist fire-fighting systems can be specified for accommodation and balcony areas in the cruise and leisure yacht markets. Unitor XFlow is tested according to multiple IMO standards. For Local Application: IMO MSC/Circ. 1387, Total Flooding: IMO MSC/Circ. 1165 (with scaling according to circ. 1385) and Accommodation: IMO Res. MSC. 265(84), replacing IMO Res. A.800 (19).

More and more leading companies have specified Unitor XFlow, particularly those building high-specification tonnage. For these applications, owners selected a low pressure system for its reliability, ease of operation and maintenance, low power

consumption and cost effectiveness. The low power consumption in particular reduces the prioritised load requirement from the generators and lowers the capacity drain from the emergency generator.

Supported by the dedicated WTS technical and operational team, Unitor XFlow provides a proven option for owners and yards seeking a highly efficient and cost effective fire-fighting solution.

More regulations with regards to fire standards will be coming in to effect, especially for new type of ships such as LNG and battery powered vessels. The challenge for the future will be creating the appropriate safety standards for these vessels. **NA**

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# Viking innovates for better standards

Viking Life-Saving has released a further two products to bring better standards of lifesaving equipment to the market

With recent incidents such as *Costa Concordia* and *Sewol* ferry there has been a strong focus on the lifesaving equipment market and what it can do to improve safety. However, the lifesaving equipment manufacturers providing the equipment and training believe there is also the operational element to be considered.

Hans-Henrik Madsen, vice-president global service, Viking Life-Saving, explains that: “the equipment is tested in heavy weather sea trials and is designed to perform in list and trim conditions heavily regulated by SOLAS and will inflate automatically when the hydrostatic release unit (HRU) is submerged in water. However, in a highly unusual case where evacuation has not been initiated in due time and the ship capsizes, the conditions are outside the realm of the equipment design.”

Madsen goes on to explain that liferaft systems are currently tested for 10deg list and 20deg trim to meet with the SOLAS regulations. One of the main constraints of placing a liferaft is the height at which it can be placed on the vessel, taking this into account and that of the location of muster areas onboard, give an indication of where the systems should be located on a vessel.

One of the most recent developments from Viking Life-Saving is its yellow high-visibility exposure suit, where the company has switched from the



Viking Life-Saving's latest development for the safety market, the PV9340, high-visibility immersion suit

traditional orange to yellow because it is easier to spot in the water, it says. The latest immersion suit also features

better insulation with a Polyurethane (PU)-coated nylon outer fabric and a separate quilted thermal liner for better insulation.

Madsen adds that the suit has been developed for crew that work outdoors and would wear it in combination with a lifejacket for added buoyancy. Testing of the suit has been carried out both by clients and internal testing at Viking Life-Saving. In addition, the company has launched its work wear lifejacket, PV9340 which comes with a uniquely designed buoyancy chamber with integrated cleat attachment, the company claims for better in water performance and safer recovery.

The launch of Viking's Life-Saving's LifeCraft, last year, saw the company move into the larger mass evacuation systems market. Madsen highlights that: “the market is now steering towards increasing safety and comfort of these systems onboard passenger vessels.”

The latest super-sized, flexible evacuation system is a hybrid that brings together the best of both lifeboats and liferafts. The LifeCraft allows in one system, four liferafts to be launched with a capacity of 200 persons per craft, a total capacity of 800. The LifeCraft is also a self-propelled inflatable vessel with four engines for a high degree of manoeuvrability and safety. The system comes with a stowage and launching unit and can either be placed on deck or built into the vessel. [NA](#)



Vikings LifeCraft system on the water



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UBM

## Fighting fires with knowledge

Fire safety training is something that most of us have encountered, where we learn the basics of handling and dealing with the danger of fire. But, the quality of this information for those working onboard vessels is even more essential

Videotel has launched its updated five-part series of *Fire Fighting at Sea*. The training includes scenes filmed onboard *Vectis Osprey* and aims at giving crew basic and refresher training on how fires start, how to prevent them and their role in combatting fire onboard a ship.

“The aim of the training package, which includes a comprehensive workbook, put simply, is to save lives. Under the Standards of Training Certification & Watchkeeping (STCW) rules all crew, from officers

through to ratings, must receive training in how to prevent and fight fires. This new five-part series is aimed at all ranks – basic training for seafarers just starting out in their careers and refresher training for officers and seasoned crew. The workbook provides advice to trainers about how to divide the video viewing into sections suitable for different audiences. There are case studies to trigger discussion and a series of tests to check comprehension,” explains Nigel Cleave, CEO, Videotel.

The programme covers topics that are required under STCW. Cleave says that the screening of each video and the study or discussion of extra materials in the workbook should take a minimum of one hour, with the course having the potential to be completed in 10 hours, plus the tests. The material is designed to stimulate practical sessions on board the vessel itself, putting into practise some of the learning points highlighted, so the actual impact on training is on-going. [NA](#)

## Getting out of the water

One of the key elements of ensuring that a person will survive a MOB incident is by getting them out of the water as quickly as possible. Cobham’s latest product development, Survivor+, brings a solution to the market that does exactly that

The all-in-one life jacket and liferaft has been developed from a need in the market for more accessible safety products. Don Blackman, senior research & development manager, Cobham explains that the need has become apparent that current lifesaving equipment is not always effective in certain situations and that lives are still being lost at sea because the necessary equipment cannot reach them, such as in the case where life preservers are thrown.

From the key element of how to get someone out of the water as quickly as possible, Cobham started to investigate possible solutions to achieve this by looking through its product portfolio. From this a vacuum-packed liferaft has been developed. “There are no systems, which you can get people out of the water in this way,” claims Blackman. “It is about survivability and this system looks to increase that by decreasing the risks of being in the water such as hypothermia, cold water failure and spray,” he explains.



The Survivor+ weighs 6.5kilos and is worn like a typical lifejacket. The front part of the system is the same as a life preserver with a vacuum-packed liferaft in the back. Survivor+ automatically deploys when immersed in water and is ready in roughly 60 seconds.

Blackman says: “The system is designed to be worn when crew are outside. As part of the research carried out they were tested to be worn 100% of the time and were tested in cycles of 8-10hours.”

The Survivor+ has completed all the materials and performance testing required under the IMO Life-Saving Appliance (LSA) Code, Section II which was issued by Lloyd’s Register. Due to the systems uniqueness it has undergone three levels of testing and specific testing as a life preserver and as a liferaft. [NA](#)

Survivor+ has the look of a traditional life preserver but with the addition of a personal liferaft built in

# LSA gets innovative about safety

Liferaft Systems Australia has been developing new lifesaving equipment that is to focus on the ease of use for passengers and crew

**T**he Liferaft Systems Australia (LSA) research & development department is currently working on a new marine evacuation system (MES) that will be significantly lighter, smaller and safer to use, the company says. Prototype testing has started and approval testing the equipment will commence by the end of this year.

LSA says that it places considerable emphasis on the importance of effective crew training and work in close partnership with all ship operators to ensure crew training is optimised. “We believe that MES training is important for all crew regardless of their function onboard, therefore non-seafaring crew members can be easily trained to deploy the LSA MES. LSA provides a bespoke Power-pointbased interactive training presentation and crew operation manuals with each ship set of MES as a minimum,” says Peter Rea, European manager, LSA.

In addition to this LSA offers tailored training packages to all vessel operators. For example, qualified LSA MES training instructors can train an entire ship’s crew or ship operator training personnel who are then qualified to train their own crew. LSA also offer a comprehensive range of aids to complement theoretical and practical training programmes. “One of the unique aids offered is the LSA Mobile MES training unit. This effective unit comprises a 6m MES slide and large capacity liferaft which is easily transportable and can be quickly erected in a convenient location on shore or on the vessel car deck,” adds Rea.

LSA also encourages ship operators to use mandatory periodic MES deployments as crew training exercises. To witness the MES being deployed is the most effective training experience. LSA says that it ensures that its regional representatives attend these deployments regularly to give continuous support to shipowners and operators with specific regard to improving training provision.



LSA's 14m MES deployed from Boreal Transport Nord AS vessel *HUSØY* built at Fiskerstrand Verft

In recent times passenger ferries have increased capacity. LSA are of the opinion that large capacity liferafts need to have more than one crew to ensure that all safety concerns are addressed. Currently the regulations require only one crew per liferaft, irrespective of liferaft capacity, however LSA are of the opinion that any liferaft with capacity greater than 135 persons should be allocated additional crew as a mandatory requirement. LSA are in discussions with flag administrations with regard to the minimum crew member requirement for large capacity liferafts. This is in line with lifeboat requirements regarding concerns regarding large masses of persons in a confined space and in an emergency scenario.

LSA is continually pursuing ways to improve the design of the inclined slide-based MES, which was first conceived in 1992. The original design concept from LSA was to have an MES, which was easy to deploy and provided a rapid yet safe evacuation for all persons regardless of age, physical size, ability,

disability or injury. The LSA MES can be deployed by one person either at the MES station or from the vessel bridge. Unlike alternative MES, the company says there are no complicated winches, hydraulics, electronics or connections to the ship’s power required. The LSA MES is comprised of an inflatable MES slide and pre-connected large capacity liferaft. If additional capacity is required then additional liferafts stowed elsewhere on the vessel are deployed and positioned at the outboard side of the liferaft connected to the MES slide.

Therefore, if the MES station is inaccessible or unusable due to collision damage or fire for example, then additional liferaft capacity is still available. The Norwegian Maritime Authority (Sjøfartsdirektoratet) identified this as an issue in 2013 and specifically focused on MES, which may have more than one liferaft stowed in a single container or packed together in a single unit. Ensuring there is always sufficient redundant capacity will enhance the overall safety of the vessel.

LSA MES are installed globally on a large number of passenger and personnel carrying vessels of all types and sizes including high speed and conventional passenger ferries, naval vessels, special purpose ships and large private yachts.

LSA has several projects within the passenger ferry sector currently. LSA is providing evacuation systems to two LNG-powered ferries for the Norwegian operator Boreal Transport Nord AS, being built by Fiskerstrand Verft in Norway. The vessels will be delivered in 2015 and will each have two LSA 14m MES with 100 person self-righting liferafts. This follows on from the successful completion of a four-ship contract for the same owner, also built by the same shipyard. The double-ended conventional ferries each had two 14m MES. Two of the vessels had LSA 128 open reversible liferafts installed while the other two had LSA 100 person self-righting liferafts installed. *NA*



LSA's Mobile Training Unit as used by BC Ferries

## Virtual medical treatment over the air

Imtech Marine has announced the launch of its Telemedicine package that will allow crew to have access to in-depth medical treatment onboard

**M**edical emergencies can occur at anytime and anywhere and with access to the appropriate medical services out at sea not readily available. The Telemedicine package will offer crew access to emergency aid at the touch of button.

Rob Verkuil, general manager connectivity, Imtech Marine, explains that: "Today if there is a serious incident onboard, the crew does not have access to the high-tech equipment and diagnostic tools that are need to treat or handle a serious injury without calling for the aid of the coastguard."

Telemedicine allows the crew to contact a specialist at a medical or virtual emergency room (VER) for medical advice and guidance, and bring specialist care to the patient onboard. Imtech Marine says that it has set up a VER at a hospital in Bremen, Germany.

The audio/video communication to the VER and the real-time transmission of the patient's vital signs enable the specialist on

shore to get an impression of the patient's condition and an informed diagnosis. A crew member can be guided through all the necessary measures to aid the patient.

"Crew members may only have basic first aid knowledge. With Telemedicine it gives them access to someone that can guide them in carrying out more specific procedures to help that crew member," adds Verkuil.

Imtech Marine says that Telemedicine is easy to use for those without medical training. The system allows correct first aid treatment much easier and provides necessary information for a follow-up treatment. The specialist on land can diagnose the symptoms and the severity of the emergency, initiate important medical steps, make recommendations to the crew, give instructions for treatment or request the rescue of the patient. If necessary the patient can be monitored by the specialist until the arrival of an emergency service on-site.

The Telemedicine package features an emergency system for first aid on site, 24/7 access to high-level medical service, real-time audio/video connection, transmission of all vital parameters via wireless connections, accurate assessment of the situation and advice on patients rescue; if needed, audio/video guided first aid treatment, competent diagnosis and therapy instructions, integration and fixed installation inside the sick bay possible and electronic documents of all incidents.

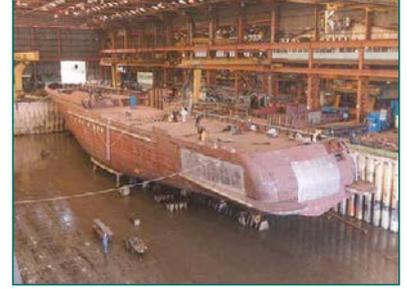
The technical requirements of running Telemedicine is a connection of a minimum 128kbit/s and optimum 512kbit/s. Verkuil says that it is advising customers who buy this package to use a VSAT system or Inmarsat Fleetbroadband FB500 along with supporting antenna and communication system in case of power outage. Imtech Marine has sold its Telemedicine package to one owner, with more orders coming as this technology becomes more prominent, explains Verkuil. *NA*

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

The 3<sup>rd</sup> RINA International Conference on Ship & Offshore Technology in Indonesia will take "Developments in Ship Design & Construction" as its theme, and will bring together members of the international maritime industry to present and discuss the latest developments in the ship design and construction process which will provide the improvements in productivity and cost-competitiveness necessary to respond to the demand for lower cost of ownership and greater environmental sensitivity. Whilst covering developments in all ship types, it will look particularly at developments in those vessels which are essential to the economies of countries in the region, e.g. fishing vessels. Papers are invited on the following topics for all ship types:

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# Hamburg Nordic orders LNG container feeders

Environmental control areas are changing the economics of shipping and, therefore, changing the design of vessels. Operating from the Baltic to the UK, Finnish operator Containerships with its partner, shipowner Nordic Hamburg, have ordered four LNG powered feeder ships to operate the route

Operating solely in an environmental control area (ECA) Containerships with its partner, shipowner Nordic Hamburg, has decided to order four 1,400TEU container ships with four options from the Guoyu Shipyard Yangzhou City of Jiangsu Province in China.

The ships are owned by Nordic Hamburg and will be delivered in the second half of 2016 and the first half of 2017, before going on to long-term charter to Containerships operating on a loop from St Petersburg, via the Kiel Canal to Rotterdam and the UK.

Operating at a speed of 19knots the 170m vessels will have a capacity of 1,368TEU and will have specially designed cell guides within the cargo hold that will allow the vessels to carry 45ft containers along with a total of 372 reefer boxes.

Dr Rowil Ponta tells *The Naval Architect*: “These vessels are the first LNG container vessels” and “they employ state of the art technology.” He says that there are essentially two options open to owners who operate in ECAs, they can use either liquid or gas fuels.

The choice is to buy expensive low sulphur distillate fuel, which must have less than 0.1% sulphur content from January 2015, or an owner can retro-fit scrubber technology and continue using HFO, or order new vessels fitted with dual fuel engines which can also operate on LNG as Nordic Hamburg have done.



Nordic Hamburg and its partners have ordered four 1,368TEU feeder ships with four options for delivery in 2016 from the Guoyu Shipyard in China

“In the long run the ECA zones will be widened, the EU and the US are leading the way today in the future there could be an extension of the European ECA to the Mediterranean and the Chinese are spending billions of dollars to convert coal fired power stations to LNG,” says Ponta. He added that: “LNG is the best [fuel] you can have in an ECA zone”.

Although Ponta does also point out that for international trade the global supply chain of the fuel is not yet in place, but for local operators in ECA areas the system can work efficiently, while acknowledging that there are some developments that still need to be made to make LNG an even better choice, such as solving the problem of methane slip.

Powered by seven cylinder Wärtsilä 50DF low pressure LNG and diesel dual

fuel engines the ships are well equipped to operate continuously within an ECA zone and can also revert to HFO should the ships sail outside of the sulphur restricted regions in the Mediterranean, for example.

Dutch naval architects SMB have designed the vessels in partnership with the owner and the yard and the designs include some innovations, including the hull form and the cargo flexibility with the vessels’ ability to carry a mix of box sizes and the high number of reefer plugs.

Nordic Hamburg is in the process of selecting a LNG fuel system provider, Ponta says the company has narrowed the choice down to three possible choices, Wärtsilä, TGE and MAN with the company set to award the contract as the magazine goes to press. All the systems use Type-C fuel storage tanks. **NA**

**TECHNICAL PARTICULARS**  
**1,400TEU container ship**

Container capacity:	1,368TEU, including 639 x 45’ft
Deadweight:	16,900dwt
Length overall:	169.95m
Reefer Plugs:	372
Service speed:	19knots

# The LNG virtual pipeline

As interest picks up in LNG, Gaslink looks to supply to the more niche pockets of the market that are developing

Portuguese LNG Logistics company Gaslink has been working on its shipping links for lower capacity LNG routes that do not require the expense of an LNG carrier, but where there are growing pockets of LNG development that still need the supply of LNG.

For this Gaslink uses ISO intermodal cryogenic containers to ship LNG across short sea distances with 40 specially designed containers made by Chart Ferro. By using cryogenic containers means that the shipment of LNG can be done on a routine basis and in effect create a LNG virtual pipeline.

Gaslink, a Grupo Sousa company early this year started a new route for the shipment of LNG from Sines LNG Terminal through Lisbon to Madeira for the Madeira island LNG satellite plant, also operated by the company. The LNG satellite plant has an energy output of up to 450GWh/year. The operation took less than a year to put into place, the company says and in the first six months of operation of this route Gaslink has claimed that more than 600 LNG ISO containers have been successfully supplied.

The ships that operate on the route are operated by Grupo Sousa, a relevant



Pedro Amaral Frazão, director & COO, Gaslink explains development of short sea LNG shipments

maritime operator and shipowner in Portugal. Each container vessel, currently two on this route, are currently carrying around 14 to 15 cryogenic containers, equally around 30 containers in transport at a time with each container having a capacity of around 36m<sup>3</sup>.

Pedro Amaral Frazão, director & COO, Gaslink explains that there are still challenges in the regulations of LNG, such as the stowage of the containers which must be transported on deck due to the safety aspects. Also, the

containers either full or empty are treated as they are full and must have segregation space. He adds from a safety aspect that Gaslink has easy access and clear coordination and communication lines with the vessels that operate the service, for any cases of emergency. There is a clear protocol in how the containers are handled and monitored along the logistic chain.

As for the shipment of LNG, Frazão says that the main concern does not stem from a regulation base, but in operation and the handling of this type of cargo and containers at the terminals. He continues by explaining that traditionally there are three main ways in which containers are moved from ship to quayside, the best solution for handling this type of cargo is through ship to shore cranes.

This form of shipping can provide a cost effective solution for the needs of smaller LNG installations. Frazão highlights that the latest installation cost €12 million (US\$15 million) and took less than a year to go into operation, making it cheaper and easier to operate than a full offshore structure. Once the infrastructure is in place then it is just a matter of adding the ships to freight the LNG to the plant. In future Frazão adds that this solution may be applicable to low sulphur emission areas, where there is a virtual pipeline in place to supply the fuel needed for the maritime community. *NA*

Gaslink operates a service where up to 30 specialist containers are in transit creating a constant supply chain



# Making the most of LNG

The take-up of LNG as a fuel is gathering pace with a number of deepsea vessel operators looking to order 'LNG ready' ships while the short sea sector has made some inroads with some firm dual fuel orders. As a result DNV GL is offering the industry a guide to handling LNG safely, which it has called Recommended Practice

At last month's SMM exhibition in Hamburg, Germany, Hyundai Heavy Industries (HHI) and United Arab Shipping Company (UASC) signed a deal for the development of 17 LNG ready container ships.

DNV GL will class the vessels and says that the ships will be capable of switching to LNG quickly and cheaply. Per Holmvang, DNV GL's programme director for environmental protection technologies and R&D, told *The Naval Architect*: "The new ships, 11 vessels of 14,500TEU and six 18,800TEU ships will vent points, a completed risk assessment, an engine that is easy to connect for dual fuel operations, space for vent ducts, space for fuel tanks and the space for a bunker station."

According to Holmvang the expansion of environmental control areas (ECA) is very likely with Japan, Turkey and perhaps the northern part of The Mediterranean all possible ECA zones.

If Holmvang is correct then the demand for LNG may well increase and it is with this view in mind that DNV GL has produced a guide to handling LNG for ship operators, bunker operators, ports and regulators alike.

According to DNV GL the main purpose behind the guide, called Recommended Practice (RP), is to protect life and the environment and to offer guidelines to the industry concerning "the three main elements for the safe development and operations of LNG bunker facilities: Safe design and operation, safety management systems and risk assessments".

It is understood that the two main differences between conventional fuel and LNG is the cryogenic temperatures



Tor Svensen (far right), CEO of DNV GL Maritime presents an Approval in Principle, recognising the technical feasibility of the LNG fuel system design for the A14 and A18 series of container vessels to HHI and UASC.

at which the LNG is stored and the low flashpoint of the fuel and that these differences require different handling and an understanding of the risks involved. DNV GL acknowledges that ISO guidelines for the use of LNG "explicitly" covers the three major elements and says that the ISO guidelines were used as the basis for the RP.

DNV GL says "The common ground is international laws and standards. These regulations provide an internationally accepted starting point for any development of bunkering facilities and their safe operation."

The RP was released earlier this year; however, the IMO Sub-Committee on Carriage of Cargoes and Containers which met last month has agreed a draft code for the handling of LNG (see News Analysis page 12).

With an agreed code the RP will set out specific methods for dealing with particular situations. We will look at LNG spill behaviour and flash fires and set out a clear requirement for certain accident scenarios with the idea that in

the event of an emergency the industry can do it right first time," explains Holmvang.

He insists that: "DNV GL is not giving the industry a solution, but a framework for the safe development of the LNG industry."

As such the RP can offer support for designers of bunkering facilities and operators of such facilities and the vessels taking fuel onboard. "The bunkering scenarios that are directly covered by this RP are those that are introduced in the 'ISO LNG bunkering guidelines' /1/: truck-to-ship, terminal-to-ship and vessel-to-ship. The methodology presented may with special considerations also be used for other scenarios or means of supply of LNG, for example for the use of portable tanks."

According to DNV GL the risks inherent in the bunkering of LNG are associated with the either the hardware or the location of the bunkering activity. This may vary depending on the level of traffic around the bunkering location, the size of passing vessels and

“simultaneous operations”, most notably the loading of passengers.

“This RP will assist the user in identifying and managing the different contributions to the overall risk picture.” There are at least three organisations involved in any bunkering operation, the supplier of fuel, the buyer of fuel and the regulator a fourth presence may be the terminal operator where the bunkering takes place who will be interested in the safety management of the operation.

The RP will also assist in the development of the bunkering facility including the strategy and feasibility, design, planning and construction,

and operation of the facility and the development of safety management systems and performing risk assessments.

It also outlines at length the various “layers of defence” including the equipment necessary to prevent spills and leaks, coupling and disconnection operations, venting masts, hoses and, amongst other items draining and stripping operations.

A second layer of defence looks at fire prevention, in particular it looks at the prevention of electrostatic sparks igniting the gas, cryogenic spill protection and leakage detection.

A final layer of defence is described by DNV GL as: “Emergency preparedness

which serves as the third layer of defence in terms of establishing emergency preparedness procedures and plans to minimise consequences and harmful effects in situations that are not contained by the second layer of defence.”

The machinery for LNG bunkering is slowly but surely being put into place. The Recommended Practice offers advice for safely establishing the infrastructure and as the vessels are now on order, such as UASC’s 17 large container ships, the demand from that infrastructure can be expected; particularly if the regulatory framework, such as the ECA zones, are expanded substantially. [NA](#)

## Latest CNG carrier on the blocks

The latest development of gas carriers, a 2,200m<sup>3</sup> compressed natural gas carrier, which will be classed by ABS

**A**BS says that before this project, there had only been conceptual designs for compressed natural gas (CNG) carriers. The CNG carrier has been designed at China’s CIMC Ocean Engineering Design & Research Institute for Indonesian owner Perusahaan Listrik Negara (PT PLN). The inaugural carrier will be 110m in length with a sailing speed of 14knots and will transport natural gas from fields in East Java to the island of Lombok for a CNG plant that will come into operation in 2016.

Rob Whitney, manger-marine, environment and LNG, ABS explains that for the type of route the vessel will be operating on a CNG carrier if more practical than an LNG carrier. “LNG carriers possess larger capacity, which makes them suitable for long distance transportation. But, since LNG carriers have high demands on temperature control and need to liquefy LNG before transportation and gasify the liquid gas before utilisation, the cost of transport is high.”

He further adds that the technical challenges with this type of ship, is the dual fuel propulsion system and cargo containment system band cargo containment system. As a loading container of transporting compressed natural gas, the cargo containment system is composed of about 800 cylinders, which maintain a high pressure of 25kg and at the same time ensure stability and safety during transportation. “ABS will focus on strengthening the value and piping system to reinforce the cargo containment securing system and its pedestal,” he adds. [NA](#)

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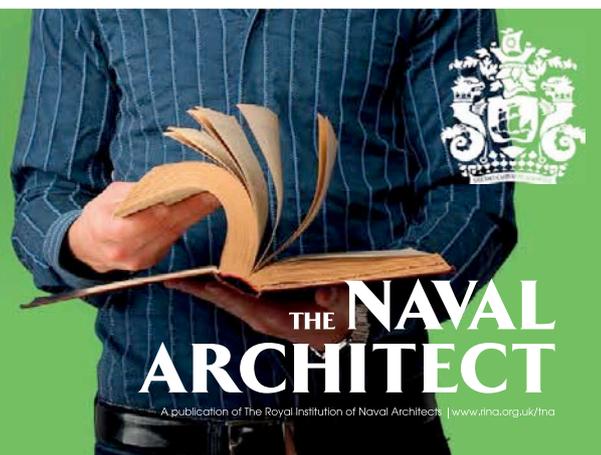


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# Is LNG a feasible fuel solution for short sea vessels?

From the 1 January 2015 the new sulphur emission regulations will come into force. Jan Jaap Nieuwenhuis, manager design department and Wieger Duursema, naval architect, Conoship explains the technical feasibility of LNG to meet the regulations

**F**or cargo vessels operating in Emission Control Areas (ECA's), which amongst others include the Baltic Sea, North Sea and the waters around the US, it will no longer be legal to burn fuels with a sulphur content over 0.1%. As a consequence, operating on HFO is no longer allowed, at least not without techniques that remove sulphur emissions from the exhaust gasses.

For new to build ships intended to operate part of the time in ECAs there are basically three options to comply with the regulations:

1. Switch to low sulphur marine fuels, such as MGO
2. Switch to another fuel type, such as Liquefied Natural Gas ("LNG")
3. Install an exhaust gas cleaning system: a (wet) scrubber.

There are more alternatives, including methanol, biofuels and renewable energy sources, but their availability is currently too low to be considered a viable solution.

Within the shipping and shipbuilding industry, various parties heavily promote LNG as the future fuel for (Short Sea) cargo vessels. Various examples have shown that operating a cargo vessel on LNG is technically feasible and also the availability of LNG bunkering facilities is rapidly improving. However, based on Conoship's experience from a large number of projects, Conoship came to the conclusion that, although LNG is currently undeniably one of the cleanest fuels and often a suitable solution, it is clearly not always advisable.

## Design considerations

To fully understand the impact of an LNG propulsion system on the design of short sea vessels, and to be able to give unbiased advice, Conoship

recently developed a number of LNG fuelled concept designs. These designs cover ships in the range of 4,500 – 12,000dwt. Conoship considers LNG to be a solution to be advised when:

1. The impact on the design is acceptable
2. The outcome of the economic analysis is in favour of LNG.

Both aspects are of course "linked", as the design impacts the economical/operational performance of the vessel.

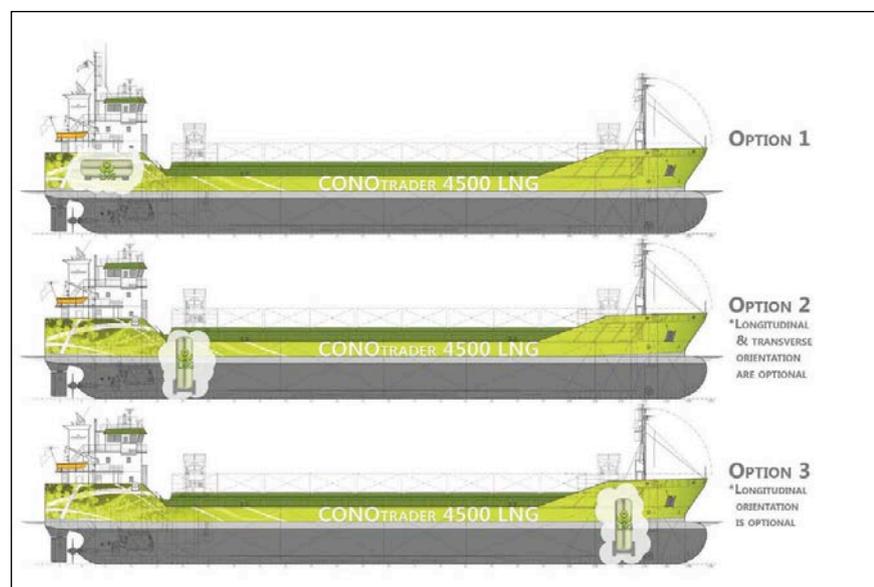
One of the important aspects in the design process for a ship with a LNG propulsion system is the selection of the engine type: dual fuel (LNG/diesel) or mono-fuel (LNG only). For the majority of the general cargo ships a dual-fuel engine will be preferred over a mono fuel engine, since dual-fuel engines of the recent generation allow a switch to the cheaper HFO when sailing outside ECAs. This will help to reduce the operational

costs as long as HFO is cheaper than LNG.

One of the other main aspects to consider when considering LNG as a fuel for short sea cargo vessels, is the required volume of the LNG tanks. A considerable tank volume is required to have a practically acceptable range since:

- The volumetric energy density of LNG is much lower than that of HFO
- Due to the cylindrical shape of the tanks used, the tanks have a low space efficiency, where HFO bunker tanks are easily integrated in the ships hull. There are other types of tanks, such as membrane tanks, but these tanks are much more expensive (for small quantities) and therefore not relevant
- Only about 80% of the geometrical shape of the tank can effectively be used as the maximum filling level is 90% filling to cover for expansion of the fluid and the minimum level is 10% to maintain the low temperature of the tank.

Figure1: Evaluation of LNG tank positions



	Reduction of investment costs					
	100%	100%	80%	80%	60%	60%
	Increase of total fuel consumption in ECA's					
MGO price	100%	130%	100%	130%	100%	130%
100%	7.9	6.1	6.3	4.9	4.7	3.6
120%	4.9	3.8	4.0	3.0	3.0	2.3
140%	3.6	2.8	2.9	2.2	2.2	1.7

For each project a careful evaluation of the required range and operating speed should be made, to define the optimal tank volume.

The required LNG tank volume will especially affect the design of ships for the smaller deadweight ranges up to about 5,000dwt. Within the range of up to 5,000dwt, very often the main dimensions cannot freely be defined by the designer because of a number of hard design requirements concerning (for example) gross tonnage, length or width. In many cases, trying to fit a LNG tank in such a vessel, will either lead to a smaller hold volume, or to a violation of one of the design requirements.

Further, the LNG installation will slightly increase the light ship weight of the vessel. But, in most cases it is possible to counter this effect by increasing the block coefficient of the hull, or by slightly increasing one of the main dimensions, without a large penalty in fuel consumption. For new designs, no problems concerning the trim and stability were encountered, as long as the LNG installation was taken into account from the beginning.

### Economic feasibility

The economic feasibility is a combination of the operational costs, the investment costs and the vessel's potential income. The investment costs of LNG systems are generally high: primarily as a consequence of the high purchase costs of equipment, but also the installation costs and engineering costs are significant. The operational costs for LNG are primarily a combination of fuel (LNG and MGO Pilot fuel) and maintenance costs.

To define the economic feasibility is not a 'static' calculation. The experience is that determining the economic feasibility is a delicate matter that stands and falls with parameters such as estimated time within the SECA, expected operational speed (defining the fuel consumption) and expected fuel pricing. Sensitivity analyses are required to get a feel for the economic feasibility of operating a short sea cargo vessel on LNG.

### Concept design

The concept design for a 4,500dwt LNG fuelled general cargo ship was based on the following design requirements:

- L < 85m;
- 4,500dwt;
- GT < 3,000;
- Single hold, box shaped;
- Large deck area;
- Sailing area Worldwide, but dominantly North Western Europe;



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The performance of this LNG-fuelled design was compared to a similar vessel operating on LNG.

To define the required tank volume, a typical operational profile for this vessel was defined in co-operation with a number of owners. This resulted in an expected average yearly fuel consumption, for the situation that (1) the vessel is allowed to sail on HFO inside ECA's (scrubber installed), (2) the vessels switches to MGO inside ECA's and (3) the vessel switches to LNG dual fuel:

1. MGO: 937tonnes of MGO (182g/kWh, 42.7MJ/kg, 840tonnes/m<sup>3</sup>).
2. LNG (dual fuel): 788tonnes of LNG per year (7505kJ/kWh, 49MJ/kg, 440kg/m<sup>3</sup>), and 13tonnes of MGO pilot fuel (2g/kWh).

Based on the expected required operational speed and sailing distance between bunkering ports, a relatively small 100m<sup>3</sup> tank was deemed sufficient for the ship. For the overall arrangement of the vessel the main question was where to place the LNG tank? Considering the requirement for a single shaped hold, and a large deck area, three optional LNG tank positions were evaluated.

The most elegant position for the LNG tank is to integrate the tank in the aft ship, close to the bunker station and the engines. In that position, the required double-walled piping distance is kept to a minimum. Furthermore, it results in the largest hold volume and for some owners

even more important, hold length. This solution will however result in a slightly higher gross tonnage, since an additional accommodation layer is required.

Together with equipment suppliers, the additional investment costs are estimated to be €1.5 million (US\$1.9 million). (relative to the benchmark vessel with diesel engine switching to MGO). It was further assumed that the maintenance costs for the LNG propulsion system are similar to the maintenance costs when switching to MGO. So the operational costs are dominated by the fuel costs. Bunker prices for MGO are estimated to be about €615 (US\$790)/tonne, of LNG it is estimated to be €480 (US\$616)/tonnes.

The total costs over a period x [years] are a combination of the operational costs and the investment costs:

1. Switching to MGO; There are no investment costs (benchmark);
2. Switching to LNG.

Based on the figure below, the pay-out period is about eight years. After eight years, operating on LNG will economically be more attractive compared to MGO, based on the current operational profile and current fuel prices.

### Sensitivity analysis

A pay-out period of eight years for a 4,500dwt vessel is currently too long to be acceptable for most shipowners. A sensitivity analysis provides insight in

the influence of the different parameters on the pay-out period. Because the pay-out period is currently too long, the parameters are influenced such that the pay-out period of LNG becomes shorter, ie; the variations show what should happen to make LNG a feasible solution. The applied variations are:

- Additional Investment cost reduction: reduction in two steps: 20% and 40% reduction to 80% and 60% of the current investment costs respectively;
- Total fuel consumption in ECA's: increase in one step, by 30%. ie; more time spend in the SECA;
- Fuel price increase of MGO: in two steps, an increase by 20% and an increase by 40%.

The resulting pay-out periods are shown in the table below. For a number of parameter combinations the pay-out period decreased to under five years, which by many shipowners is considered as a maximum pay-out period. *NA*

### Conclusion

The concept designs make clear that LNG can be a viable solution for short sea cargo vessels, but the actual feasibility strongly depends on the combination of the design requirements, the operational profile, the fuel consumption and the fuel prices. These parameters should be closely considered for each case separately, as clearly not in all cases LNG is the sensible fuel of the future.

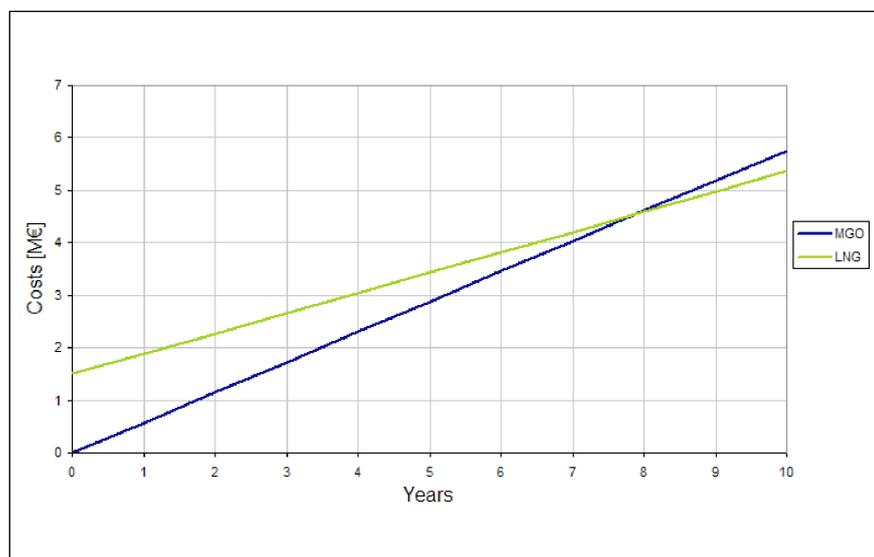


Figure 2: Payback time of operating on LNG

# VAF Instruments goes with the flow

Ship efficiency is increasingly important as fuel costs rise and environmental concerns are becoming more significant for the IMO, EU and shipowners alike. Edwin Schuirink, technical product manager, explains how flowmeters are an important piece of kit for the shipowner

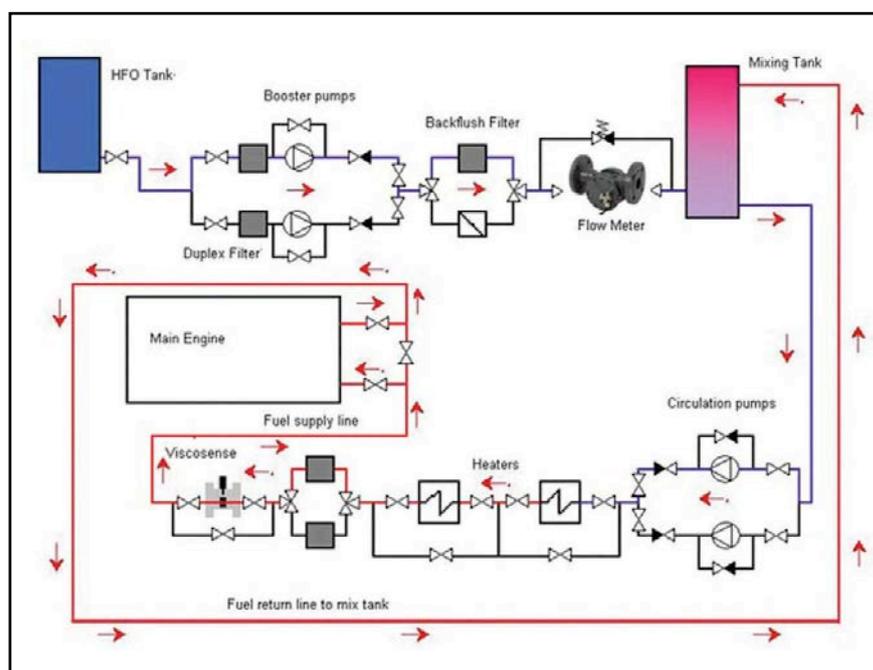
One of the most important and most frequently used measurements in this case is the measurement of fuel consumption, for which flow meters are used. Different configurations of multiple flow meters are possible, depending on the lay-out of the fuel system onboard and the number of engines to be measured.

During the last few years mass flow (coriolis type) meters are more frequently used onboard ships. In the past, the maritime industry did not consider a mass flow meter as a reliable solution for the harsh conditions found onboard ships, particularly when it comes to meters for bunker measurement, times are changing.

## Flowmeter accuracy

Due to the increasing awareness of fuel consumption, the accuracy of the flow meters is also of higher importance. The VAF PD (Positive Displacement) flowmeters, which are widely used in these applications, are precision instruments.

VAF's PT flowmeter



Fuel consumption monitoring systems can let shipowners monitor fuel consumption more closely

The measuring tolerances are less than 0.2% over a large measuring range. Each flow meter is calibrated on a high-end calibration rig, before it leaves the factory.

In the market, however, increasing numbers of users appear to believe that mass flow meters are more accurate than the well-known PD type meters. This tendency might be based on the idea that mass flow meters measure the mass directly by means of the coriolis principle. However, at a small measuring range the accuracy of a mass flow meter can be as high as the PD meter accuracy, but throughout the complete measuring range the accuracy of a PD flow meter is much higher.

When temperature measurement is integrated in the PD flow meter the measured volumes are automatically compensated for volume change due

to expansion. The disadvantage of the PD type meters might be that the crew uses the bunker delivery note to manually adapt the fuel density as input to the fuel monitoring system. An accurate density sensor integrated in the fuel system can address this.

## Differential measurement

The best position for a fuel flow meter is before the mixing tank, in the supply line to the fuel booster unit. Temperature of the fuel before the mixing tank is below 80°C and in this part of the fuel system there is no fuel circulation or high-pressure pulsations present. It is important to realise that in any inlet / outlet measurement system the error is always made on the circulated flow over the engine(s).

The percentage of this error is higher in comparison to the consumption of the engine, as the consumption is a smaller figure, (i.e. the difference between inlet and outlet fuel flow). Application of mass flow meters in an inlet / outlet measurement system will certainly increase the price of the fuel monitoring system and moreover engine vibrations will influence the lifetime and accuracy of these meters, which use frequency

measurement and phase shift as input.

When applied as a bunker meter the mass flow meter does have an advantage, since this meter can detect the unlikely event of having so called “cappuccino” (air mixed in with fuel) in the bunker fuel. The lower density of “cappuccino” will not be detected by a PD meter without a density sensor and this can result in a fuel bill stating more tonnes of fuel than you received in reality. In response to the “cappuccino” bunker

problems experienced by a lot of shipowners and charterers, VAF Instruments will introduce the ViscoSense3D density sensor later this year.

The above statements make it clear that accurate fuel flow measurement starts with choosing the right meter configuration and appropriate and accurate sensors. The best concept for a fuel monitoring system will differ per application, per fuel system and per ship. *NA*

## Opening the CIG umbrella

Central Industry Group has recently rebranded its organisation and with that has launched a ship design and construction package for its customers

The Netherlands-based Central Industry Group (CIG) was originally founded in 1972 as CIG Centraalstaal, which focused on the supply of aluminium and steel building kits. Today, CIG has expanded and now offers customers the whole package from ship design through to the construction on the vessel. To be able to achieve this CIG has created what it calls a synergy between its separate group members and with recent rebranding to the company to bring that element to the fore.

Maarten Sickler, technical director of the maritime division, CIG explains that: “We are bringing our companies together and looking towards where the market growth is going to develop vessels that will have a value through their service life. A good vessel is one that makes money.”

CIG uses Nupas Cadmatic for the modelling of its designs. Nupas Cadmatic is an engineering tool for ship hulls, piping and machinery, HVAC, cable trays and outfitting engineering. The company has highlighted that it has developed in house this software due to it being able to handle advanced 3D model options and powerful production models.

CIG Maritime division sees companies such as Vuyk Engineering, now called CIG Maritime Technology, along with, Bremen-based SEC piping (CIG Piping Technology) and Shipkits (CIG Shipbuilding) to offer the package of ship design through to



Shipkits shipyard now CIG Shipbuilding under the CIG rebrand

shipbuilding. CIG has invested in both expertise and flexibility for owners that are looking at more specialised projects.

“We are trying to keep away from just focusing on ship types. We are embracing shipbuilding as a project with

owners, which also allows us to have our own approach to customers and their requirements,” explains Sickler.

Bringing these names under the CIG umbrella has not just expanded the CIG client base, adds Sickler, but also allows for

two way cooperation where if a client is looking for a specific need, CIG can pass that through to a specific company in the group that can work on the project independently.

A recent project that CIG has worked on is the development of the *Atlantic Dawn* series for Hartmans. *Atlantic Dawn* is the first vessel in a series of four vessels, which was delivered last year with the other vessels in the series being delivered in 2014.

*Atlantic Dawn* was built by CIG's Shipbuilding, which outsourced the design and engineering of the project to The Netherlands-based C-Job naval architects and engineers. The design of the vessel was developed from a smaller heavy-lift vessel *Deo Volante* in 2011. The requirements of the contract included that the vessel had a voluminous cargo area, open top and was fitted with two heavy-lift cranes of 150tonnes, located on the starboard side of the vessel. Due to the restricted dimensions and draught these factors will enable the vessel to have access to more ports than standard heavy-lift vessels.

*Atlantic Dawn* has a slim hull shape, with a particularly low block co-efficient in combination with the requirements for lifting heavy loads over the starboard side. Sickler explains the significance of this part of the design is that another vessel can moor alongside *Atlantic Dawn*, which can then transfer cargo from the quayside to the other vessel. Because of this though, special attention was needed for the tank arrangement. Large volume heeling tanks have been placed in the sides, which are fitted with an Azcue transfer pump, with a capacity of 600m<sup>3</sup>/h that is installed in a pump room half way along the piping duct. The total bilge/ballast pump capacity is complimented with two bilge/ballast pumps and two general service pumps,



Maarten Sickler, technical director of the maritime division, CIG highlights the future developments of CIG

located in the forward pump room. To be able to transport high volume, low weight cargo with a high centre of gravity the vessel also has large volume ballast tanks to compensate for the cargo.

The upper cargo deck, between the stern of the vessel and the aft bulkhead of the superstructure, flush over the remaining length and full width of the vessel. The 11 pontoon type upper deck hatch covers and seven tween deck panels can be stowed, in stacks of three or four. These stacks can be in several positions in the hold opening to obtain the least possible obstructions in that opening.

The large NMF cargo cranes each have a maximum swl of 150tonnes at 16m and a capacity of 38tonnes at a maximum outreach of 28m. Both cranes can also

operate in tandem to facilitate the moving of large project loads. During 'high-load' cargo crane operations, the use of a 'stability pontoon' is required, due to the relatively small beam (required for higher speed hull shape). This pontoon, with the dimensions 11m x 5.50m x 3.40m, is normally stored flush in the cargo deck, next to the funnel. When deployed, it is put overboard with the aft cargo crane and hooked into the side of the vessel. The pontoon is then partially filled with sea water by gravity, thus providing a stable buoyancy component to counteract the lifting forces.

The ship is provided with one Berg Controllable Pitch Propeller (CPP), which is powered by a 4,000kW MaK 8M32C marine diesel engine via a reduction gearbox. The gearbox, a Renk RSV710, has a Power Take Off (PTO) to a shaft alternator. The Berg CPP as well as the Renk gearbox were delivered by AMW Marine. Wolfard & Wessels Werktuigbouw was responsible for the complete 3D design and outfitting of the engine room, including ship's systems, piping and assembly. A semi-balanced spade type rudder is operated by Rolls-Royce Rotary Vane steering gear. The ZF Marine stern and bow thrusters, each driven by a Leroy Somer 300kW electric motor, for good manoeuvrability. [NA](#)

*Atlantic Dawn* demonstrates the process that is offered to shipowners



# Structural Load & Fatigue on Floating Structures

25-26 February 2015, London, UK



## First Notice & Call for Papers



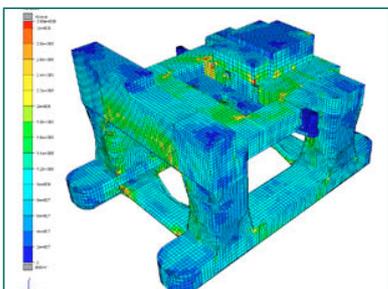
Floating structures, whether ship shaped, semi-submersible or spar design have been deployed in offshore oil developments for storage, processing and offloading since the 1970s. In recent year this type of technology has also been extended to also include floating LNG plants and re-liquefaction units, and process and power generation plants.



Today these systems are being deployed in more remote and harsher environments, and sometimes beyond their original design life, this results in increased loading, for example from ice, that affects not only on the structure but also critical components such as mooring systems, flexible risers and umbilical's, bearings, and swivels. This means the investigation into through life structural analysis and the effects of fatigue on a structure is important not only in the assessment of risk, but the potential in extending the life of a structure.

RINA invites papers from naval architects, class societies, operators, researchers, and builders on all related topics, including:

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- Life extension
- Stress load monitoring, inspection & maintenance strategies



*Selected papers may be published in the Transactions of the Royal Institution of Naval Architects*

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The safety of the seafarer and protection of the maritime environment begins with good design, followed by sound construction and efficient operation. Naval architects and engineers involved in the design, construction and operation of maritime vessels and structures can make a significant contribution to safety and the Royal Institution of Naval Architects, with the support of Lloyds Register, wishes to recognise the achievement of engineers in improving safety at sea and the protection of the maritime environment. Such recognition serves to raise awareness and promote further improvements.

The Maritime Safety Award is presented annually to an individual, company or organisation that in the opinion of the Institution and Lloyd's Register, is judged to have made an outstanding contribution to the improvement of maritime safety or the protection of the maritime environment. Such contribution may have been made by a specific activity or over a period of time. Individuals may not nominate themselves. Nominations are now invited for the 2014 Maritime Safety Award.

Nominations of up to **750 words** should describe the nominee's contribution to:

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**The closing date for nominations is 31 Dec 2014. The Award will be announced at the Institution's 2015 Annual Dinner.**

Nominations may be made by any member of the global maritime community and should be forwarded online at [www.rina.org.uk/MaritimeSafetyAward](http://www.rina.org.uk/MaritimeSafetyAward) or by email to [MaritimeSafetyAward@rina.org.uk](mailto:MaritimeSafetyAward@rina.org.uk)

Queries about the Award should be forwarded to the Chief Executive at [hq@rina.org.uk](mailto:hq@rina.org.uk)

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www.osea-asia.com

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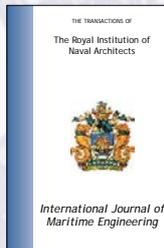
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# Damaged Ship III

25-26 March 2015, London, UK

## First Notice & Call for Papers



Recent incidents at sea have shown that investigations and understanding of the behaviour of damaged ships are as important as ever. Significant progress has been made over the last 10 years but there still remain numerous scientific and practical challenges.

After any major accident it is imperative to rapidly quantify the damage, assess damage stability and the residual strength of a vessel. Damage stability appraisal must also consider the likelihood of progressive flooding, the effect of the mass and motion of flood water within the vessel, capsizing probability and effect of waves on stability. There is a need to consider both the global strength capability of the ship structure and the local residual strength of damaged and buckled plating and the effect of flooding on internal structure.



Following on from the successes of two previous RINA Damaged Ship conferences; this event will focus on the assessment and analysis of stability, strength, sea worthiness of a ship damaged by collision, grounding, structural failure, fire or explosion. It will also consider procedures to minimise risks for passengers, crew, ship, and environment and to develop safe countermeasures including sequences for transferring crew, offloading cargo, and ballast water, for salvage operations.

RINA invites papers from designers, builders, operators, classification societies and legislative government bodies on topics including:



- Initial damage assessment and verification
- Behaviour of a damaged ship in a seaway
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*Selected papers may be published in the Transactions of the Royal Institution of Naval Architects*

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