

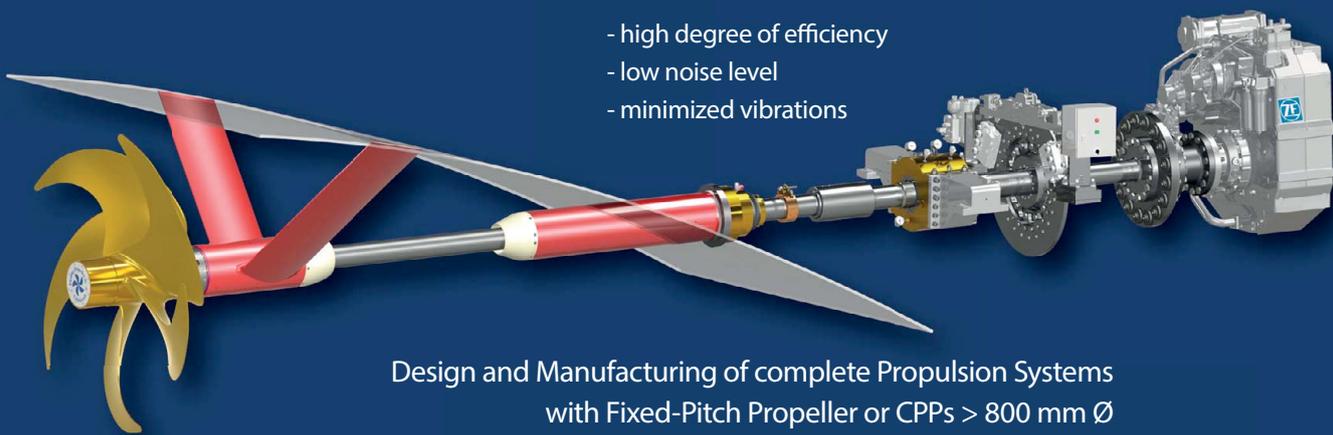


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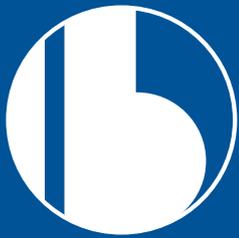
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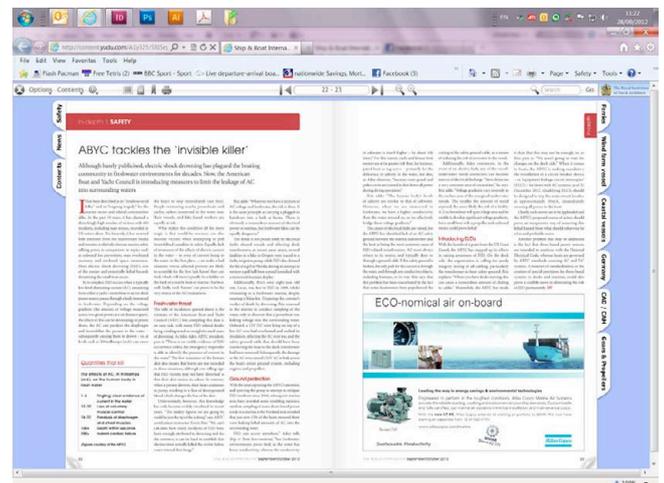
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Overcapacity policy key to balanced shipbuilding industry

Rongsheng Shipyard sought government support last year as the shipbuilding crisis continued to bite

Shipbuilding is changing, it is not only becoming technologically more challenging, but the market in which ship operators compete is becoming more challenging and that means that fewer ships are being ordered.

Following the financial crisis in 2007-8 demand for cargo ships declined dramatically, but new orders were still being delivered. This meant that freight capacity, the supply side of the equation, was growing rapidly, while consumer demand for goods such as consumer durables and oil and other things transported by sea diminished.

The supply and demand balance in shipping was gone and as a result freight rates collapsed, which meant that owners were not able to make payments on new vessels as easily and in some cases at all.

A similar situation has occurred in the shipbuilding sector with the growth of yards, particularly in China, up to 2007 happened in order to meet the huge demand for new vessels, when the crisis came and the demand for new vessels collapsed the number of shipyards competing for the paltry demand was simply too many.

Overcapacity in the shipbuilding industry remains even six years after the initial crisis enveloped the industry. But, today the signs are that governments are looking to take control of the overcapacity problem. In the three major shipbuilding nations there have been differing approaches to the yard overcapacity. In Japan IHI Corp's shipyard division was merged with The Universal yard while Mitsubishi no longer constructs ships at its Kobe yard.

In addition the Japanese have opted for a collaborative approach to developing new technology and government and industry has invested in identifying the Japanese shipbuilding as offering state-of-the-art technology to premium owners.

In South Korea government has taken a more puritanically capitalist approach allowing failing yards to close if they cannot find business and some small yards have ceased operating. However, with orders taking up to two years to complete the closure process can be long. Many yards are under the control of financial institutions who maintain operations until the last orders have been fulfilled.

During this period many of South Korea's major yards have transformed their businesses building vessels for the offshore sector and only maintaining their general shipbuilding for the high end sector such as membrane LNG carriers and very large container ships.

South Korean yards have effectively abandoned the lower end of the market, in most cases, preferring to leave this sector of the industry to the Chinese. Government in China has recognised that the shipbuilding industry, both globally and nationally, is suffering from the abundance of yards, some 1,647 according to the China Association of the National Shipbuilding Industry (CANSI).

In a meeting in London last month Tor Svensen, CEO of the maritime division for DNV GL, told the audience that: "China is not growing as fast as predicted and neither are the so-called BRIC countries either."

He went on to say that 3,200 ships had been contracted in 2013, 96.7 million GT, the third highest total on record, and that signifies that the orderbook is starting to grow again, "A net increase of 30 million GT, high contracting has been triggered by low newbuild prices and the Eco-labelling of more efficient ships."

Scrapping remains high also, says Svensen, including some comparatively young ships, this is partly due to "regulatory obsolescence," he says. But, Svensen also argued that there must be a redress in the supply and demand balance in China's shipbuilding industry also.

It appears that the regulatory authorities in Beijing are in agreement with Svensen and are possibly even one step ahead. Having noted the parlous state of some yards' finances and the lack of orders along with the poor working conditions for employees and the poor quality of some vessels delivered from Chinese yards the Ministry of Industry and Information Technology has issued a directive that it says will help consolidate the shipbuilding industry, making it more efficient, cleaner, safer, more productive and of a higher standard.

Issue 55 was introduced on 1 December 2013 and is the ministry's answer to the overcapacity conundrum. Just how this regulation plays out will become apparent over the coming two or three years, but overcapacity along with over-ordering combined with slow global economic growth could make any recovery in the shipbuilding sector, long, slow and very painful. *NA*

Rules

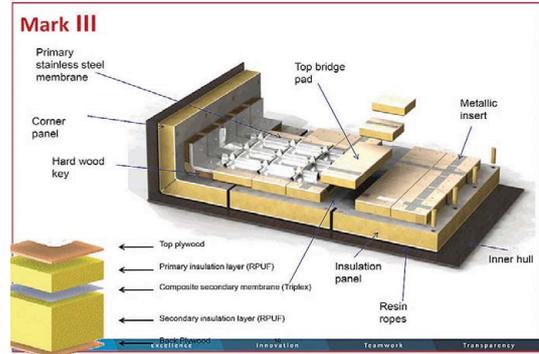
IACS acts on boxship safety

According to DNV GL major accidents such as those suffered by *Costa Concordia* and *MOL Comfort* occur as a result of a series of errors.

Speaking in London DNV GL CEO for maritime Tor Svensen believes we may never know definitively the causes for the loss of *MOL Comfort*, though he felt that it was significant that MOL had strengthened *Comfort's* sister vessels and that the vessels classed by DNV GL were safe.

“We have analysed our ships and I’m comfortable that the ships we class are safe,” Svensen explained, adding that he did not think that other post-Panamax container ships would suffer from a similar accident.

However, DNV GL believes that it is prudent for the International Association of Classification Societies (IACS) to produce a unified requirement for the structural analysis performed on these vessels and set minimum criteria on how such an analysis should be performed. In addition Svensen says that increasing the envelope for protecting a vessel’s structure from overloading, by using the more extreme cases as guides, thereby giving a wider loading safety margin will add another measure of security for mega-container ships.



A cut away of the MKIII membrane system

TECHNICAL PARTICULARS

Pegasus

Length:	210m
Width:	32m
Gross tonnage:	52,500
Maximum speed:	24.5knots
Number of decks:	12
Number of passengers:	2,474
Number of crew:	189
Number of cabins:	675
Garage capacity:	800 cars

LNG

Power for the people

Brittany Ferries has ordered an LNG powered ferry to be built by STX France in Saint-Nazaire for delivery in 2016.

The 210m *Pegasus*, which will reportedly cost US\$372 million, will be constructed with GTT MKIII membrane fuel tanks and will have a capacity of nearly 2,500 passengers. *Pegasus* will be the largest ship in Brittany’s fleet when it is operational on the UK to Spain routes. Another three Brittany Ferries will be converted to LNG power by GTT

The LNG power *Pegasus*, will be Brittany Ferries largest vessel



Green Ships

Sailing with the wind

A collaborative effort between industry, academia and government in Japan reportedly seeks to develop an 80,000tonne sailing vessel capable of sailing on wind power alone in the right conditions.

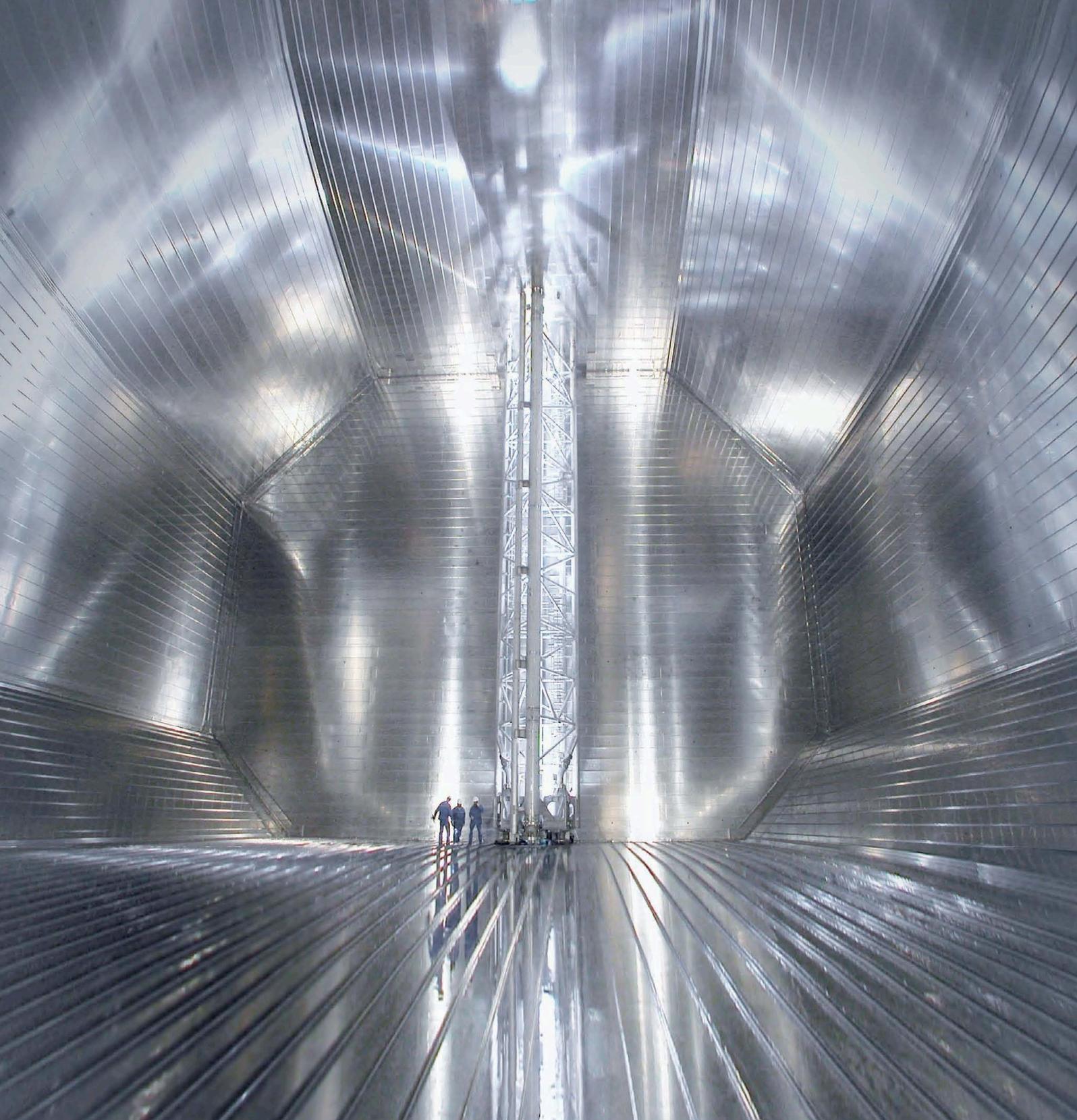
Mitsui O.S.K. Lines, Nippon Yusen Kaisha, Kawasaki Kisen and Oshima Shipbuilding along with government and the University of Tokyo are looking to build a half size prototype ship in the Nagasaki yard. Some ¥10 million (US\$97,000) in funding has been provided to the consortium.

Five computer controlled sails on the vessel measuring 20m wide by 60m high will be able to propel the vessel without supplementary power in wind speeds from 27mph and higher and will switch to conventional power or a combination of wind and diesel when wind speeds drop.

Fuel Technology

DNV GL assesses HFO alternatives

Second guessing the economy is always a difficult activity, long-term predictions are even more unreliable, but DNV GL has attempted just that



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with its January position paper, *Alternative Fuels for Shipping*.

Led by senior researcher Christos Chryssakis the study looks at how the market for marine fuels could develop. Effectively Chryssakis argues that the driver for change is new regulation aimed at limiting the impact of global warming.

“We can stabilise the global temperature increases to 2°C if greenhouse gas emissions can be decreased by 60-80%,” says Chryssakis. In order for shipping to play its part in the battle for the planet shipping must adopt technical and operational measures and will also need to adopt alternative fuels.

The DNV GL position study looks at which fuels are the most likely to be used in the medium to long term. Initially, ships will most likely trade using LNG, ship electrical power, biofuels, LPG and methanol. Unsurprisingly DNV GL believes that LNG will be a winner with an increase in orders already detectable and infrastructure developments being considered in South East Asia, the North Sea and North America.

Hybrid vessels including electrically powered ships will also be in the mix, some 20% of the existing fleet could retrofit electrical power DNV GL estimates. Typically tugs, ferries and offshore vessels, that is short-range coastal ships, would be the most likely markets for these fuels.

However, the class society did recognise that LNG may not be the complete answer in the longer term. LNG reduces NO_x, SO_x and particulates significantly, but CO₂ emissions remain at around 80% of HFO levels meaning that the long term solution may lie in either biofuels or methanol.

“There are three primary sources for biofuels, edible crops, non-edible crops from plant waste and algae; the last option remains an expensive option,” says Chryssakis.

Biofuels need considerably more research before they can be used in the maritime sector, with long term storage a problem and the clogging of filters could also raise issues that need to be understood and solved. Not least of these issues is that if biofuels were to be produced in sufficient quantities to power all the ships operating in emission control areas, some 50m tonnes, crops would need to be grown on land equivalent in size to Greece.

Regulation

Green groups warn IMO on Polar Code

Environmental groups have warned the IMO that agreement reached last month “poses significant new threats to the Polar environment”.

According to the Brussels based Transport & Environment (T&E) the final draft of the Polar Code will allow non-ice strengthened ships to operate in waters that are apparently ice free following the regional melting of ice in the Antarctic and Arctic Oceans.

“The IMO today [24 January] reached preliminary agreement on rules for the vessels, which will increasingly include oil tankers, container ships and cruise ships potentially operated by crew not accustomed to such harsh conditions. Blinded by the prospect of ‘ice-free’ operations enabled by the sea ice melt, the IMO makes the fateful assumption that these ships can safely operate without special hull protection or restrictions such as reduced speed,” says a T&E statement.

A number of environmental protection groups, including Seas at Risk and T&E, as members of the Clean Shipping Coalition, as well as the Antarctic and Southern Ocean Coalition, Friends of the Earth US, and Pacific Environment, say that the Polar Code “lacks ambition” and will allow vessels to use potentially damaging fuel such as HFO, which they say is could be particularly harmful to the Polar eco-systems in the Arctic region, though the fuel is banned in Antarctica.

Bill Hemmings, speaking for the green groups says: “A Polar Code which fails to address the major environmental dangers of increased shipping opens the door to potentially catastrophic consequences should a disaster happen. Environmental protection has essentially been put on the back-burner through the active lobbying of the shipping and cruise industry which consistently dismisses ecological concerns.”

Newbuildings

Taiwan builder earns new orders

Hydra Shipping and Syra Shipping have ordered a 1,800TEU feeder container ship from the state-owned Taiwan shipbuilder CSBC Corp.

The US\$25 million each ships are expected to be delivered in mid-2015. The orders for these ships will be welcomed at CSBC which has seen a decline in sales during 2013 through the economic recession. The company achieved NT\$24.89bn (US\$831.05m) in sales during 2013, down 19.6% on 2012.

People

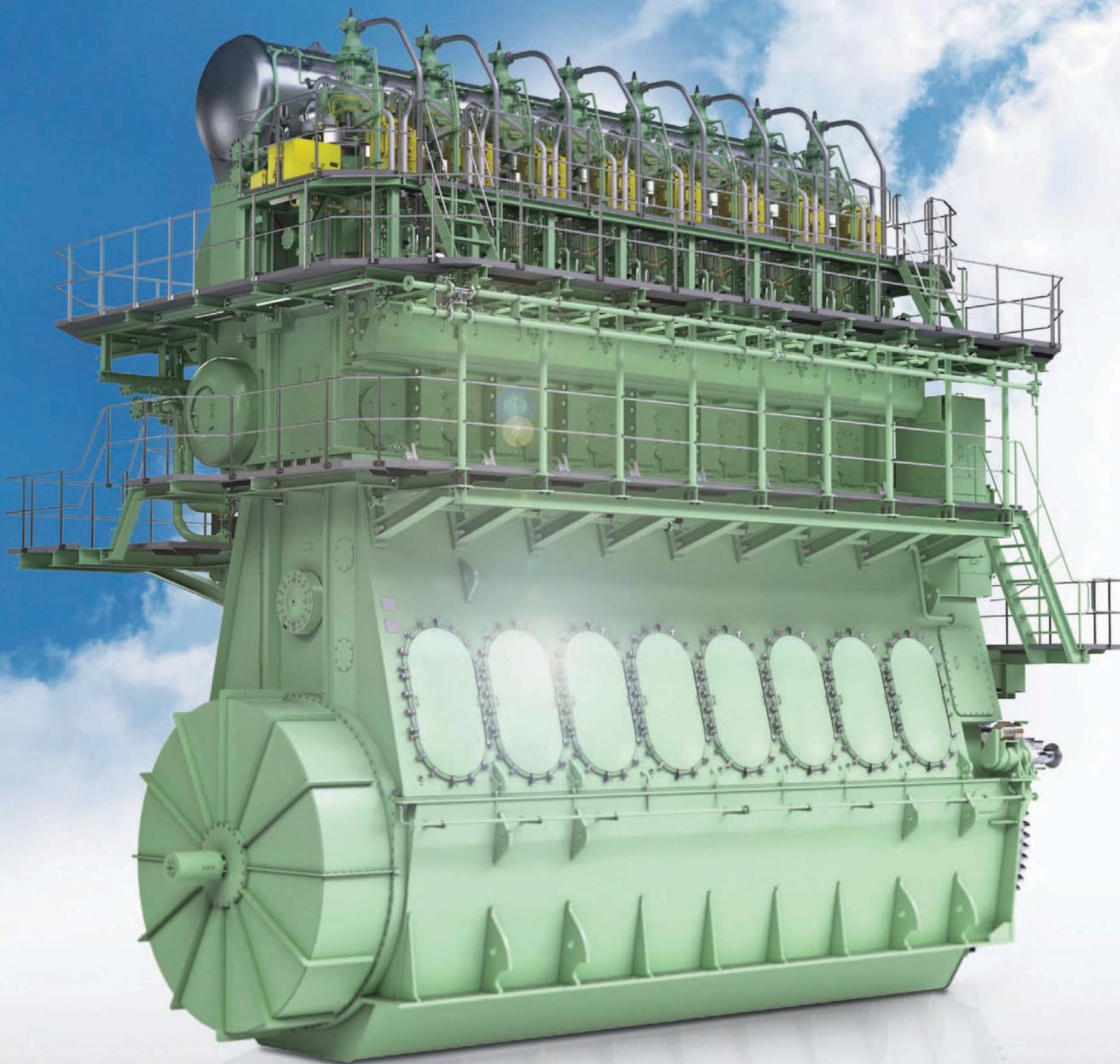
Aker MD bows out

Reko-Antti Suojanen will replace the retiring Mikko Nini as managing director at Aker Arctic. In addition following the acquisition of 66.4% of the company’s shares by Finnish Industry Investment Ltd a fully owned Finnish government entity Aker Arctic Technology Inc.’s extraordinary shareholders’ meeting appointed a new Board of Directors.

The Board members are Ole Johansson, Juha Koskela (ABB Oy), Antti Kummum (Finnish Industry Investment), Valborg Lundegaard (Aker Engineering & Technology A/S) and Juha Marjosola (Finnish Industry Investment). Ole Johansson was nominated Chairman and Juha Marjosola Vice-Chairman of the Board.

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Avoiding that special bending moment

December 2013 not only saw the adoption of new harmonised common structural rules for tankers and bulk carriers but the formation of a team to look at containership issues, while a preliminary report was also issued on the ongoing investigation into the *MOL Comfort* casualty, writes *Sandra Speares*.

IACS has unanimously adopted new harmonised Common Structural Rules (CSR) for oil tankers and bulk carriers. The new rules will apply to all oil tankers over 150m and bulk carriers over 90m in length contracted for construction on or after 1 July 2015.

The CSR will be presented to the IMO, which will verify their compliance with the IMO Goal-Based Standards (GBS) that will be compulsory for new building contracts signed on or after 1 July 2016.

Roberto Cazzulo, Chairman of the IACS Council, said: "This is a historic achievement and the culmination of many years of hard work by technical specialists from all member societies and intensive and continuing consultation with industry and authorities at every stage. Together we have invested a huge amount of time and money to develop these rules."

Among the main benefits of the new CSR ship is that designers will be able to work to one common standard applicable to both ship types; more comprehensive structural analyses including finite element method (FEM) calculations covering fore and aft parts; new rule checks including new buckling, fatigue and ultimate strength criteria; all this will enhance the safety and reliability of the structure.

"These harmonised rules take into account feedback from experience of the Common Structural Rules, introduced in 2006, and very extensive input from the industry" Cazzulo commented at the time of the announcement.

At the same meeting, the IACS Council decided to take a proactive approach to the structural safety of containerships, following a comprehensive review

of existing technical requirements for hull structural design, construction and survey. IACS decided to expand the scope of current IACS unified requirements for post-Panamax containerships. These requirements will cover two important areas: scope of hull girder strength assessment and specific loading cases that will provide more comprehensive safety margins.

"The new IACS unified requirements should be considered as a proactive measure to ensure an acceptable level of consistency amongst all IACS Societies and will ensure that class and industry follow a state-

of-the-art methodology for structural analysis of post-Panamax containerships," Cazzulo said.

As far as containerships are concerned IACS permanent secretary Derek Hodgson says the association does not believe there is an endemic problem with them or that there are any loopholes in the rules. However, IACS is introducing some unified requirements, not because there is any loophole, but because "we are generally applying ourselves to the requirements for containerships. I think in the past you will probably find that there was

less scope for unified requirements in containerships and there is more attention to them now. Perhaps the scope wasn't there because of the changes and differences in the actual operational use of containerships"

Unlike other classes of ship, there is a huge variation in the number of containers onboard a vessel and the weights involved.

IACS is investigating and going to expand the unified requirements for box ships covering two areas, hull girder strength assessment and specific loading cases. More comprehensive safety measures or margins are going to be provided in those two particular areas. "This is regarded as a proactive measure and we are very actively engaged on that at the moment." A project team is being set up and "a considerable amount of expertise is being put onto the job," Hodgson says.

"These harmonised rules take into account feedback from experience of the Common Structural Rules, introduced in 2006, and very extensive input from the industry"



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Most IACS members will be represented although there is always going to be more expertise available from some members than others because of the number of containerships they have in membership. “We do have the top experts involved from all the major societies”.

Work is expected to take some months after which a unified requirement will be presented to the IACS Council and would go forward from there. Hodgson estimates it would probably be implementable in about a year. At the moment it is difficult to assess what the project team will find and whether there will be anything particularly controversial that may hold up deliberations but “it is step in the right direction and some kind of finite end, and a finite conclusion in the not too distant future”.

Hodgson stresses that this move was not brought about in the light of recent casualties like the *MOL Comfort*, but was part of on-going work by IACS to consider the rule process. “Containerships is just one of those areas which we would look at from time to time. It isn’t as a result of the *MOL Comfort* but a result of an ongoing investigation and research into what has happened in the past and what will happen in the future. It is not just a knee-jerk reaction”.

One issue that is a driver is the growing size of the new generation containerships. “There are obviously going to be different forces at work”.

In the case of *MOL Comfort* the reasons why the ship sank are not known, and the evidence is at the bottom of the ocean. So a lot of the conclusions will be informed conjecture.

The common structural rules harmonisation was a massive process and although IACS has adopted these they have not yet entered into force and that will come in July next year. CSR is being presented to IMO for verification of compliance with Goal-Based Standards. It will then become compulsory for newbuilding contracts signed after, 1 July, 2016.

The rules are still being worked on taking into account industry comments, and while IACS is happy with the rules as they are, there will be room for future changes although for a year after their introduction there will be no changes. “It is difficult for shipyards to find they are building to rules that are changing all the time,” Hodgson explains. He feels the harmonised rules will be of immense benefit because shipowners will be able to work to one common standard with more comprehensive structural analysis and new rule checks all of which will enhance safety and reliability.

“It is a culmination of a massive exercise by IACS, and IACS should feel proud of that.” It is, he stresses a joint exercise with industry and industry views have been taken into account and have been positive and constructive. “Industry wants to take part in the process because they are affected so much by the process and they have a lot to offer. The best way to get the best set of rules is by working together”.

IACS remains the final arbiter, however, because it is responsible for the rules and “we are the experts”. A first common package of rules has already been presented to IMO, with a second package of CSR rules to be presented in June 2014. The IMO evaluation against GBS will be completed by 1 July 2016.

Hull girder strength and verification of container weights were two of the issues considered in the interim report on the *MOL Comfort* accident by the Committee on Large Container Ship Safety, which was issued in December 2013.

While the Committee is still in the process of developing safety measures, the Committee recommends that the following actions be carried out on ships with loading capacities similar to or greater than 8,000TEU class as temporary safety measures.

“A visual safety inspection on the bottom shell plates to the extent possible should be conducted on large container ships which do not require ballast water to maintain stability (primarily ships over 45m breadth, carrying 8,000TEU or greater) to confirm the presence of buckling deformations. Where the deformations are found, consult with a classification society regarding the proper measures to be taken.

“With regards to the proper management of cargo weight on the hull for large container ships in the 8,000TEU class and over in particular, cargo loading planning for actual voyages could be frequently reached to the maximum permissible still water bending moment (hogging condition). In accordance with the deliberations at the IMO related to the enforcement of container weight verification prior to loading, verification of the actual weight of container cargoes provided by the shipper is recommended as a safety measure for large containerships.

“Other general items for caution include rough sea avoidance manoeuvres such as speed reduction.”

In a statement after the report’s release Mitsui OSK Lines said: “MOL has done everything possible to ensure safe operation. Since the incident occurred, MOL has taken the following measures, including safety measures, which were recommended in the interim report mentioned above.

- MOL conducted emergency safety inspections targeting all six of *MOL Comfort*’s sister vessels, and then arranged docking for work to reinforce their hull structures as additional safety measures. With this step, the target vessels secured about twice the hull strength of the standard set by Nippon Kaiji Kyokai (ClassNK), which conforms to International Association of Classification Societies (IACS) standards
- MOL continues to pay special attention to the operation of this type of six sister vessels to reduce the stress on hulls by adjusting ballast water volume

MOL also conducted safety inspections on the outer bottom shell plates of its operated large containerships in addition to the above six vessels, and already confirmed there is no safety problem. *NA*



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Lifesaving & ship safety

Ocean Safety reveals latest lifejacket

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Bridge & communication systems

Transas Marine launches Navi-Planner

The updated version of the voyage planning software Navi-Planner 4000 has added functions that will boost its versatility and convenience, says Transas.

In addition to working with the Transas Admiralty Data Service (TADS), the latest version of the Transas Navi-Planner has been optimised to handle Admiralty Vector Chart Service (AVCS) charts and permits. This functionality has been developed in cooperation

Transas upgrades its Navi-Planner 4000



between the UKHO and Transas Marine. This means that regardless of the ECDIS type installed onboard, all users will get official charts to their ECDIS with only a few clicks on the screen.

Transas Navi-Planner 4000 is also compatible with the Admiralty Information Overlay (AIO), which includes all Temporary and Preliminary Notices to Mariners (T&P NMs) and provides navigational information from the UKHO's ENC validation programme. The Overlay makes the whole passage planning simpler and safer by clearly showing where important temporary or preliminary changes may impact a voyage, says the company.

www.transas.com

Ancillary equipment

UT99 AG presents its oil mist separator

The company UT99 AG has received approval from DNV GL for its oil mist separator for crankcase ventilation of combustion engines and for lubricating oil tank vent for turbines.



UT99 AG gets approval from DNV GL

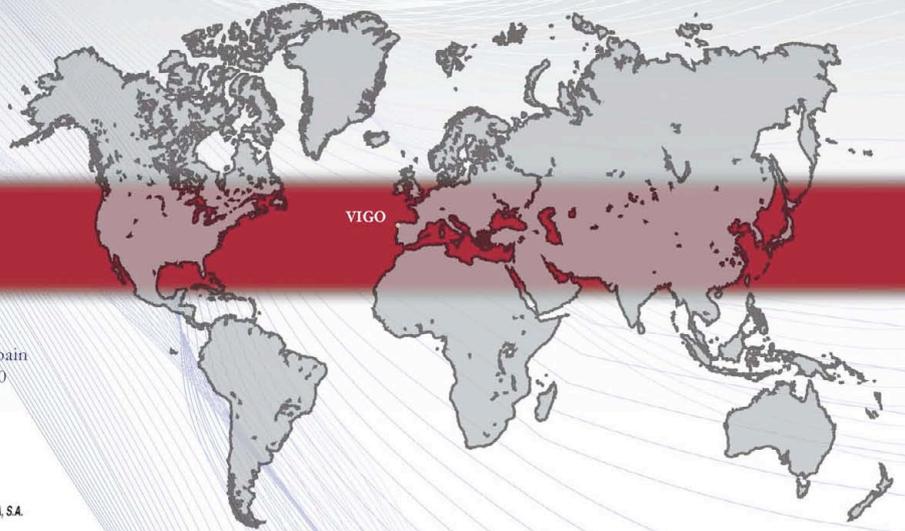
Environmental and safety requirements are getting higher in the marine and offshore sectors UT99 AG has said that with the GL approval the UT99 AG has proven that their products fulfil the highest demands on safety and reliability. Furthermore, the discharge of oil emissions from the crankcase ventilation and from the lubricating oil tank ventilation, respectively, is almost completely eliminated. Depending on the model residual oil amounts below 1mg/m³ in the exhaust air (e.g. blow-by) will be ensured.

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The modular design allows a wide variety of options while reducing the cost and variety of components and spare parts. The application areas include open and closed crankcase ventilation in internal combustion engines as well as the lubricating oil tank vent for turbines. The electronic under pressure control in connection with electrically driven fan ensure a constant adjustable negative pressure under all operating conditions. The ATEX approval of the device allows the use even in hazardous areas.

www.UT99.ch

Environment

Alfa Laval secures PureSOX deal

Following a similar order from DFDS earlier in 2013, Alfa Laval has received an order for PureSOX placed by Dutch shipowner Spliethoff. The order from Spliethoff is comprised of PureSOX systems for five con-ro vessels. The vessels will be retrofitted between June and December of 2014.



Alfa Laval to supply its PureSOX to Spliethoff

PureSOX is a hybrid scrubber system, able to operate with either seawater or fresh water. While the technology is relatively new, it has been demonstrated

to reduce sulphur content in vessel exhaust by more than 98%, the company has claimed.

Spliethoff, one of the largest shipowners in the Netherlands, has been operating with PureSOX aboard *Plyca*. Alfa Laval delivered the system in 2012, and it has been in continuous use aboard the vessel ever since it was installed. Sailing within the North European ECA, *Plyca* has logged more than 6,000 hours in full compliance with the new IMO regulations.

www.alfalaval.com

Ancillary equipment

Flow meters for boil-off

Level and flow instrumentation suppliers Allison Engineering have received an order for its ST110 Gas Flow Meters to be used onboard LNG ships to measure 'boil-off' gas.

The ST110 can be functionally tested and calibrated without the need to remove the sensor from the pipeline. It features an internal purge tube that runs the length of the sensor and allows the operator to generate a known flow across the sensor element. The resultant signal output can then be compared to the factory baseline test certificate.

The ST110 flow meter is ATEX certified and complies with the emissions trading system (ETS) phaseII requirements for carbon trading. The flow meter housing is made from 316 stainless steel and Hastelloy C for wetted parts, with control options via 4-20mA signal, HART, Profibus PA and Fieldbus H1 as required. It can operate at process temperatures up to +450°C and offers a turndown ratio of 1000:1.

www.allison.co.uk

Lifesaving and ship safety

Eurovinil keeps mariners afloat

Eurovinil, one of the brands within the Survitec Group portfolio, has launched its latest leisure liferaft aimed at the Italian market. The EV ISO-9650-1 Leisure Liferaft is compact, easy to store and takes up minimal deck space and can be deployed in just 40 seconds, the company said.

The main features of the liferaft are that it is durable and made from lightweight PU material that allows it to be resistant to corrosion and abrasion. The liferaft also comes with high volume water pockets that give the liferaft maximum stability when inflated, and a canopy that is manufactured in high visibility orange to SOLAS standards, providing added protection from the elements. The canopy

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is also fitted with an internal and external strobe light, to make it easier for search and rescue teams to locate the liferaft at night. Other characteristics of the EV ISO-9650-1 Leisure Liferaft include a semi-rigid boarding ramp for quick, easy and safe boarding, as well as interior and exterior lifelines to help occupants stabilise themselves in heavy seas, the company said. The liferaft is supplied in either a weather proof valise or a sleek, lightweight container, which features a document/certificate holder and handles, to make transportation easier. Three emergency pack options provide rations for up to 24 hours, over 24 hours and SOLAS B operation.

www.survitechgroup.com

Lifesaving & ship safety

Viking evacuates the masses

Marine and fire safety equipment manufacturer Viking Life-Saving Equipment has launched another of its lifesaving products, the Viking LifeCraft system.

The LifeCraft System is a self-propelled inflatable vessel with four engines that the company says has a high degree of manoeuvrability and safety and comes with a storing and launching unit, either placed on deck or built in, containing up to four LifeCraft units with a capacity of 200 persons each, for a total capacity of 800 persons.

Other features of the LifeCraft System include a specially designed chute system, which helps evacuees with special needs, such as children, the elderly and those on stretchers.

The system also takes up less room than lifeboats, freeing deck space for shipowners keen to provide their passengers with more cabins, shopping opportunities and other journey enhancements, said the company.

www.viking-life.com

Eurovinil launches latest liferaft on to the market

Ballast water management

Clean Marine supplies Stolt tankers

Clean Marine has been selected by Hudong-Zhonghua Shipbuilding in China to supply exhaust gas cleaning systems (EGCS) for two 38,000dwt chemical tankers being built for Stolt Tankers and NYK Stolt Tankers.

The two vessels are built in a series of six sister ships, where the remaining four vessels will be designed with the flexibility to add an EGCS at a later stage. The order will enable these new vessels to comply with sulphur emissions legislation without switching to more expensive fuels.

Clean Marine has developed its EGCS based on the Advanced Vortex Chamber technology. The system's integrated fan and gas recirculation technology allows the one EGCS unit to simultaneously serve several combustion units. The system supplied to Stolt Tankers is a hybrid system that will allow the vessel to operate seamlessly in all types of water (including low alkaline and saline water) without loss of efficiency. Furthermore, the Clean Marine EGCS meets the current pH limit for washwater discharge in Europe and USA with a good margin.

www.cleanmarine.no

Clean Marine secures EGCS contract in China for Stolt



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Detecting the sound of a CleanShip

CleanShip is a project designed to prevent and detect fouling on ships, which frequently have to be taken out of service to be cleaned due to the formation of fouling from the marine environment on the vessels' hull. The CleanShip project team report on their progress

A consequence of hull fouling is considerably more fuel is consumed through a hull that becomes increasingly inefficient resulting in both an economic and environmental impact.

The marine industry globally spends significant capital (equivalent to billions of dollars) in addressing fouling, using a variety of protection methods such as coatings (Figure 1). The CleanShip project (www.cleanship-project.eu), a pan-European collaboration across UK, France, The Netherlands, Spain, Greece and Turkey, coordinated by the Brunel Innovation Centre (BIC) based in Cambridge, England, UK proposes an effective non-invasive solution, based on an ultrasonic approach, for improving the maintenance of ships.

The solution is to deploy long range ultrasonic waves travelling throughout the steel plates of a ship's hull for, as much as possible, (i) the prevention of fouling and (ii) the detection of fouling.

Biofouling

Biological fouling (biofouling) stems from the formation of organisms on a surface immersed in water and may consist of organic molecules (proteins, fatty acids, and carbohydrates), microorganisms (bacteria, protozoa, algae, fungi) and multicellular organisms (barnacles, colonial hydroids). This is a significant problem for all marine structures such as ships, offshore rigs, oceanographic sensors, etc. (Figure 2).

After six months without protection against marine fouling deposits, biofouling growth increases the drag on a hull so much that a ship may have to use up to 40% more fuel and correspondingly to produce 40% more CO₂ emissions. The marine industry spends many billions worldwide in the prevention or removal of marine fouling, using a variety of

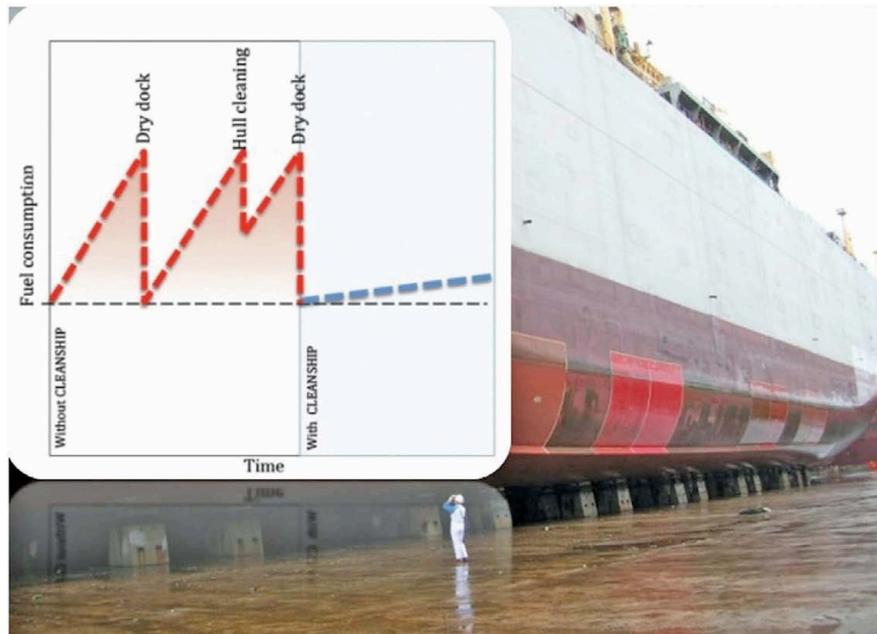


Figure 1: a) Protective coatings on ship hull1 (inset: Idealised view of CleanShip benefit)



Figure 2: Some examples of biofouling1; build up (a) and a close up view on mussels (b)

(a)



(b)



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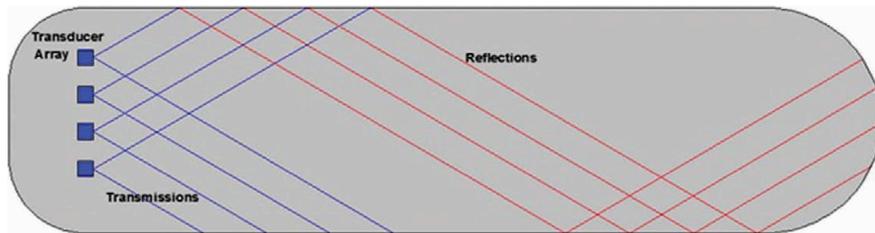


Figure 3: An example schematic of possible wave propagation through the ship's hull.

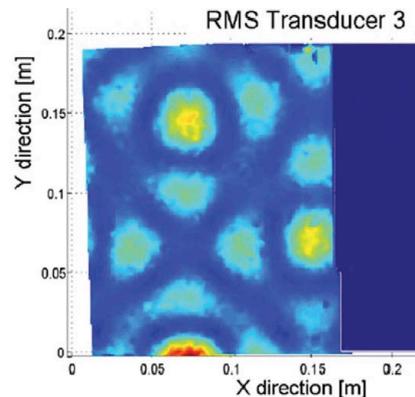
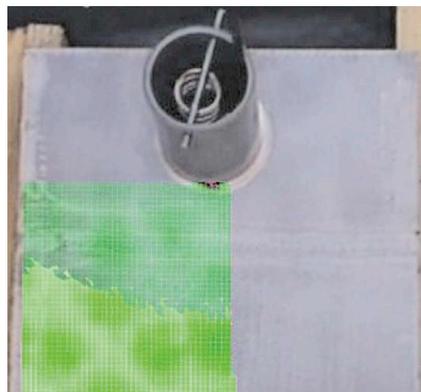
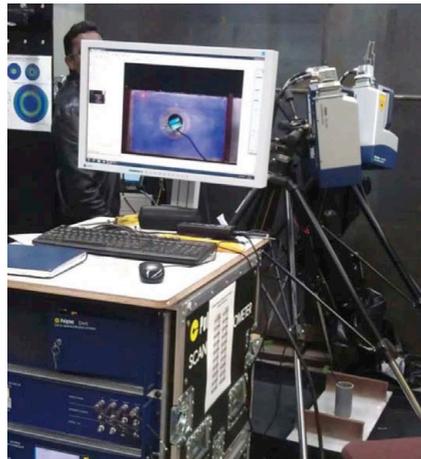


Figure 4: BIC's Polytec 400 Laser scanning vibrometry in action (a), vibrometry of wave propagation from a single source on steel plate (b), example surface vibration on plate (c) indicating regions of relatively high (bright) and low (dark) intensity of vibrations on plate (d).

cleaning tools in dock, yet fouling still costs the world shipping industry. There are also serious health and safety issues associated with the widespread use of biocidal antifouling coatings, which harm marine life and enter the food chain. Clearly existing methods of fouling prevention and removal are in urgent need of improvement.

The CleanShip project proposes a novel, non-invasive and cost effective approach for fouling prevention without the need for taking a ship out of service. For a closer look at the operations and exploring

potential sites to consider, the consortium met in Istanbul and visited a shipyard to this effect.

The CleanShip approach is to deploy long range ultrasonic waves travelling throughout the entire ship's hull below the water line in two ways (i) The use of leaky (Lamb wave mode) continuous waves to prevent or slow down the accumulation of fouling by driving biomolecules away from the hull (ii) Continuous monitoring of the attenuation changes of pulsed waves caused by the growth of fouling in its early stages, to allow earlier and cheaper

removal. Long range ultrasonic testing relies on the use of ultrasonic guided wave modes in the kilohertz range (typically between 20-300kHz) with relatively long ultrasonic wavelengths in comparison with conventional ultrasonic testing. These waves propagate with low attenuation in media, covering a large distance away from the ultrasonic source (Figure 3). For visualisation of ultrasonic waves travelling across a surface, a state of the art 3D laser scanning vibrometer from the BIC, housed at TWI, Cambridge site has been used. This has proven to be significantly informative in gaining a better understanding of surface behaviour and material response to transduction (Figure 4).

The CleanShip project has mainly the two following goals:

i) Fouling Prevention

It is anticipated that a ship's hull is to be permanently excited with an ultrasonic wave of a frequency in the region of tens of kHz. Accordingly, the wave can be launched from a transducer at a single location on the ship and yet travel through the entire hull with very low power absorption in the hull itself.

With the CleanShip system, any fouling formation would be subject to forces due to the vibration of the hull surface. These ultrasonically generated forces would be expected to keep microorganisms away from the hull, discouraging any settlement. The CleanShip system can be operational whether a ship is moving at sea or is stationary in a port, subject to careful design of the system (Figure 5).

ii) Fouling Detection

Ideally, pulsed ultrasound of a similar frequency range to the ultrasonic waves used for fouling prevention will be transmitted and detected from a single location after travelling up and down the entire length of a ship's hull. As fouling builds up it is expected that the received wave will be attenuated. In order to compensate for spurious signal changes through eventual long-term instrument drift and temperature fluctuations, the received wave will always be measured relative to a second echo travelling

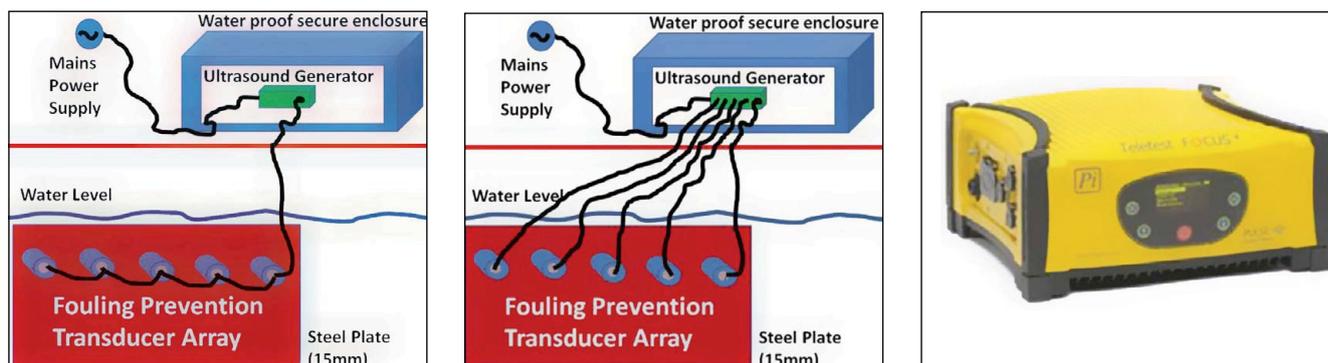


Figure 5: Schematic of a possible configuration for fouling prevention. a) single channel b) multichannel and c) Teletest (courtesy of Pi Ltd.); a versatile commercial ultrasonic system offering both single and multichannel capability

through a fixed path in the hull. As hull fouling tends to occur over wide areas, a very high sensitivity allowing the detection of very thin layers of fouling build is anticipated accordingly.

The main advantages of CleanShip will therefore be: use of preferably low frequency ultrasound in wave modes to provide total coverage of fouling prevention on a ship hull, from a transducer array location and at power levels much lower than those needed for industrial cleaning through cavitation for example.

- Use of low frequency ultrasound in wave modes to provide total coverage of fouling identification on a ship's hull, from an array of transducers
- Use of attenuation measurements for the detection of fouling build up on a ship's hull
- Use of a comparator echo through appropriate signal processing algorithm(s)
- An advanced signal processing algorithm for computing the long term attenuation changes due to fouling
- Optimal wave propagation scenarios through simulation for system design.

In order to achieve these CleanShip objectives, the project work is broken down into eight work packages consisting of five Research and Technology Development (RTD) work packages (WP), one Demonstration WP, and one other WP for dissemination and exploitation, and one work package, devoted to consortium management by BIC, which runs for the entire project life. The work programme has been carefully divided into a number

of tasks for successful and timely delivery of the CleanShip project, due to conclude in 2014.

Modelling and initial field test and observations

The Centre for Research & Technology Hellas (CERTH) has performed modelling on ultrasonic wave propagation. Properly designed finite element analysis (FEA) models have been designed and implemented to accomplish the purposes of modelling the propagation of ultrasonic waves in a ship's hull and predicting the ultrasound power levels required to prevent fouling build up. This analysis is expected to provide inputs into the design of the high power ultrasound transducer and generator.

BIC has carried out initial trials at the WRS Marine site for biofouling prevention on steel plates equipped with transducers, kindly provided by Sofchem and characterised by BIC. Both single and multichannel generators (including Teletest) have been experimented with for inducing ultrasonic waves on plates for the duration of the trial, which was approximately 45 days. Initial results revealed the condition of the plates (after 20 days), which mostly had rust on them, albeit at different levels. An interesting observation was that one of the plates excited ultrasonically at about 20kHz was the least rusty compared with the other plates. In general, there was no apparent fouling on the plates. Further analyses will be performed and results interpreted in due course to establish a sound understanding of the effects of ultrasound for antifouling purposes.

Future work and horizon

Following feedback from the initial field test and subsequent investigation CleanShip

project will proceed with trials on painted plates in the field and supporting laboratory analyses, considering the potential influence of welds and stiffeners towards prototype demonstration. On the horizon, system optimisation and efficiency towards realisation of the technology industrially shall be the key alongside considering possible effect(s) of climate conditions in the long run (warm versus cold waters; North Sea versus Mediterranean Sea).

Acknowledgments

The research leading to these results is coordinated and managed by Brunel University and has received funding from the European Community's Seventh Framework Programme managed by REA-Research Executive Agency <http://ec.europa.eu/research/rea> FP7/2007-2013, under grant agreement 312706. CleanShip is a collaboration between the following organisations: Brunel Innovation Centre of Brunel University, Sofchem Sarl, Enkon Endustriyel Kontrol Kaynak Sanayi Ve Ticaret Limited Sirketi, Innovative Technology and Science Limited-InnotecUK, WRS Marine Inspections and Services BV, Lloyd's Register EMEA, Centre for Research and Technology Hellas, Fundacion Research & Innovation.

This paper's authors are: Mathew Legg, Ignacio Garcia de Carellan, Vassilios Kappatos, Cem Selçuk, Tat-Hean Gan from the Brunel Innovation Centre, Serafeim Moustakidis from the Centre for Research & Technology Hellas, Pierre Olivier Jost of SofChem and Teo Karayannis of Lloyd's Register EMEA. **NA**

Hudong-Zhonghua led by innovation

Hudong-Zhonghua Shipbuilding (Group) Company Limited achieve the highest standards of LNG shipbuilding in China. Zhang Wen Hao and Sheng Jun report from the Hudong-Zhonghua yard

From the delivery of its first LNG carrier *Dapeng Sun* in 2008 to the operation of its sixth LNG ship *Shenhai* in 2012, Hudong-Zhonghua has successfully grasped the pearl of the shipbuilding crown.

Its success has seen Hudong-Zhonghua building LNG carriers for Exxon Mobil Corporation (ExxonMobil) and Mitsui O.S.K. Lines, Ltd. (MOL). The projects have changed the production and management models at the yard significantly and have raised the yard's capability of building more high-end vessels.

"Super LNG Carrier", a documentary about the building of LNG ship *Shenhai*, was shown at the Festival de Cannes in 2012, drawing much attention from both within and outside China. The media claimed that *Shenhai*, built by Hudong-Zhonghua, is at the forefront of technology in the world and the building of *Shenhai* has realised the highest shipbuilding standards in China. While fellow shipbuilders commented that Hudong-Zhonghua's technological standards have matured, marking the strength of and turning a new page for China's shipbuilding industry.

The success of Hudong-Zhonghua is mainly built on innovation and technological advancement. Hu Wen Ming, secretary, Party Leadership Group of the China State Shipbuilding Corporation (CSSC), said: "Innovation and R&D are the keys to the sustainability of a corporate. Hudong-Zhonghua has to strengthen its advantageous position in building LNG carriers, speed up its expansion and seize the core technology of LNG technology."

The role of IT in LNG shipbuilding

Hudong-Zhonghua has been striving to build more LNG carriers for the past 10 years. Following CSSC's development strategy: "Led by innovation that creates demand"; and the idea of evolving from construction to improvement and further to R&D, Hudong-Zhonghua has increased its input into R&D



The second LNG carrier built for ExxonMobil/MOL being launched

in order to raise its competitiveness in the LNG ship sector.

To ensure the improvement of the construction standards the yard has utilised information technology in the construction process. The ship design software, SPD, developed in-house is well-known in the shipping industry. With its market share on the rise every year, SPD is as competitive as software developed by foreign companies, such as Tribon. The SPD system has been utilised in the construction process of LNG

ships built for foreign owners, raising the precision and efficiency of the design.

Ship product data management software PDM and precision management software have also been used on actual constructions to digitalise the storage and management of data. Shipowners commented that Hudong-Zhonghua has formed an integrated digital platform for design and construction.

On 30 September 2013, the second 172,000m³ LNG carrier built by Hudong-

Using the sectional method of hull construction while building an LNG ship



Zhonghua for ExxonMobil and MOL, the largest membrane LNG carrier built in China, was launched.

Among the eight LNG carriers built by Hudong-Zhonghua, the second one was the most complete when launched. Construction processes held in the dock lasted around four months, the shortest on record in China. Digitalised design has helped improve the technology standards of hull block manufacturing. The readiness of ship blocks for the second LNG carrier reached 50% before docking.

The installation of core components, such as insulated cargo tanks, started in the dock. Around 4,000 insulated cargo tanks have been installed before launching. Hudong-Zhonghua has worked out the sweep blast technique with shipowners, classification societies and paint suppliers. The LNG carriers built for ExxonMobil and MOL are the first batch of LNG ships using anti-corrosion methods in China.

ExxonMobil and MOL assess their global strategic partners every year. The ranking of Hudong-Zhonghua among all partners is stepping up year by year with its work fully recognised by the shipowners.

Scaffolding platform lowers costs

Hudong-Zhonghua has managed to build scaffolding platforms for the ExxonMobil/MOL LNG carriers in China and has obtained a patent for the whole design. Building four 172,000m³ LNG tankers in this way can help save a total of around RMB10 million (US\$1.65 million) in patent fees.

Scaffolding platforms, which are for workers to work inside cargo tanks, is one of the major technical challenges when building an LNG tanker. Hudong-Zhonghua has paid high patent fees to use the technology from Italy on the first five LNG carriers it built. However, there are apparent design anomalies in the Italian design and there have been more than 1,000 drawing revision requests. The shipbuilder says it has spent much time and effort revising the design.

The structure of a scaffolding platform is very complex and needs to be tailored for every LNG vessel model. Since the construction of the first batch of LNG vessels, Hudong-Zhonghua has learnt from experience and researched its own scaffolding platform design. Since the R&D

works for the ExxonMobil/MOL LNG vessel project commenced in June 2010, designers have gone through processes of general arrangement design, optimisation of part design, patent avoidance, block division, detailed structural design, and strength calculation and have finally finished more than 1,500 drawings and gained the design patent.

Shipowners have requested a 200mm wide distance between the scaffolding platform and the tank bulkhead and after modifications in the design the yard can

meet this requirement. The shipbuilder has optimised the detailed design of 10 functional parts including peripheral and boundary areas, diagonal support legs and the main girder. The patent application for the whole design has been approved, while the patent application for the design of peripheral and boundary areas is being processed. The scaffolding platform designed by a Chinese company is more stable and better fits the needs of LNG carriers to be built in China.

In order to save costs, Hudong-Zhonghua has recycled 130,000 pieces, and 1,000 types

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Technicians from the scaffolding unit discussing installation issues

of scaffolding system structure components which weighed a total of 2,960 tonnes, and has saved around RMB60 million (US\$81 million). A complex scaffolding platform, which is large in scale, is a kind of light supporting structure. The manufacturing of a scaffolding platform requires a highly precise installation, calculation of force and total weight control. Therefore, technicians not only need to consider the metal strength of components, but also the weight of each component to the gram level.

There are 72,000 structures in a scaffolding platform, and each structure contains a few components. If every component is overweight, the total weight of the platform will be overweight by tens of tonnes. The requirement that the weight of each component must be precise to the gram level has driven designers to deliver the finest possible result.

While the weight of components must be controlled precisely, the strength of each component also needs to be guaranteed. Production was not smooth from the beginning. Technicians discovered there were broken parts in the first batch of components delivered to the yard.

Since then, they have been highly alert and strived to find out the reason behind any failures. Incidents that led to the collapse of scaffolding platforms during the shipbuilding process have caused injuries and huge economic loss in foreign shipyards before. Technicians have conducted metallographic

tests to the components and have found strength defects. Hudong-Zhonghua has then sent its crew to the suppliers to provide guidance and related test data, and thus solved the strength issues in the defective components.

Meanwhile, Hudong-Zhonghua has completed the majority of the design work for the scaffolding platform in the APLNG project, laying the foundation for the building of more vessels of the same model. Nowadays, the demand for LNG carriers in China and the diversity in ship models have both increased. Being able to design and manufacture scaffolding platforms has helped to promote the making of LNG components in China.

“Our goal is to reduce injuries, diseases, operational accidents and pollution to zero during the construction process of LNG ships,” ExxonMobil and MOL emphasised. The shipowners stressed that the building of LNG carriers must be “harmless”. Hudong-Zhonghua has promised that safety always has the highest priority in the yard and the company will enhance its safety management, understanding that timely delivery is not the only evaluation criteria to assess the success of an LNG ship project.

Both ExxonMobil and MOL have strict requirements over safety at their shipbuilder's yards, there must not be any death; upon discovery of a safety issue, the yard needs to halt operations to solve the problem. As early as June 2009, ExxonMobil and MOL held a due diligence investigation on Hudong-

Zhonghua. Since then, the two companies have paid numerous visits to the shipbuilder to discuss technology, business, safety and quality issues. The two shipowners have sent a monitoring team to conduct a comprehensive study on Hudong-Zhonghua and have set very detailed requirements over safety issues.

Although the yard has successfully built LNG carriers before, it is the first time the shipyard has worked with shipowners that belong to the world's top 500 league and it knows it must pass the test on international safety standards to become the only Chinese player to compete internationally on LNG shipbuilding contracts.

Hudong-Zhonghua conducted a comprehensive training programme to meet the requirements of ExxonMobil and MOL before commencing construction of the lead ship. In only three months, the yard provided HSE and quality training to around 6,800 staff and relevant training and assessment to outsourcing partners to ensure they are qualified to work on the project.

The shipowners' monitoring team participated in the training and assessed the results. The operational environment has been improved via the promotion of the establishment of an HSE management system which was approved by the owners.

Since 2010, Hudong-Zhonghua has continuously strengthened its safety measures. The yard has started to hold due diligence investigations on projects, job position safety analyses, individual risk assessment, safety knowledge surveys, safety culture forums and lunch seminars on safety issues, etc. The owners' monitoring team has also participated in every session and recognised the shipbuilder's work.

Hudong-Zhonghua has invested a lot of resources and manpower on work safety. Duan Feng Shuang, secretary, Party Leadership Group at Hudong-Zhonghua said the company is actively building a safety culture within the organisation and its safety management is gradually meeting international standards. As long as the company is able to develop safely, it can enhance its core competitiveness. Therefore, it's worthy. According to international shipowners, Hudong-Zhonghua's senior management team has provided a strong pledge and leadership over safety issues and has thus significantly improved the safety condition. **NA**

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Deconstructing China's shipbuilding industry

In a bid to modernise its shipbuilding industry Beijing has set out the criteria under which Chinese shipyards will have to operate in the future. The Ministry of Industry and Information Technology directive, Issue 55, became law on 1 December last year and industry experts say that many yards will struggle to survive as a result

Overcapacity in the shipbuilding industry is most evident in China where many small to medium sized private yards have, until recently, offered cheap alternatives to the superior quality of vessels built in neighbouring Japan and South Korea.

According to the China Association of the National Shipbuilding Industry (CANSI) the country has some 1,647 yards which had some US\$3 billion worth of orders on their books in the first half of 2013, about two thirds of the total for the previous year, but some analysts expect more than 30% of these yards could close over the next few years.

Low cost labour, a global economic boom and a shipbuilding boom to match in the early part of the 21st century combined to encourage the development of a highly fragmented, inefficient and, in parts, antiquated shipbuilding industry.

China's own economic boom over the last 20 or so years has also had its effect with demand for energy rocketing, particularly for heavy industry such as shipbuilding, and that demand is being met by the building of significant numbers of coal fired power stations.

Those power stations have contributed to the heavy pollution suffered in December last year and they continue to churn out pollution that the government now recognises must be dealt with as a matter of some urgency.

The Ministry of Industry and Information Technology (MIIT) document, Issue 55, sets out government requirements for the modernisation of the Chinese shipbuilding sector as part of that drive to modernise the industry. "The nation encourages enterprises to expand, improve their technological standards; establish a modern shipbuilding model; raise the design and manufacturing standards of shipbuilding; raise production efficiency and product quality; improve environmental protection, production safety and health management



Rongsheng Shipyard has won an order for new ships relieving some of the financial pressure on the company

of employees; reduce resources and energy consumption; and eliminate outdated capacity," says the directive.

According to the directive MIIT will issue licences to yards complying with Issue 55 that will allow the yards to operate, failure to comply with the new legislation will mean that licences are refused, or if previously issued will be revoked.

Provincial departments will be responsible for overseeing the implementation of the directive and those yards that do not meet MIIT requirements "will be asked to be reformed according to the criteria. Local departments should actively promote the improvement and advancement of the production condition of enterprises, encourage the merger and reform of enterprises, and speed up the elimination of outdated capacity, via integrated economic, market and legal methods," according to the Issue 55 regulation.

Achieving the goals laid out by the new law will not be simple as yards will be required to improve their working practices, employment rules, environmental records, energy efficiency and safety records all of which will require significant investment from the yards.

According to most industry experts the hardest hit sector will be China's privately owned small to medium sized yards who will struggle to meet the new employment regulations and the efficiency and anti-pollution drive.

Many private yards are already struggling with cash flow difficulties and the new regulatory burden could prove too much for them. China's largest privately owned yard, China Rongsheng Heavy Industries Group, has already reported cash flow difficulties and asked the government for a bail out in July last year.

First half losses at Rongsheng amounted to RMB1.3 billion (US\$213 million) following

The Ministry of Industry and Information Technology Directive Issue 55

- The application, examination and announcement of the “Criteria for the Shipbuilding Industry” (the Criteria): i) The Ministry of Industry and Information Technology (MIIT) will manage the standardisation and management of the shipbuilding sector. Enterprises will draft an application report based on the requirement of the “Criteria for the Shipbuilding Industry” and provide relevant information; submit the report to the MIIT via the local shipbuilding industry department. Headquarters of enterprises should collect information and application reports from subsidiaries and submit to the MIIT and copy the reports to local and provincial industry departments.
- ii) Shipbuilding industry department of provinces, autonomous regions and municipalities will conduct a primary examination of applications. Headquarters of enterprises should conduct primary examination of applications from their subsidiaries. The actual situation of applicants will be examined according to the Criteria during the primary examination.
- iii) MIIT will assign relevant industry organisations and professional institutes to verify the applications according to the Criteria.
- iv) MIIT will publicly announce the list of applicants that have passed the examination and verification. If no objection is made to the list of applicants, MIIT will make a formal announcement of the list of enterprises that fulfil the Criteria.
- MIIT will actively monitor the list of enterprises that fulfil the Criteria. Local shipbuilding industry departments and headquarters of shipbuilding enterprises have to conduct a re-examination annually. MIIT will also conduct random examinations.

Qualification of listed enterprises will be removed from the list if the enterprise:

- i) commits fraud;
- ii) refuses to be re-examined;
- iii) can no longer fulfil the requirements of the Criteria;
- iv) is responsible for a serious accident or negative event, that leads to a serious social effect

Enterprises should be informed prior to the removal of their qualification and be given opportunity to defend themselves.

- Enterprises that do not fulfil requirements of the Criteria will be asked to be reformed according to the Criteria. Local departments should actively promote the improvement and advancement of the production condition of enterprises, encourage merger and reform of enterprises, and speed up the elimination of outdated capacity, via integrated economic, market and legal methods.
- The list of enterprises formally announced will receive policy support from the government; while those that are not qualified to be listed will not receive government policy support.

Issue 55 will require yards to meet standards for:

- i) Facilities, equipment and survey requirements
- ii) Shipbuilding technology and capability requirements
- iii) Technological innovation and product requirements
- iv) Staff requirements
- v) Quality control system
- vi) Safety, environmental protection, employee’s health, and social responsibility

the collapse of orders. The yard reported just two orders in 2012 with a value of US\$55.6 million, significantly below the yard’s target of US\$1.8 billion.

One analyst says: “Rongsheng’s cash flow problems have meant that workers have not been paid and they have gone on strike, for

a couple of months now, the government injected some cash to allow the yard to finish ship orders.”

Significant numbers of staff, the yard will not specify how many, have already been made redundant at Rongsheng following the company’s reported RMB1.3 billion

(US\$214.65 million) loss in the first half of last year. With this level of decline yards like Rongsheng are expected to find it very difficult to meet the new regulations laid out by MIIT.

Nevertheless, the company did manage to secure an order from Hong Kong-based

operator Ocean Line for up to six VLOC vessels, with the first ship due for delivery in 2015. This may keep the wolves at bay, but the yard will still need to meet the new regulations and become more efficient, with better working practices.

Government is now demanding that yards only consume energy equivalent to 0.2 tonnes of coal for every RMB10,000 (US\$1,650) revenue achieved. Steel utilisation rates are required to exceed 90% and automatic and semi-automatic welding rates must reach 65% or over. Ships built are required to meet all relevant [national and international] standards for safety, environmental protection and energy efficiency.

Yards will have to meet strict requirements for yard layout, including mechanisation requirements and access to the sea and a land mass commensurate with the size of the yard. All shipyards will be required to meet quality standards established by third parties, such as ISO 14000 among others. In addition will need to establish research & development departments and invest 2% of their revenue in R&D.

MIIT are also targeting the quality control systems of yards and are demanding that yards establish quality control systems that include independent assessments from quality control organisations.

Perhaps the biggest change, however, will come with the introduction of safe working practices and employee rights to improved working conditions. Apart from stipulating, what would appear to be the obvious, which is that yards should employ technicians qualified in the various aspects of shipbuilding such as surveyors, electrical engineers and hull specialists, Issue 55 requires all employees involved in welding to acquire recognised training in the field. Other technicians are now also required to hold relevant qualifications.

In an understated way Issue 55 will revolutionise the working conditions of staff at Chinese yards according to one expert observer. Hu Jin-Tao, president and senior architect at Shanghai ship designers SDARI, told *The Naval Architect*: “Chinese yards are staffed by sub-contractors and those staff are known as farm workers and they are just trained as workers.”

Minimum training was given to the “farm workers” when they left the fields to work in the yards, but these workers have no insurance, no pensions and no right to



JS Amazon was the first of the Crown 63 bulk carriers delivered last year, Crown 63 is the latest in the successful Crown series built by Sinopacific

employment, Issue 55 will mean yards will not only need to train staff, but also offer staff permanent employment.

“Many of these workers are working far too hard at two shifts a day, this can’t go for the long term,” explains Jin-Tao.

Staff are also aging and new staff will need to be employed and trained all adding to the growing costs of complying with Issue 55. “Good yards will get business so poor yards already have a problem,” explained Jin-Tao, “Issue 55 is another stone on their shoulders.”

The weight may be further increased by Issue 55’s requirement to invest a minimum of 2% of revenues in research and development. For some of the better run yards R&D budgets will already be available and the development of new products may come in a variety of ways.

Sinopacific, for example, has developed its own successful designs in the Crown, Tiger and Dragon series of ships. The private yard has focused on bulk carriers, small gas carriers and offshore support vessels. The company is now looking into producing feeder container vessels, but its latest drive for development has been its partnership with Ulstein and Rolls-Royce in the offshore vessel market.

According to Sinopacific Chairman Simon Liang the trick is to “chase only one rabbit”. In effect the company is narrowing its focus and concentrating its efforts to maximise its ability. Liang told *The Naval Architect* that Sinopacific likes clients that send criticisms, because it helps the company to improve.

“We received 5,000 comments from

Thenamaris’ technical team during construction, it took our engineers six months to work our way through it, but they are a company with professional principles and they check that your design calculations and that our designs are good enough to meet their special requirements. It was a very rich experience for us and it helped to improve our production,” explained Liang.

According to Sinopacific the recession in shipping has allowed the company to focus on R&D and develop new designs. “We must also understand the harmonised common structural rules (CSR-H),” says the company.

CSR-H will mean that bulk carriers are more standardised, but CSR-H is about safety and that must be balanced against the Energy Efficiency Design Index (EEDI), which is about efficiency. More steel will be required to implement CSR-H, 10-15% more from the original CSR and the latest regulation requires a further 5% in steel weight, says Sinopacific.

As Sinopacific has developed the designs that they know best and has entered into partnerships that will help the company develop their designs Jiangnan Shipyard has looked to developing designs for a more sophisticated market sector that will help the yard meet the Issue 55 R&D requirements.

Jiangnan Technical Director Hu Keyi says that the group is looking into building small LNG carriers and floating storage regasification units (FSRU), floating storage units (FSU) and floating, storage and offloading (FSO) units.

These units will include the use of Gaztransport & Technigaz’s (GTT) MKIII Flex membrane. “We have spoken with GTT

and completed the first mock up,” explained Hu Keyi. The group is looking to develop a 50,000m³ LNG carrier. Hu Keyi says that the yard is interested in using the MKIII Flex because it has a much lower boil off rate than comparable membrane systems: “it is very suitable for FSU’s,” he says.

“Moving from a MKIII Flex mock up to a full scale building is a big step,” adds Hu Keyi, “but we have submitted designs for a [LNG] bunker ship and we are waiting for the owner to respond, then we may look at larger ships.”

In addition the yard signed, just before Christmas 2013, a deal to build a 35,000m³ ethane carrier with options for a further three vessels with Navigator Gas. These ships will be the world’s largest ethane carriers and are set to take advantage of the US shale gas market, which will have a surplus of ethane.

The Navigator vessels will incorporate MAN GI low speed dual fuel engines with four auxiliaries, two conventional and two dual fuel as a way to use any boil off gas. The 180m vessel will be delivered in early 2016.

In the context of the new regulation, Issue 55, yard companies such as Sinopacific and Jiangnan would appear to be well placed to meet the new directive. Others have not been so lucky. “A lot of yards have already closed in Jiangsu and Jijiang provinces, many more will close, only a small number of yards had orders this year, around 30% had orders in China this year,” says Bestway deputy managing director Qing Bin Jun. He

adds that the situation will be clearer by the end of this year.

Li Chen technical director at Shanghai ship designers Odely says that excessive capacity must be dealt with, he believes that many of the “low standard, low tech” yards will struggle to survive and will either close or merge when faced by the reality of Issue 55.

“Issue 55 has serious and strict requirements to upgrade the shipbuilding Industry and the government must push yards to satisfy these requirements...it will make the industry more efficient, green and creative,” Chen argues.

Odely also experienced a slow-down in its business as a consequence of the global recession, but the company is now recovering some of the lost ground. Chen says that the company worked to produce good services and strived for technical developments during the years of recession, now the company is expanding, taking on a further 40 engineering staff.

According to Odely the shipbuilding market has shown some signs of life in a few sectors, including the bulk carrier, gas carrier and, in a lesser way, the container market.

These signs of life are not significant enough to be regarded as a full scale recovery and with Issue 55 applying pressure there is a possibility that many yards will lose staff, possibly creating social problems in particular regions where workers have been laid off.

There are some rays of light in, what appears to be, a never ending tunnel. Zhoushan Changhong International Shipyard (ZCIS) opened in 2012, following the collapse of the Tsuji yard, which was operated by a Japanese company.

Jiangsu Xin Chang, notable for its work in scrapping ships has invested RMB6.7 billion (US\$1.1 billion) in the 3 million m² ZCIS and has so far built a floating dock, for the yard’s own use and a couple of handymax vessels for domestic owners for delivery next year.

UK-based Graig Shipping, known for using previously untried yards, such as its large bulk carrier order in Vietnam some years ago, is currently negotiating the building of a number of ships including an order for two Kamsarmax bulk carriers with an option for a further four vessels.

ZCIS business manager Xu Fan says the company has no other orders as yet, but the company is talking to a number of “overseas owners”. The new yard will focus on bulk carriers using a SDARI design.

“We will start with bulk carriers, but the team [at ZCIS] has experience in building PCTC’s and chemical tankers also, so we may do more complex ships within the next five years,” says Fan.

Though ZCIS was unaware of Issue 55 Fan was certain that the yard company was financially robust enough to withstand any pressure that might result from the directive, though she acknowledged that many yards were under pressure and others had already been closed through bankruptcy.

Issue 55 “will cause social problems” says one source, he added, “there will be a period of pain for both private yards and the banks, but state yards will be protected by the state itself, though they will need to meet the new rules, but investment should not be a problem.

According to Jin-Tao 2014 will be a stable year with a slight drop in revenues for the yards, but he explains this is in effect the calm before the storm. “Orders, today, are at the border between profit and loss [for the yards] so any increase in the price of steel will tip the balance. *NA*



Sinopacific’s Yangzhou Dayang Shipyard where the Crown series of ships are built

China's designers branch out

A deep global recession has had a devastating effect on the shipbuilding industry and persuaded some of China's best known ship designers to move into new businesses in an effort to maintain their revenues. Some of the new businesses are quirky, others considered a natural progression of their existing work

Quality in the maritime equipment manufacturing market in China, which supplies the shipyards with pumps, pipes, valves and a plethora of other equipment, has not been the watchword of the industry according to Hu Jin-Tao president of the Shanghai-based Ship Design & Research Institute (SDARI).

Ships built in China, says Jin-Tao, are heavier than similar vessels built abroad, partly because of the quality issues in China. "Mechanical and machinery outfittings are heavier in China," admits Jin-Tao, "The quality of machinery in Japan is higher so they have a lighter, better design, but some people are so concerned about the quality of Chinese equipment that they require standbys, spares in case one machine, such as a pump, fails; reliability is an issue," he says.

As a result SDARI see a gap for high quality maritime equipment in the Chinese shipbuilding market and the company plans to fill that gap by designing its own high quality equipment and sub-contracting its manufacture to trusted factories.

The backbone of the SDARI designed fleet has been the Green Dolphin series of bulk carriers, but Jin-Tao says: "no two ships are the same" even though the basic design is the same. It is a buyers' market and they can choose equipment and yards must agree to the changes.

SDARI expects the new company to begin trading later this year with Jin-Tao managing the project in its early stages. The



DNV GL and SDARI introduce new green Dolphin bulk carrier concept

ship designer will hold the technical and marketing functions of the new company which will begin with equipment and, if successful, will move into client services such as vessel construction supervision for owners and the development of existing performance monitoring programmes, with its partner, NAPA, which will be an essential element of the Energy Efficiency Operating Index, explains Jin-Tao.

Across town another well-known ship designer is also looking to diversify its business, but Bestway is looking to take advantage of the growing wealth of Shanghai residents and to that end has entered into collaborations with housing companies to set up yacht clubs in newly built residential areas.

Bestway deputy managing director Qin Bing Jun, told *The Naval Architect*: "our yacht business has only been operating for three years, but we have established two clubs, one on the river and one west of Shanghai."

The idea of the collaboration is for prospective home owners to buy a yacht at the same time as they buy their home. Factories for the construction of the, comparatively small, vessels have been established and staff have been sent to Italy for training in the yacht designs, with the training coming from the original yacht designers, but the vessels themselves are

built in China.

A third ship design house has taken a more conventional route to satisfy its need to diversify its business. Odely has recently moved into new vessel designs, multipurpose vessels (MPV) and gas carriers, LNG, LEG and LPG in C-Type tanks. Odely designs its own tanks, because it wants to be certain that the critical areas of the design, in particular at the interface between the tank and hull which, says Li Chen, Odely technical director, is a "very important part of the design, it can be very problematic".

Odely's C-Type tank was designed using analysis from finite element modelling (FEM), which saves materials and generally gives better results explains Chen. "In addition we can integrate this expertise into the offshore market where we now build semi-submersibles and a new concept MPV that is designed to serve the offshore sector," he says.

United Faith, a domestic owner, is looking for "dozens" of these 150m long vessels, which will be powered by MAN two-stroke engines run on standard HFO. The 50,000dwt semi-submersible ships will be ro-ro vessels with open top features. The owner is currently looking for a suitable yard to build the ships, explains Chen. **NA**



Bestway diversifies into the yacht market

Inspired by water



VISIT US
AT APM, THE
PAMARINE
STAND Q07

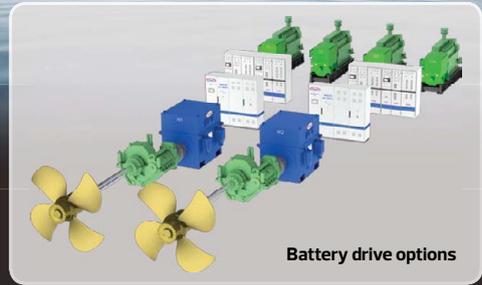
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Huanghai paves way for entry into cruise ship building market

Bo Hai Jing Zhu is the largest ro-pax ferry built at the Huanghai shipyard and the company believes that the experience it has gained in building the vessel will allow it to make the considerable leap from ferries to cruise ships

Cruise shipping in China is expected to take off as the more affluent Chinese look to spend their disposable income. However, one shipbuilding insider, who wanted to remain anonymous, told *The Naval Architect* that a concept cruise vessel has already been designed for a domestic owner, though it is unclear who the designer is and to which yard it would be contracted to at this moment.

“The ship is expected to operate around the North China, South Korea, Japan and South East Asia region and will accommodate 1,500 people on the 50,000gt vessel,” says the source. The vessel’s hull and machinery will be designed by a Chinese



Bo Hai Jing Zhu is the largest ro-pax built at Huanghai shipyard

naval architecture company, while the hotel section will be contracted out to a specialised company, he added.

However, he says that the project is stalled at the moment. “The Chinese don’t like sports or visiting historic sites like the Americans and Europeans, they like to gamble, but the government is not keen on issuing gambling licences,” the source explained.

In addition, Chinese tastes in decoration and their culinary perceptions are significantly different to those enjoyed in the West and as such any Chinese built vessel designed for the Asian market will reflect those sensitivities, says the industry insider.

No such concerns were apparent with the design and construction of *Bo Hai Jing Zhu* for the Bohai Ferry Company at the Huanghai Shipbuilding Co. Designed by the Shanghai based Ship Design & Research Institute (SDARI) the vessel and its sister, *Bo Hai Cui Zhu*, serve the Dalian to Yantai route meeting the significant demand for transit in north-eastern China.

The vessels have a capacity of 2,500 lane meters (amounting to 221 trucks or 580 cars) and 2,038 passengers on offshore service or 1,570 passengers for international short distance voyages.

Three fixed decks (No. 1, 3,5 deck) are used for trailers, two ramps and doors at the ship’s bow and stern provide external

access to deck 3, it is convenient for the trucks to enter from one ramp and exit from the other ramp, improving loading and unloading efficiency. A removable ramp on deck 5, which can be tilted at each end, and a liftable platform are provided for internal traffic flow.

There are 315 cabins on three decks seven, eight and nine and the main public spaces are the Kara Ok rooms, chess rooms, tax free shop and mess room on deck eight.

The vessel has been designed and built to meet the latest environmental standards of fuel efficiency and to fulfil China Classification Society requirements. This includes measures to keep the vibration and noise to a very low level. In addition, the vessel complies with the severe damage stability requirements based on MSC.216(82).

Bo Hai Jing Zhu is equipped for both international and internal offshore services with special consideration for Chinese Maritime Authority rules in the Bohai Gulf.

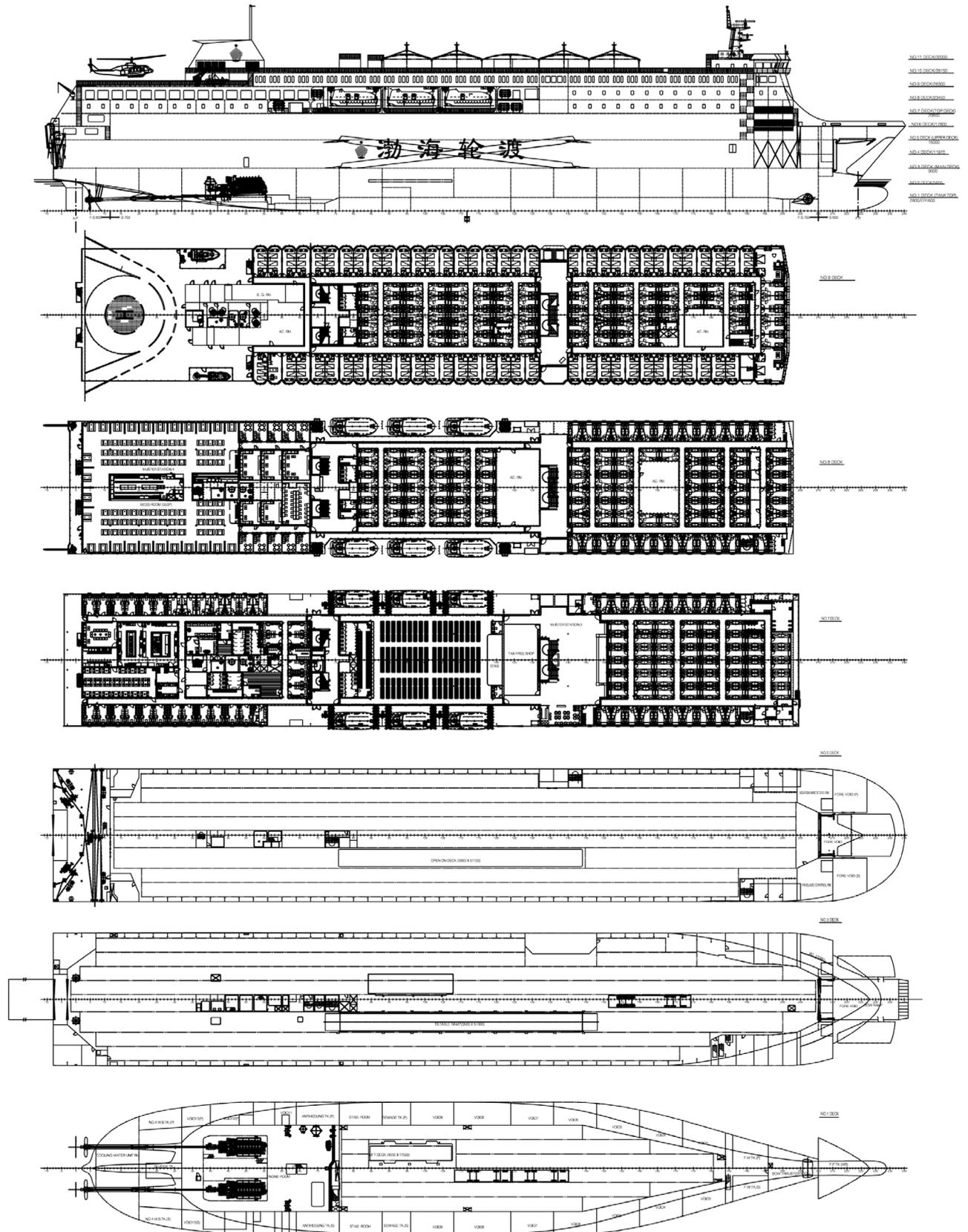
The main engines form part of a MAN package which includes two gearboxes, shafting, and two CP propellers. Electrical power is supplied by two 1,600kW shaft-driven generators and three 720kW diesel-driven gensets, and the capacity of one or two shaft-driven generators is enough for normal sea going conditions. **NA**

TECHNICAL PARTICULARS

Bo Hai Jing Zhu

Length oa:.....	187.71m
Length bp:	164.00m
Breadth moulded:.....	28.00m
Depth moulded	
To main deck:	9.00m
To upper deck:.....	15.00m
Draught	
Scantling:	6.80m
Design:.....	6.20m
Gross:.....	34,222gt
Displacement:.....	20,222tonnes
Lightweight	
Design:.....	5,209tonnes
Scantling:	7,597tonnes
Speed, service:	20.06knots
Classification society	
and notations:.....	CCS★CSA Ro-Ro Passenger Ship, PSPC(B); Ice Class B★CSM MCC
Main engine	
Manufacturer:.....	MAN Diesel & Turbo
Model:	16V32/40 CD
Number:	2
Output of each engine:.....	8,000kW

GA for Bo Hai Jing Zhu



Lynceus offers 21st century search & rescue option

Lynceus low power wireless body area network technologies enables the unobtrusive tracking of people for onboard and overboard search and rescue, significantly increasing survival chances for casualties through the early location and rescue of people in danger.

Today's cruise ships are pushing the boundaries of technology. The largest cruise ship sailing today, with a building cost in excess of €1 billion (US\$1.35 billion), carries more than 8,000 people onboard (passengers and crew) while an average cruise ship (which costs between €30-100 million (US\$40.89-136.3 million) carries 1,500-3,000 passengers.

Despite the huge investment in the construction of new cruise ships, the cruise industry still suffers from the loss of life at sea and this has a negative effect on the people trust and preference when they are about to select their means of transport or holidays. According to an industry assessment by Vanem & Ellis in 2010 [1], the cost of a loss of life at sea was estimated at between €3.2 -5.9 million (US\$4.36-8.04 million) per fatality, while the total cost including the loss of passenger faith and support in cruises and maritime transportation is still unaccounted.

A large number of studies and investigations carried out following casualties involving ships have identified the need to improve the evacuation, mustering and abandoning procedures, especially on passenger ships, as these are getting ever larger. An essential stage in the above procedures is the counting and accounting for all persons onboard a passenger ship and controlling their movement for safe abandoning. The importance of this stage has been further highlighted in the relevant sections of the STCW Convention and Code of 1995 [2] as amended for passenger ships. Namely, the requirements of section V/2 & V/3 of the STCW Code for ro-ro [3] and passenger ships respectively.

The reports from the investigation of various serious incidents or casualties on

passenger ships, which resulted in the loss of life, revealed the urgent need for improvements in the evacuation, mustering and abandoning procedures and especially on tracking and locating the whereabouts of each person onboard, at first, and secondly on the proper and correct counting of personnel. The last two are considered as the weak links in the whole process of ensuring the safe evacuation of all persons onboard. Even though a lot of effort has been made to tackle these severe safety issues by developing intelligent systems, which will enable passenger tracking while onboard and in the sea during an emergency, until recently there was no system available which could localise and track people in real time and use this information in an efficient and cost effective manner. However, since April 2012, an FP7 project called "Lynceus" (<http://www.lynceus-project.eu/>) is developing innovations taking into account the key requirements for safe evacuation and search and rescue application areas, pushing current technology beyond the state-of-the-art and significantly contributing towards minimising the risk of loss of life.

It is expected that by the end of the project in March 2015, a new family of safety related product prototypes will be introduced to the maritime industry by the consortium partners.

Challenges of wireless sensor technologies

Lynceus is tackling the localisation problems which remained previously unresolved mainly due to the unavailability of wireless wearable technology which can work efficiently in harsh communication environments, such as a huge steel structure (ship) and extreme environmental conditions in the case where people are in the sea. Major technological barriers that hamper low cost and safe evacuation include:

- 1) Unavailability of extremely low powered, low cost wireless technology which could be embedded in wearable items such as life jackets, or bracelets, and enable real time localisation/tracking of the person wearing them. Techniques based on RFID tags [1] are limited to counting of passengers while limited transmission range requires a large number of RFID readers, thereby escalating the cost

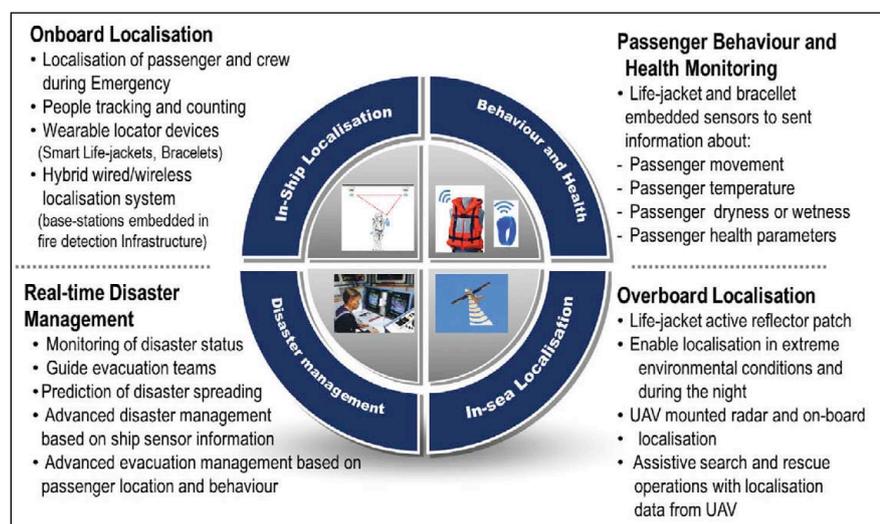


Figure 1: Overview of the Lynceus main research and development areas

- 2) Unavailability of technology to monitor passenger behavior and health status in real time during an emergency. The behavior of people during an emergency is unpredictable, which creates an additional risk factor in efficient and complete evacuation and prioritised assistance
- 3) Cruise ships are huge steel structures which consist of a very challenging environment for wireless communications. Extreme multipath prohibits the large deployment of low powered wireless sensor networks while it also induces significant challenges in real time localisation/tracking
- 4) The deployment of thousands of wireless sensor nodes induces many challenges in the communication system as far as robust routing, communication protocols, and bandwidth availability is concerned
- 5) The technical barriers for robust wireless sensor network deployment in ships prohibit the deployment of various emergency monitoring sensors, which will enable efficient monitoring of the emergency (fire, water ingress) spreading. As a result, current monitoring systems do not provide a full picture of the escalation of the emergency, thus the decision support systems are insufficient since they lack real-time information feedback from the emergency in the surrounding environment
- 6) Unavailability of low-cost and robust technology able to localise people in the sea. GPS based systems have not been commercialised in this industry mainly due to their very high cost for mass deployment.

Targeted fields of innovation

Lynceus develops innovative solutions to the aforementioned problems through a top-to-bottom system approach taking into account the key requirements for the cruise ship industry. The primary safe evacuation and search and rescue application areas where the Lynceus technology pushes the technology beyond the state-of-the-art and significantly contributes towards minimising the risk of loss of life are summarised below:

People localisation in ship: Even though there are various systems for wireless sensor localisation as described above, it is the first time that such a system is developed for the extremely demanding environment of a ship. Lynceus provides a breakthrough for

the current 'manual' approach since it gives search and rescue teams a novel tool for localising people and ensuring that they have been safely evacuated.

Passenger status monitoring: Lynceus revolutionises the current safe evacuation decision making approaches since it enables for the first time real time monitoring of basic behavioural information of passengers. Knowing whether passengers and crew are actively taking part in the evacuation process will significantly contribute towards efficient rescue prioritisation and optimisation of safety crew resource allocation.

Emergency progress/escalation: The project aims to significantly add to the current systems' capabilities by offering a wireless network where ad-hoc sensor nodes could be easily deployed to monitor a vast range of parameters that describe the current situation of the emergency in a dynamic changing environment.

“Lynceus creates a large family of technologies which will push current practices”

Passenger counting and identification: The Lynceus technology introduces an automatic approach for passenger identification and counting at muster stations and life rafts, minimising errors that may occur through the current verbal identification process. Lynceus can provide each individual's identity by associating his lifejacket with information from the ship's manifest using a user friendly and reliable handheld device, ensuring an accurate, reliable and time efficient counting and identification system.

Safe evacuation and emergency management decision support: Lynceus provides the safe evacuation and emergency management decision making process with a vast amount of information about passenger's position and behaviour in real time. This unique information feeds advanced decision support algorithms, which provide efficient decision making support based on real time data.

People localisation in sea: The use of Unmanned Air Vehicles (UAV) together with an innovative active radio beacon technology will revolutionise the current search and rescue processes/techniques since for the first time a person overboard will be able to transmit their position through the Lynceus technology embedded in their life jacket.

In summary, Lynceus creates a large family of technologies which will push current practices from ship localisation to individual people overboard localisation and identification. These technologies are integrated into a single safe evacuation system, described in the next section.

The Lynceus system

The targeted innovation of the Lynceus system described in the previous section are achieved through the following four research and development areas, illustrated in figure 1.

a) Onboard Localisation:

The principle of the Lynceus tracking procedure will be the localisation/tracking of moving smart life jackets and wrist bracelets. The project builds on an ultra-low-power radio frequency (RF) and digital signal processing (DSP) system-on-chip (SoC) technology which is combined with new innovative wearable antennas and low powered embedded electronics so as to develop the Lynceus wireless node able to be embedded in various marine products (i.e. life jackets, smoke detectors, etc).

According to international maritime standards and industry procedures, each passenger and crew member is equipped with a life-jacket in case of emergency. The Lynceus technology enables the development of a new generation of 'smart' life-jackets with an embedded wireless sensor node and miniaturised close-to-body wearable antennas able to be uniquely identified in the network.

In order to facilitate the localisation of such moving life-jacket nodes, Lynceus is also developing sensor gateways which could be easily integrated into the ship's fire detection system in order to facilitate a base station wireless backbone able to collect the communication information from the moving smart life jackets and perform the localisation/tracking of each passenger. These low powered gateways are embedded in fire detection and smoke alarm sensors and act

as the base stations for a position estimation process where localisation targets will be the lifejackets and bracelets.

The principle is to use the ship's existing wireline fire detection system and integrate on the new wireless infrastructure needed for the passenger localisation, but also for monitoring a wide variety of emergency sensors distributed around the ship.

The localisation information gathered by the Lynceus 'smart' fire detection gateways is sent to the central system via cable, while wireless links are used as an additional redundant network in case the first one is damaged. Lynceus technology will, therefore, significantly outperform the current RFID based systems which have a limited communication range, are not able to acquire, process and transmit any sensor information, and require the deployment of a completely new infrastructure (RFID readers) that escalates the implementation cost.

b) Passenger behaviour and health monitoring:

Lynceus introduces the integration of miniature sensors within Lynceus wireless nodes and the use of innovative sensor signal processing techniques in order to provide basic behavioural and motion information to the central evacuation decision support system. Embedded sensors provide information about passenger movements in order to identify whether the passenger is active in case of an emergency situation.

This information is extremely important so as to identify people that are trapped, have collapsed or are unconscious, but still alive, and to prioritise assistance. Motion sensors when combined with health monitoring sensors will enhance the ability of the decision support system to guide the ship's rescue teams for finding/tracking lost passengers within the ship.

c) Real time monitoring for emergency management:

Lynceus develops 'smart' wireless sensors/detectors with embedded wireless modules able to acquire data from a variety of sensors. In this way installation of the

system in an existing infrastructure can be facilitated with minimum effort and cost. A backbone network is used so as to provide power to "power-greedy" devices or sensors/actuators, but also for data communication while the wireless network would be used to create additional leafs (battery operated piconets) stemming from the cabled backbone allowing various

sensors/actuators to be very easily installed in any place of the ship.

Therefore, real time monitoring of water level, temperature and other vital parameters become feasible and this is very important for providing vital information about the spreading of the damage/emergency ensuring a more efficient response and emergency handling.

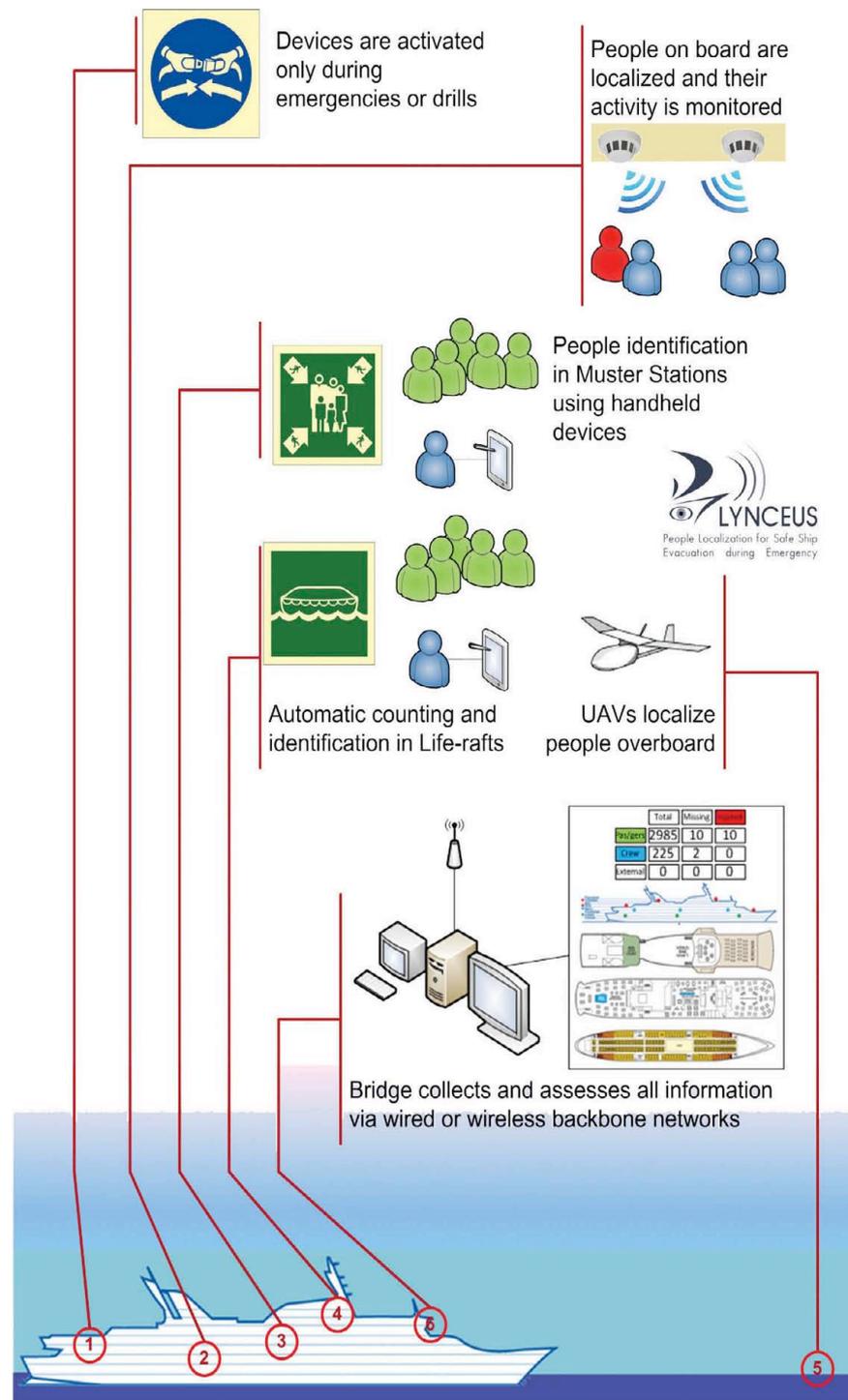


Figure 2: Description of the main Lynceus system functionalities

All localisation, behavioural, motion and emergency related information is directed to the central real time monitoring and emergency management support system, capable of providing a quick and accurate decision support to the ship's command. Intelligent decision support algorithms based on the industry's standard evacuation procedures are being developed so as to fuse and process the vast amount of data received, thus enabling accurate decision support. The system will be an additional decision support system to the ship's Master as per the relevant SOLAS provisions and STCW requirements on Crowd and Crisis Management.

d) Overboard Localisation:

The Lynceus project also develops a reliable and low cost localisation/tracking system for persons overboard. Because the requirements are very challenging with respect to onboard localisation, Lynceus employs an optimised, compact, and light-weight electronic device, which uses an 'active reflector' localisation technology by means of miniaturised radar embedded in the lifejacket.

The 'active reflector' devices consume less power and offer vastly larger detection ranges at better accuracies compared to RFID technologies. Moreover, if integrated in silicon technology, such as a reflector patch comprised of a low cost solution for overboard localisation, it can be widely deployed in life-jackets.

Compared to the state-of-the-art search and rescue procedures, which are based on detecting the lights coming from the individual's lifejacket lamp or on hearing the life-jacket's whistle, a more reliable localisation and identification is achieved by this 'active reflector' technology.

Furthermore, Lynceus incorporates the use of unmanned aerial vehicles (UAV) flying over the emergency area, equipped with Lynceus technology radars, in order to localise people overboard and notify the search and rescue agencies faster than other available technologies.

The project is developing the active reflector-based radar by using a UAV as a base station, which will be able to localise the 'smart' lifejackets during its flight. The radar will scan the area from certain positions so as to enable triangulation-

based localisation of the lifejackets, which means that a single UAV is able to localise all passengers overboard. The advantage of such a UAV is the possibility to localise individual passengers in record-breaking times, to communicate their position and identification to the nearest costal Maritime Rescue Coordination Centre even under very harsh sea conditions and in complete darkness.

A conceptual overview of the Lynceus platform, which integrates all the functionalities of the aforementioned technologies, is illustrated in figure 2. It can be seen that the wireless infrastructure to be developed through the deployment of a network of 'smart' fire and smoke detection sensors will be used not only for the real-time passenger localisation/tracking (which is the main target of this project), but also for gathering essential emergency related sensor information.

Project implementation and expected outcome

The goals of the Lynceus vision, described in this paper, are fully supported by the European Union. The technologies involved in meeting these goals are currently under development through a €3.5 million (US\$4.77 million) European Union Seventh Framework Programme project, called Lynceus.

The project started in April 2012, and is expected to end in March 2015. During this three-year period, the required technologies for meeting all aforementioned challenging goals and delivering an economically viable solution for all stakeholders are being developed based on existing technological knowledge and competitive solutions shared by the consortium partners.

The project is carried out by a European consortium, involving key stakeholders of the maritime and electronics fields, as partners. Four key technological partners, SignalGeneriX, CSEM, Technical University of Dresden and MARINEM, provide their expertise in developing the integrated electronic components and systems which will meet the requirements and market needs of the consortium.

Lloyd's Register Marine has been contributing on the specificities of passenger ship design and operation in terms of fire safety and evacuation,

including insights on the relevant regulatory framework.

Louis Cruises is also a key partner, which has been providing the consortium with cruise ships for testing and validating the various components of the Lynceus system in the actual environments they are built for. The consortium includes specialised enterprises which focus on life-saving and survival marine equipment (Canepa & Campi), fire detection and smoke alarm marine equipment (Safe Marine), smart fabrics (ATEVAL), UAVs (G.G. Dedalos), and emergency management decision support systems (OptionsNet), providing their technical specifications for the respective subsystems.

A group of marine and electronic system associations (Foro Maritimo Vasko, SEPVE) also provide key insights on their respective markets and strongly support its exploitation and dissemination activities. Finally, TALOS is in charge of the management activities of the project.

The partners have come together to provide a balanced match of technological skills, industrial objectives with business synergies. Based on this organisation, and on the expertise of the partners, the Lynceus project will soon be able to provide a large variety of products ranging from life saving and survival marine equipment, fire detection and smoke alarm marine equipment, safe evacuation/abandoning and emergency management decision support systems, to Maritime search and rescue equipment and services.

Above all, all partners share the same vision of providing the ability of saving human lives in case of an onboard emergency. The fact that the Lynceus technology will be able to locate each and every passenger and crew member, will significantly increase the chances of reducing human casualties during emergency situations. **NA**

References

- [1] *Evaluating the cost-effectiveness of a monitoring system for improved evacuation from passenger ships*, Erik Vanema; Joanne Ellis, Safety Science, Elsevier, Volume 48, p.788-802, (2010)
- [2] *Standards of Training, Certification and Watchkeeping* (www.stcw.org)
- [3] *Roll-on/roll-off (RORO) ships are vessels that carry wheeled cargo and passengers.*

Cruise safety dominates regulations following *Concordia* tragedy

Safety and security have dominated the cruise shipping agenda in the past year, as the wreck removal operation for *Costa Concordia* continued and the US Government Accountability Office issued its report on the implementation of the Cruise Vessel Security and Safety Act. Sandra Speares reports

Market conditions as well as green regulations have been pushing the cruise lines to further explore energy efficiency measures and technology to reduce their eco-footprint.

RINA's conference on design and operation of passenger ships in November last year, highlighted some of the challenges faced by the passenger shipping industry in terms of their approach to assessing cruise ship stability, as well as practical steps that can be taken to improve evacuation procedures in the event of a casualty and risk assessment for passenger ships.

David Ridden, principal consultant at Burness Corlett Three Quays, highlighted the practical difficulties of assessing the stability of cruise ships, which have been increasing in size and in numbers during the past 20 years.

The growth in passenger numbers has occurred at the same time as regulatory changes aimed at ensuring adequate margins of stability in intact and damaged conditions.

He maintained that the: "statutory requirements for confirming the accuracy and reliability of the lightship properties remain largely unchanged and do not reflect the increased risk presented by ever larger passenger ships."

As cruise ship operators seek to improve the appearance of their ships and the amenities on board, this results in potential weight changes which result in the need to verify lightship properties, he explained. Lightship surveys tend to be done when the ship is in service and are sub-divided into a dry survey, a tank survey and draught survey.

Other issues he raised were the weight of stores onboard. If the ship was in service when the survey was made it was likely to be fully stocked with stores, in which case there might be difficulty in accurately estimating the weight. In the same way, the more passengers on the ship, the greater margin for error.

Other concerns included that in the past practically all tanks had sounding pipes,

whereas these had now been replaced by gauges and surveys show: "they are sometimes faulty, he said. There were also problems with draught surveys if draught marks were in the wrong place, or weather conditions made reading them difficult. Given the design of the after hull of some cruise ships reading the aft hull marks might be difficult", he added.

Given that the cruise industry is growing, both in size and in numbers of passengers onboard a single ship, so are the difficulties of successfully evacuating passengers and crew in the event of an emergency according to Dr Daniel Povel of FutureShip – part of the DNV GL Group.

Since July 2010 passenger ship newbuildings have to comply with Safe Return to Port regulations, which addresses redundancy of propulsion and safety systems following a fire or flooding incident. However, the new rules only apply to ships built since the rules came into force, but Povel explained at the conference that

Costa Diadema latest technologically innovative ship for Costa from Fincantieri



the philosophy of Safe Return to Port could be applied to existing vessels using a risk assessment method. A system vulnerability and availability assessment addressing passenger ship systems capabilities following an accident could increase safety for passengers and crew, as well as prevent down time in a shipyard, or compensation payments, Povel said.

Safety and security on cruise ships has been at the centre of a newly released Government Accountability Office report in the US on the implementation of the Cruise Vessel Security and Safety Act 2010 and crew industry safety practices. The point of the review was to establish whether cruise lines met all the requirements of the Act, and also any actions taken following *Costa Concordia's* grounding to improve the safety of cruise ships visiting US ports.

The report found that the cruise industry and federal agencies had implemented 11 out of 15 of the Act's provisions.

“Lightship surveys tend to be done when the ship is in service and are sub-divided into a dry survey, a tank survey and draught survey”

According to US Coast Guard officials, the report states a notice of proposed rulemaking is in development to address three of the four remaining provisions. The three provisions relate to technologies to firstly detect a person going overboard, secondly maintain a video surveillance system to assist in documenting crimes on the vessel, and thirdly transmit communications and warnings from the ship to anyone in surrounding waters. “A policy linked to the fourth provision on the certification of trainers who provide the CVSSA course on crime scene preservation to cruise line personnel, is, as of December 2013, undergoing review at the Department of Transportation.”

The report raised some concerns about crime reporting and amendments to the Act have been tabled to deal with this aspect.

Following *Costa Concordia's* accident the Cruise Lines International Association (CLIA) identified 10 safety-related policies in 2012 that were adopted by all member cruise lines by July 2013.

These policies include improvements to vessel passage planning and life jacket stowage, among other things. The IMO has also adopted a regulation, effective January 2015, requiring passengers to participate in a muster drill prior to or immediately upon departure — rather than within 24 hours of departure. CLIA member cruise lines adopted a similar muster policy weeks after *Costa Concordia's* accident.

Commenting on the report CLIA President and CEO Christine Duffy said: “We are pleased the GAO concluded that cruise lines are complying with the requirements of the CVSSA, and implementation of the law is progressing as intended. The cruise industry worked with Congress to develop the CVSSA, along with

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Norwegian Getaway, Norwegian Breakaway's sister, launched in 2014

numerous other stakeholders, and supported its passage and enactment into law.

“Although allegations of serious crime on cruise ships are a small fraction of corresponding rates on land, the cruise industry voluntarily discloses allegations of serious crime to the public so consumers can see for themselves that alleged crimes on cruise ships are uncommon. To our knowledge, no other industry provides this level of transparency.

“The GAO report notes that the low rate of alleged crime on cruise ships as compared with land-based crimes can be explained in part by the fact that passengers are in a set environment, all persons and items brought onboard are screened, camera surveillance is ubiquitous, and security personnel are present.

“We are pleased that the GAO report highlights the proactive efforts of the cruise industry in keeping with its legacy of continuous improvement in shipboard operations and safety. The report recognises that the industry adopted 10 wide-ranging safety policies in 2012, each of which are mandatory for membership in CLIA, and have been incorporated into IMO standards.”

Costa Cruises meanwhile has been celebrating the technical launch of its new flagship the 132,500gt *Costa Diadema* at the Fincantieri shipyard in Marghera. The ship, which has 1,862 cabins, will be delivered on 30 October 2014. Costa Cruises has invested a total of around €550 million (US\$746 million) in its construction and the project is employing approximately 1,000 shipyard workers plus another 2,500 employees of allied industries. The benefits in terms of

employment extend beyond the yard, especially regarding the fitting-out of the interiors of the cruise ship, with the involvement of about 400 contracted suppliers, most of which are Italian firms.

Costa Crociere CEO Michael Thamm commented: “*Costa Diadema* will be our new flagship and our tangible commitment to the future success and growth of our Company. She is the 10th cruise ship built in Italy by Fincantieri for Costa since 2000, with a total investment worth almost €5 billion (US\$6.78 billion). This investment creates wealth and employment for the country as a whole – not only during the building, but also when the ships are in service.”

“A system vulnerability and availability assessment addressing passenger ship systems capabilities following an accident could increase safety for passengers and crew”

Fincantieri’s CEO, Giuseppe Bono, said: “For many years now we’ve been applying Italian know-how to form a winning team with Costa. We hope that the country as a whole is proud of these two major companies and will not fail to support their continued growth. We’re also convinced that *Costa Diadema*, the largest ship ever built for Costa Crociere, bodes very well for the future development of our companies and the entire industry”.

SAM technology

Hamburg-based SAM Electronics, together with its associate company,

Valmarine, has supplied a combination of NACOS Platinum integrated navigation and Valmatic Platinum automation systems aboard Norwegian Cruise Line’s new 144,000gt cruise ship, *Norwegian Getaway*. Built by Meyer Werft at its Papenburg yard, the vessel is due to begin service in February from its home port of Miami.

The complete NACOS assembly comprises five X and S-band radars serially linked to five main Multipilot 1100 multi-function workstations for combined displays of ARPA radar, ECDIS and conning operations in addition to those for automatic steering and voyage planning. The touch-screen units are in turn connected to secondary stations for selectable displays of data located at port and starboard wings as well as the captain’s cabin.

Featuring standardised consoles and a common operating network, the assembly incorporates a complete range of subsidiary nav aids consisting of AIS, VDR, DGPS, EcdisPilot, doppler logs, echosounders, gyros, rudder steering and indicator and wind/weather sensors. Also included is SAM’s latest Bridge Navigational Watch Alarm System in addition to an advanced dynamic positioning system with three polar axis controllers and specialist cruise software developed by Dynamic Positioning & Control Systems.

The NACOS arrangement is complemented by an L-3 Valmarine Valmatic Platinum automation assembly complete with Safety Management and Emergency Shutdown systems, all of which are fully integrated via a redundant network. Operational control is via a dedicated communications network connected to multi-purpose workstations in the engine control room and on the bridge.

With a length of 324m and accommodation for 4,000 passengers, *Norwegian Getaway* is the second cruise newbuilding in NCL’s Breakaway-class ships following the launch last April of *Norwegian Breakaway*. Also built by Meyer Werft, the earlier sister vessel is equipped with identical SAM and L-3 Valmarine integrated Platinum systems. **NA**

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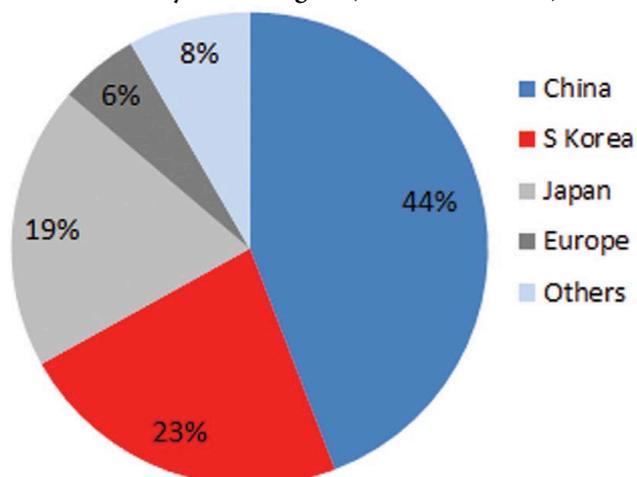


Clarkson Research Services: Historic and Scheduled Delivery

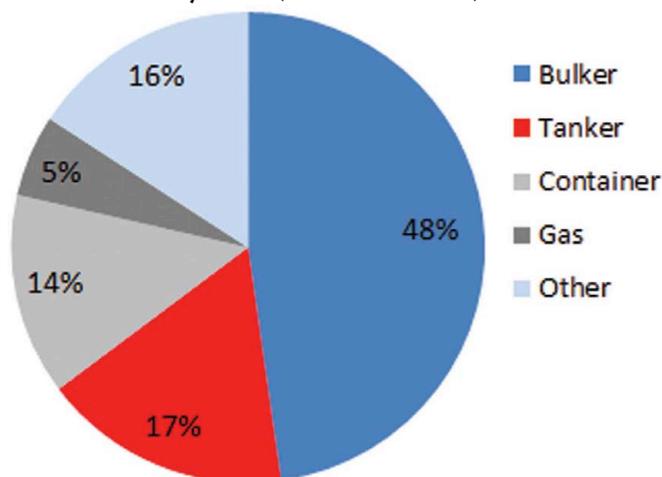
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Vessel Type	2004		2005		2006		2007		2008		2009		2010	
	1st Half	2nd Half												
VLCC >= 200,000	15	14	15	16	5	13	15	14	18	23	32	21	30	24
Suezmax 120-200,000	17	10	16	9	14	12	15	11	9	5	22	23	28	13
Aframax 80-120,000	31	21	35	30	29	21	28	28	24	44	62	34	37	31
Panamax Tankers 60-80,000	26	11	24	21	25	20	26	15	16	27	25	13	15	16
Products 30-60,000	58	60	51	48	59	56	68	65	74	92	91	67	63	43
Products 10-30,000	3	4	3	5	2	9	8	10	7	6	5	5	6	7
Chem & Spec. 10-60,000	27	34	35	41	56	45	62	62	81	104	107	71	79	63
Tankers < 10,000	25	17	27	27	20	26	31	43	59	88	68	69	60	43
Capesize > 100,000	21	20	22	25	32	28	29	27	20	24	34	77	101	112
Panamax 80-100,000	3	3	6	11	22	23	22	16	15	17	27	21	60	60
Panamax 60-80,000	35	39	41	35	36	26	22	22	23	20	18	15	18	33
Handymax 40-60,000	37	43	52	48	53	40	50	50	66	59	86	100	168	168
Handysize 10-40,000	30	35	32	36	30	32	40	51	61	57	84	109	133	147
Combos > 10,000	0	0	0	0	0	0	0	0	0	0	0	0	3	2
LNG Carriers	11	9	6	12	12	16	15	17	24	27	22	17	15	12
LPG Carriers	6	5	4	3	9	15	15	20	27	33	25	18	18	19
Containers > 8,000 teu	5	10	14	18	34	28	20	17	25	25	22	13	30	33
Containers 3-8,000 teu	39	35	38	54	45	56	60	70	72	61	62	57	79	41
Containers < 3,000 teu	40	50	63	79	87	115	105	121	140	108	70	51	56	25
Offshore	7	4	5	6	4	5	3	18	14	14	13	14	24	26
Cruise Vessels	7	3	3	2	6	1	7	3	6	4	3	6	9	5
Ro-Ro Ferries	9	6	13	6	8	6	5	8	16	5	9	7	10	8
Other	69	61	74	75	101	121	142	133	149	147	141	150	160	173
TOTAL														

Orderbook by builder region (number of vessels)



Orderbook by sector (number of vessels)



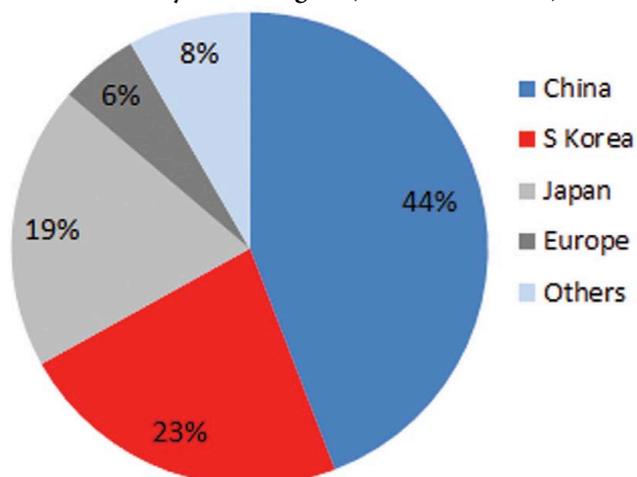


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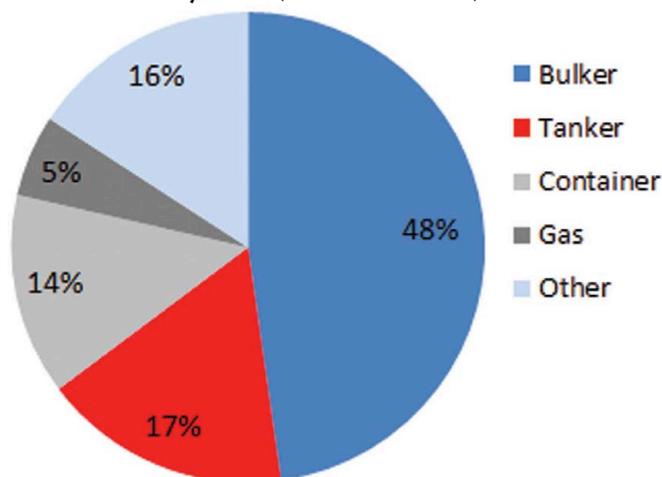
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Products 10-30,000	3	4	3	5	2	9	8	10	7	6	5	5	6	7
Chem & Spec. 10-60,000	27	34	35	41	56	45	62	62	81	104	107	71	79	63
Tankers < 10,000	25	17	27	27	20	26	31	43	59	88	68	69	60	43
Capesize > 100,000	21	20	22	25	32	28	29	27	20	24	34	77	101	112
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Other	69	61	74	75	101	121	142	133	149	147	141	150	160	173
TOTAL														

Orderbook by builder region (number of vessels)



Orderbook by sector (number of vessels)



STX designs for the future

STX Finland is keeping its finger on the environmental pulse with its conception of a green and efficient cruise vessel, the XpTray concept

The aim of the design is to develop the next generation of cruise ships not by just improving some elements, but by radically changing the whole concept of cruise ship design. The design process for the concept vessel was originally started in 2008. Today we see some of the elements of this concept being used in cruise ship design.

Whereas today's cruise ships have large passenger public spaces at two different locations, in the middle of the ship and at the sun deck level, with all necessary service facilities attached to them, in the XpTray concept all passenger public spaces are efficiently centralised in and around the experience deck. At the same time the whole superstructure with passenger cabins have gone through a major change allowing them to be more efficiently constructed.

STX Finland has highlighted that the major point of the design is that the public areas together with their service facilities have all been centralised, which allows the vessel to operate the same service level, but with fewer crew.

Tanja Sabell, communications manager, STX Finland explains that: "Technically challenging detail was the structural discontinuity of the hull and the superstructure. The XpTray concept has a wide hull compared to the narrow superstructure and there are also many large open areas in between those on the wide 'experience decks'."

The energy efficiency of the concept compared to other cruise vessels has



What the interior would look like on the XpTray concept



Propulsion layout onboard

been improved in many ways. The ship is smaller in size per passenger, thus allowing the vessel to consume less energy. This has been achieved by centralising all the passenger public areas and their service facilities on the experience decks in the middle of the ship. The multi-functionality of these areas and also the utilisation rate of these areas have been increased, which will mean that the amenity and attractiveness of passenger public areas can still be kept.

A production friendly superstructure has been developed using

multi-modular cabins, which would improve the capacity and building process of the ship.

Further efficiency features such as a waste heat recovery system and other energy efficient technologies have been included into the concept, which aims at improving the efficiency of the ship by 30 to 50% compared to other cruise ships of a comparable capacity; along with different machinery concepts with alternative fuels which have also been taken into consideration in the design.

TECHNICAL PARTICULARS	
<i>XpTray Concept</i>	
Length:.....	338.00m
Beam at wl:.....	38.00m
Gross:.....	135,000gt
Passenger cabins, all with balconies:.....	1,890
Space ratio, GT/DO:	35.7
Crew:.....	1,500



Efficient cruising on the XpTray concept

heat pumps. Total energy efficiency of the XpTray concept is easily some 30 to 40% better than most of the existing modern cruise ships”, adds Sabell.

The concept looks at running on LNG as a possible fuel, but could also be adapted to other fuels that the shipowner would want in the future. STX Finland notes that at the moment the concept is “too radically different” to be adopted into the industry. However, Sabell notes that many features, both technical and structural, of this concept can be seen in recent cruise ship concepts of major cruise ship companies.

“XpTray concept is just one example of our innovation capabilities having many exceptional features of which many will be utilised in future projects. As to whether there will be vessels based on this concept or not, is more up to courage of our customers to make such a radical decision rather than to the XpTray concept itself,” says Sabell. *NA*

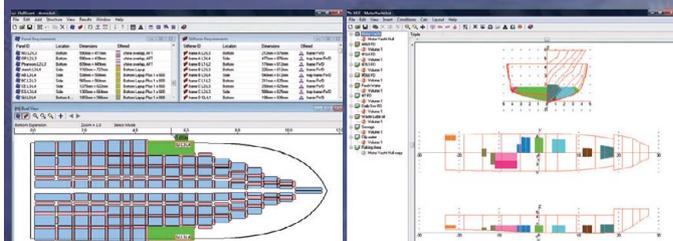
“Technically, in addition to utilisation of state of the art equipment, energy efficiency has improved for example by utilising the natural light, natural air conditioning and



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The cost of going green

Finnish-based Elomatic takes a closer look at the cost of environmental regulation for shipowners

The International Convention for the Prevention of Pollution from Ships (MARPOL) has been renewed over the last 10 years by IMO which has also ratified new conventions since. In addition the EU's renewed directive that regulates sulphur emissions was passed last year. The new regulations affect the cost of new vessels as well as vessel operations and require changes to be made to existing vessels.

Elomatic has performed an extensive study for the Finnish Transport Safety Agency (TRAFI) regarding the additional costs incurred by marine transport in the Baltic in order to meet new environmental regulations.

Investment costs and the additional yearly operating costs caused by each new regulation as well as their combined impact have been calculated for various types and sizes of vessels. The intent has been to take into account all the various factors contributing to the cost. These vessel and size specific costs have been estimated both for retrofitting existing tonnage as well as for newbuildings. Because the requirements of the renewed MARPOL Annex VI can be met using alternative solutions utilising different fuels, the costs have been calculated both for an alternative with gas oil (MGO, sulphur content 0.1%) and for heavy fuel oil (HFO, sulphur content 2.5 – 3%) in combination with an exhaust gas scrubber.

The new amendments and regulations, which have been examined have already entered or will enter into force in the future. Some of them concern existing vessels as well as newbuildings and some only newbuildings. The cost impact of the following regulations has been calculated:

- Amendments to MARPOL Annex IV regarding the discharge of sewage from passenger ships.

The Baltic Sea is designated as a Special Area under MARPOL IV and discharge of sewage into the sea is prohibited unless the ship has an approved sewage treatment plant in use. Alternatively the ship should collect the sewage into holding tanks which are emptied into reception facilities provided by the ports.

The new regulations enter into force 1 January 2016 for new ships and 1 January 2018 for existing vessels

- Amendments to MARPOL Annex V regarding prohibition on the discharge of garbage into the sea.

Discharge into the sea of food waste within a Special Area is permitted only as far as practicable from the nearest land, but not less than 12 nautical miles from the nearest land. Food waste must be ground before discharge. The amendments entered into force 1 January 2013.

- Amendments to MARPOL Annex VI regarding prevention of air pollution from ships and the EU sulphur directive.

The Marpol Annex VI sets the limits for fuel used in the SECA areas and the sulphur limit in the Baltic Sea, North Sea and English Channel will fall from 1% to 0,1% by 1 January 2015.

The Tier III NOx control requirements apply to ships while operating in Emission Control Areas. The currently proposed date for entering into force is 1 January 2021, but will be confirmed in MEPC 66 in the spring of 2014. The requirements apply only to newbuildings and possible impact is not presented here.

- The IMO Ballast Water Management Convention.

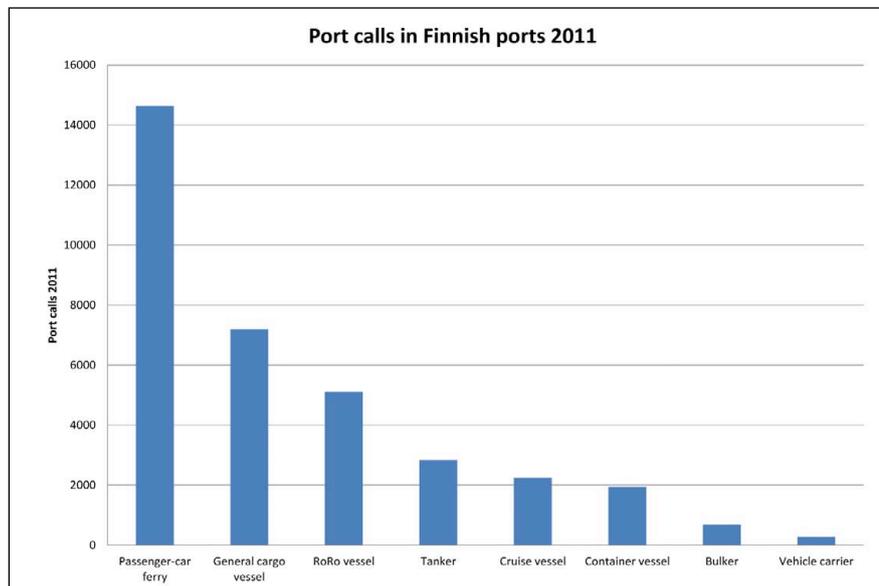
The IMO Ballast Water Convention has not been ratified yet, but it has been assumed that it will enter into force in 2014, and that the BWT system should be installed into all ships during the next renewal survey. Thus it is assumed that the BWT systems will be installed from 2015 onwards.

Vessels analysed

More than 1,600 vessels visit Finnish ports annually resulting in more than 36,000 port calls. The ships have been divided into vessel classes i.e. groups of ship types (Figure 1) and sizes (3-4 sizes per type). For each class the additional investment and operating costs caused by the new environmental regulation have been calculated.

Ship movements within the Baltic (speed and travelled distance) for each vessel have been registered through the automatic identification system (AIS) data system and the fuel consumption for each vessel class has been calculated by the Finnish Meteorological Institute using the STEAM model. Based on this information operating costs have been estimated.

Figure 1: Vessel types and port calls (Source: TRAFI)





Fire at Sea

26-27 March 2014, London, UK



Call for Papers

Fire remains one of the top three causes of loss for marine vessels in the World Fleet, and is a major risk for Ro-Ro ferries, due to their open decks, and Passenger Ships due to ever increasing passenger numbers. The risk of fire may never be eliminated, but its effects can be mitigated.

With a unique operating environment, conventional fire fighting techniques are sometimes difficult to implement onboard ship. Technologies that involve starving a fire of oxygen are generally the most popular, however they still pose risks, especially to the crew. The revision of SOLAS Chapter II-2 has put a greater focus on the prevention of fire through effective crew training and design stage planning. And advances in technology mean that detection equipment can lead to a quick response that maintains the integrity of the vessel.

To further investigate the impact of fire at sea, RINA invites papers from naval architects, class societies, regulators, operators, and researchers on all related topics, including:

- Fire management techniques
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- Fire fighting systems and equipment
- Preventative measures & training
- Modelling of fire & smoke
- Fire protection & detection

www.rina.org.uk/fire-at-sea.html

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Many of the vessels operate in international traffic so the investment costs for the environmental retrofit can be allocated for Finland only to the proportion of the vessels, that sail in Finnish waters. This can also be determined comparing the calculated fuel consumption with the average estimated fuel consumption for the vessel class.

Baseline

The baseline for the study has been that the vessels currently operate on HFO with a Sulphur content of 1% and no measures have been taken to fulfil the stipulated regulations.

The fuel used after 1 January 2015 depends on the selected solution by which the environmental requirements are intended to be fulfilled. In case of an exhaust gas scrubber retrofit higher Sulphur content can be used, 2.7%, and in case of switching to low sulphur fuel Marine Gas Oil (MGO) can be used.

The calculations have been based on a price difference of €237 (US\$322) /tonne between HFO 1% S and MGO 0.1% S as well as 270 €/tonne between HFO 2.7% S and MGO 0.1% S. No escalation over future years has been used, as it is almost impossible to predict.

The cost of the equipment is based on the information from suppliers and represents the year 2013 level.

Results

The results presented below concern only retrofits. For newbuildings the cost pattern is pretty equal. Operating and equipment costs are approximately the same as in the retrofit case while the design and installation costs are slightly smaller.

It must also be stressed that the selected solutions are such that they work properly in the northern Baltic waters where the alkalinity is extremely low. In other areas the selected solutions may differ, and the costs may vary.

Figures 2 and 3 illustrate the impact of installing a sulphur scrubber and use heavy fuel oil compared to the use of marine gas oil. The scrubber installation is a big investment, but savings can be made in the fuel costs and the additional cost for operating the scrubber is not extensive. In addition the scrubber is heavy and requires space and there may be a loss of earning capacity, that is cargo space, which has not been considered in the study. A shift to MGO on the other

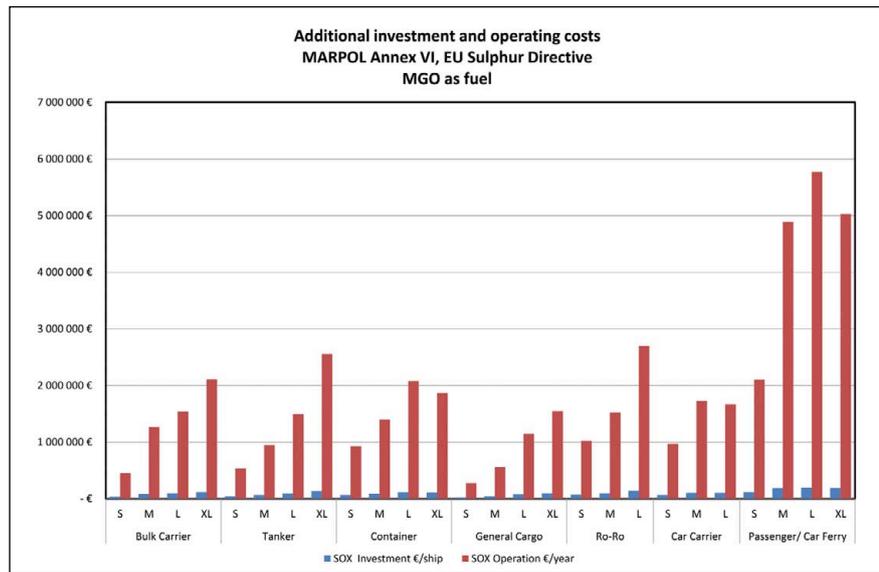


Figure 2: Investment and operating costs to fulfil the EU sulphur directive using MGO

hand, is a small investment, but increases the fuel costs radically.

The IMO Ballast Water Management Convention

The ballast water management system is a big investment for bulk carriers and tankers. For other vessels the investment is moderate, but may be technically challenging. Figures 4 and 5 show, the investment cost dominates the overall costs of the systems.

The additional costs caused by these amendments are minor compare to the costs caused by the Sulphur directive and

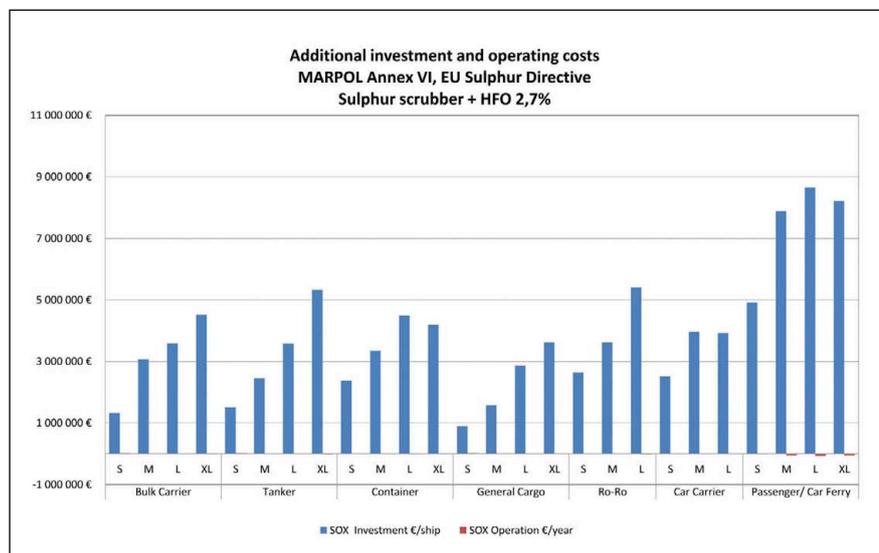
Ballast Water Management as can be seen from figures 8 and 9.

Total costs for marine traffic to Finland are presented in figures 8 and 9. A depreciation time of 10 years has been used for the investment without any interest rate.

This study shows that the costs to fulfil the sulphur directive are the dominating costs irrespective of whether the selected solution is a sulphur scrubber or a shift to MGO.

The results show a yearly additional cost ranging from €460 to €490 million

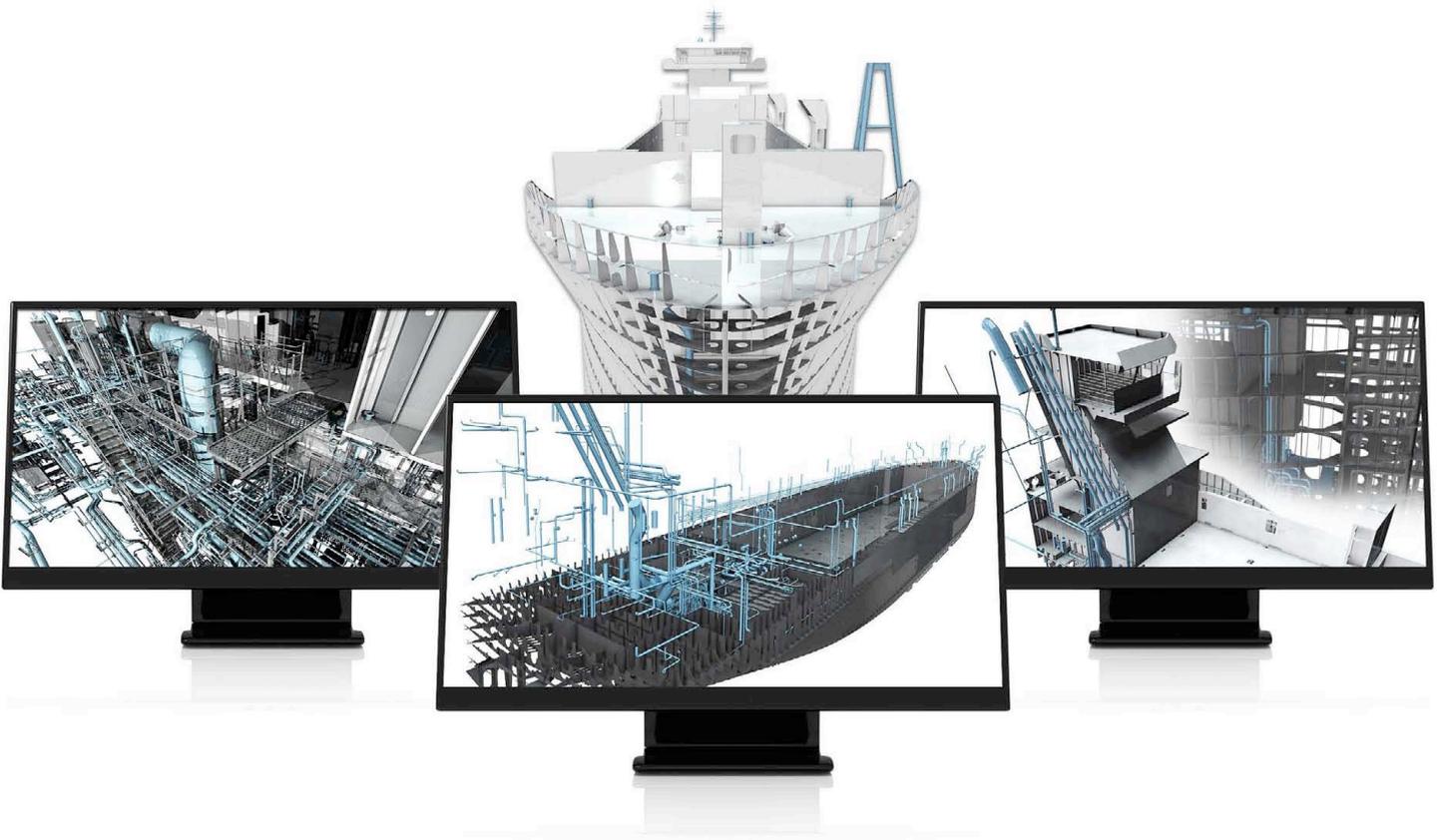
Figure 3: Investment and operating costs to fulfil the EU sulphur directive using HFO in combination with a scrubber





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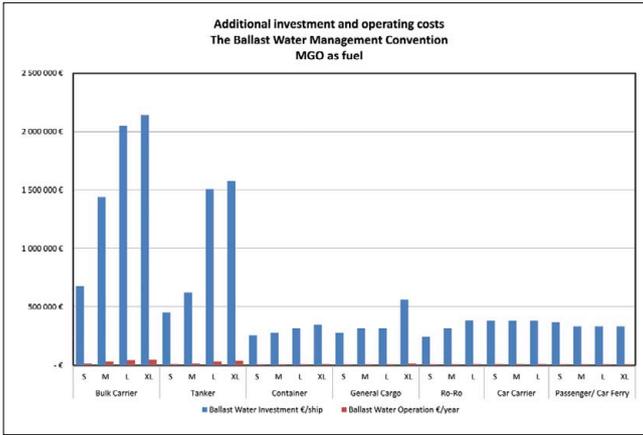


Figure 4: Investment and operating costs of Ballast Water Convention using MGO

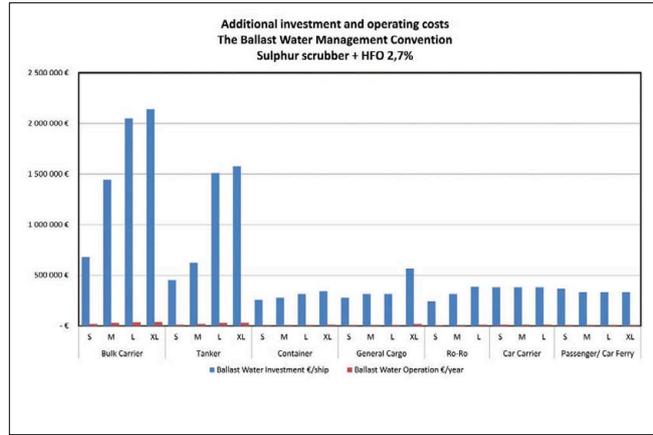


Figure 5: Investment and operating costs of Ballast Water Convention using HFO

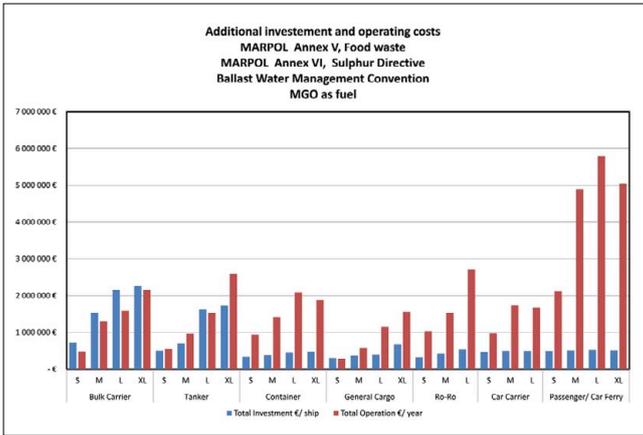


Figure 6: Combined impact of all environmental regulations using MGO

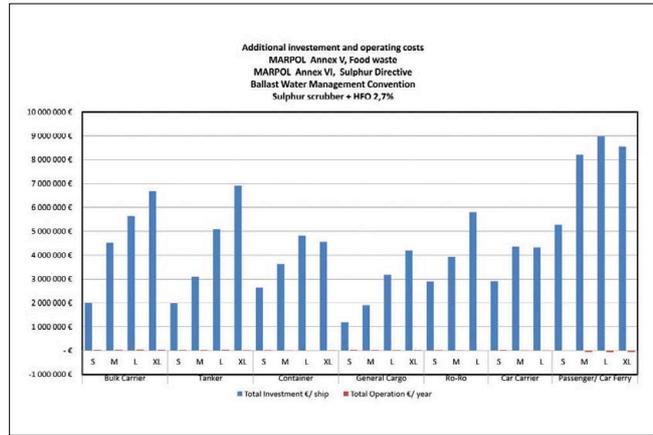


Figure 7: Combined impact of all environmental regulations using HFO

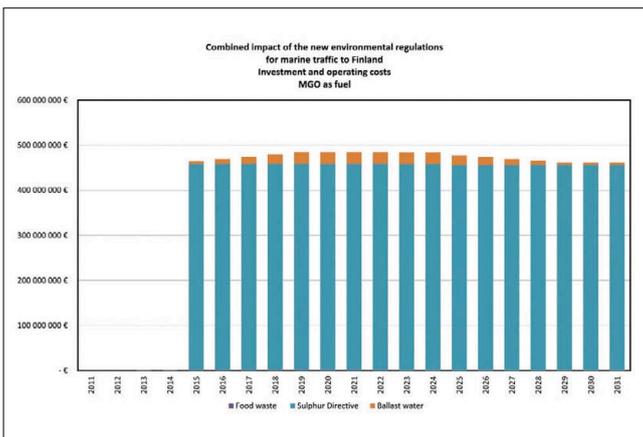


Figure 8: Yearly additional costs for marine traffic to Finland under the new environmental regulations using MGO

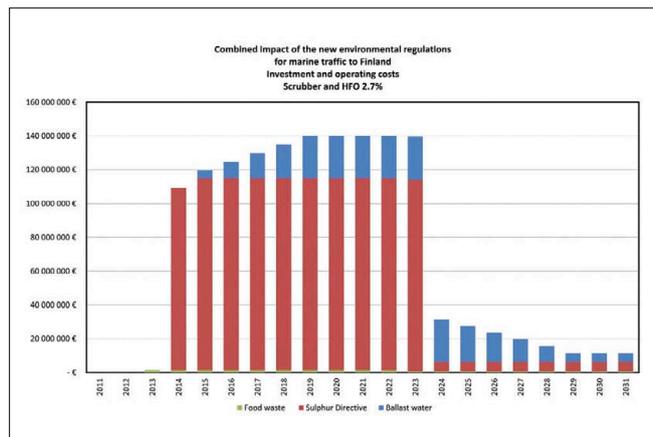


Figure 9: Yearly additional costs for marine traffic to Finland under the new environmental regulations using HFO

(US\$626-667 million) during a period from 2015 to 2031 if the EU Sulphur Directive is met using gas oil. In the case of high sulphur heavy fuel oil in combination with an exhaust gas scrubber the additional yearly cost ranges

from €120 to €140 million (US\$163-190 million) during the period from 2014 to 2023 after which the additional yearly cost will be about €5 million (US\$6.8 million). The two scenarios presented represent extreme cases, either all vessels install

scrubbers or all vessels shift to use MGO. The real case will be somewhere in-between.

The full report can be found in Trafi Publication 28/2013 (www.trafi.fi/julkaisut). [NA](#)

Auramarine cuts SOx

Better known recently for its ballast water treatment system, Auramarine has branched out in to fuel efficiency with the launch of its Auramarine fuel selector and MGO cooling system

Whilst LNG is pitched as being the fuel of the future there are still owners that will elect to run on fuels such as MGO that will meet their chartering needs better, even though the cost of the fuel can outweigh LNG costs.

“Major costs come from the MGO fuel price compared to HFO or LNG/Shale gas. This directly affects the operational costs in which the alternative MGO is more expensive. But, if you compare directly MGO and HFO bunker prices in the market it is not the whole truth. At the moment the difference is approximately US\$300/tonne. But, if several additional factors are counted, then the gap is only about US\$120 -140 /tonne”, says Arttu Ahola, MGO product manager, Auramarine.

Auramarine also points out that in case of older and smaller ships there is no sense in investing millions on abatement technology. MGO is the alternative and it is an attractive alternative when ships operate for only short periods in ECAs. MGO needs some minor modifications work to the fuel oil system, which is where the Auramarine products come in.

“Now it seems that in Europe’s marine diesel market MGO’s demand will increase from 20 million tonnes/year to 50 million tonnes/year in 2015. In Europe we already have a lack of diesel fuel. Ten-15 million tonnes/year of diesel is imported, mainly from the US. Possibly more Russian or Middle East based diesel will enter to the market in 2015. Usually most of the refinery processes are aimed to the lower viscosity road diesel production, which assures the viscosity of MGO in market, if it is too low then more effective cooling systems will be the requirement”, says Ahola.

Auramarine Ltd has introduced two products for switching HFO to MGO. The Auramarine Fuel Selector (AFS) is a automatic change over valve system. The other product is its MGO fuel cooling



Auramarine aids shipowners to switch over to MGO

system, which uses either chilled water or the vessels LT-water as a cooling medium. Cooling of MGO increases its viscosity and lubrication capabilities.

The AFS product is for shipowners who want to switch between fuels without problems from the switch between HFO to low sulphur MGO when the ship enters to ECAs (Emission control areas, North Sea, Baltic Sea, North America), and then change back to HFO when leaving the ECA. The AFS has a fully automatic programmable logic controller (PLC) change over valve system. Normally the ship’s fuel oil system can have up to 20 valves, which have to be switched in proper order and after certain time delays to get the correct fuel to be supplied to the engines at right time.

The MGO cooling system is another product that is set to cope with low sulphur fuel requirements. When the MGO fuel viscosity goes under the engine or pump

manufacturer’s viscosity limits, MGO needs to be cooled to increase its viscosity. The level of cooling will depend on the MGO fuel quality, the original viscosity of MGO used and which kind of cooling system is installed.

The Auramarine chiller, powered cooling system will cool the ISO 8217:2012 DMA fuel to 18°C and 3,0cSt viscosity. 3,0cSt viscosity is the recommendation by most engine manufacturers. The cooling system consists of a common chiller module and several cooler modules installed in correct places in fuel oil system. The cooling can be controlled either by the MGO fuel temperature or by viscosity with viscometer. This depends on the system selected.

Both the AFS and MGO cooling system products can be installed onto the same ship. Their purpose is different, but both are aimed to help the ship’s chief engineer to cope with MGO. Both systems are very small investments compared to the LNG conversions or exhaust gas abatement systems, says Auramarine.

Switching between the fuels is also not a problem if it is carried out correctly, however, if the switching is not carried out in the right order problems can occur. Auramarine has said that it is important to take into consideration the following points for switching between HFO/MGO.

- Engine manufacturers state that when changing the fuel, the temperature change rate is not allowed to change more than 2°C/min. When changing 150°C HFO to 40°C or 20°C MGO, the change-over process should then last 45-55minutes. If this is done faster, thermal shocks in the engine fuel oil pumps and injectors will occur. This will shorten the life time of components and could cause sudden breaking, which could result in power loss and even complete black-outs.
- The fuel filters in the fuel oil supply system may become blocked when rapidly switching from HFO to MGO fuel. This is because hot HFO is rapidly cooled

with cold MGO fuel. HFO and MGO fuels are not suited to each other. So some concentrated cooled high viscosity HFO debris can totally block the filters.

- If the fuel oil valves are switched too early, when the previous fuel is not consumed and out of the system, then high sulphur HFO may be returned to the clean MGO day tank. If this occurs it will contaminate the MGO, which will then not be clean enough to burn. It depends on port state control, as to whether this kind of contaminated fuel accepted will be for use in ECAs.
- Also by switching the valves too fast, the MGO fuel viscosity may drop under any engine manufacturers' or fuel oil pump

manufacturer's viscosity limits. And again this leads to rapid wearing and possibly sudden loss of propulsion.

"So I would say, that the changing over can be done manually with the exact procedure to be followed strictly. But, if you have many valves, it will be 100% sure, that some human errors will happen. An automatic valve system which is properly commissioned for the ship will prevent these kinds of problems", says Ahola.

Most of AFS change-over valve systems are installed on newbuild's. There are not so many retrofit projects, because the shipowners have not yet met the possible problems on a wide scale. "Not until 2015

onwards will MGO fuel be in main engine use and then these problems will arise," says Ahola.

The change-over valves are installed in the proper places in the fuel oil supply system. The control system can be connected to the ship's integrated automation system (IAS) and the changeover programme can be started from the machinery control room. Also the system has a data logging feature, which will save the GPS coordinates from a GPS module and also time data in which the fuel change over programme is started and ended. The report printed from logger can be shown to authorities who want to check which fuels were used and where they were used. [NA](#)

Making the Switch

Permanent magnetic motor manufacture, The Switch has developed the next-generation drive train for efficient power use and production

The latest electrical drive trains which are based on permanent magnet (PM) technology from The Switch, provides advanced control with a permanent magnet motor and a frequency converter as the major components. The controller acts as the 'brains' for energy efficiency, keeping the network stable regardless of external conditions, such as waves, speed and other influential factors.

The solution enables vessels to produce electricity more efficiently for the entire ship's network, lower costs by keeping auxiliary generators off, and allowing the main engines to operate at variable speeds and generate electricity the company says. The drive train will enable operational savings for vessels with 4-stroke, but in particular 2-stroke engines, and will help owners to comply with future environmental legislation.

"Soaring fuel prices, global overcapacity and lower profit margins are forcing shipbuilders to rethink conventional power configurations. This has opened the way for advanced technologies that are revolutionising the way ships generate and use energy for the good of the environment... in the large merchant shipping sector, where 2-stroke main engines are the preferred type of prime mover. It will enable shipowners to save up to €50,000 (US\$68,000) per month in fuel costs, which may add up to 7% more



The Switch drive train

profit per year", says president and CEO of The Switch Jukka-Pekka Mäkinen.

Adding a frequency converter to a shaft generator allows a ship to control its speed and ensure a stable source of electricity for the ship's network. The frequency converter allows the ship to choose between taking power from the main engine or from the auxiliary generators, as deemed best.

A PM machine gives high-efficiency performance over the entire operating range, significantly cutting back on fuel consumption. It is typically 2-4% more efficient at full load and 10% more efficient at part loads compared with induction

machines, the company says. These efficiencies result from a lack of current losses in the rotor, the absence of an exciter, and reduced winding losses. A synchronous PM machine contains Neodymium-Iron-Boron (NdFeB) magnets, which are materials with a very high flux density, which makes them ideal for variable speed generators throughout the entire speed range. The magnetic field is created with almost zero rotor losses.

Thanks to the improved high density, the size and weight of the drive train can be substantially reduced. This leads to greater flexibility with the limited space available in ship configurations. [NA](#)

Efficient cargo handling

Efficiency gains can be had from sources other than a ship's propulsion, such as the cargo handling equipment onboard

Rolls-Royce recently launched two ferry concepts on to the market. One of which looked at making savings by minimising the investment cost this included the simplification of the cargo handling/ro-ro solution onboard. The other looked at making savings in the long term through the efficient operation of the vessel.

However, in a time where shipowners are looking to make savings and are reluctant to place orders, can savings be gained from the ro-ro equipment onboard. "Efficiency can be measured in different ways; you need to look at individual ship needs. There are different ways of making ships more efficient," says Mattias Gunnarsson director sales and marketing, Cargotec MacGregor.



Mattias Gunnarsson director sales and marketing, Cargotec MacGregor



He highlights that from MacGregor's perspective there is no one solution that fits all for ro-ro vessels and that by simplifying the systems onboard where it may not be necessary, it will make a ship less efficient in its self. Gunnarsson also says that vessels are customised by their trade, but are not optimised in any way.

"You can optimise [ramps and equipment] based on the ro-ro services of the vessel, but some customers request that these systems should be optimised with respect to maintenance," says Gunnarsson.

MacGregor says that its customers want systems that are green and efficient, with low operating costs, lower weight and lower hydraulic spills. Gunnarsson says that to achieve this MacGregor now offers its customers a condition based monitoring system which allows the operators to see what is happening with the equipment at all times, this helps to keep costs down as maintenance can be carried out before parts break.

Continuous development is also being carried out by MacGregor looking into other materials that can be used for ramps and equipment. "We are looking to develop lightweight car decks, such as composites and steel, but we are constantly monitoring the costs of these materials as they are expensive to use," says Gunnarsson.

MacGregor is also looking into other cargo handling developments such as lashing profiles; however, he notes that old habits and fear prevents developments from going forward. The developments in cargo handling that MacGregor is working on look to expediate cargo loading.

"There has been a boom in the market [before the recession], where there was not so much focus on vessel efficiency and sizes of vessels have been growing in size. Due to this there hasn't been that much focus on cargo system design," says Ari Viitanen, director customer solutions, Cargotec MacGregor.

Car deck flooring in plywood on the ro-ro ship *Tugela*, above

Due to the financial downturn and environmental regulations shipowners and yards are now looking to create more efficient solutions, which has also been the case for MacGregor says Viitanen.

“Cargo system utilisation rates are down because cargo systems are not optimised correctly. We have to utilise the available space more efficiently and then the revenue and profitability will increase,” Viitanen explains.

He adds that based on studies that the company has carried out MacGregor believes it can optimise the utilisation rate by a maximum of 5% compared to a standard design and anything over



Ari Viitanen, director customer solutions, Cargotec MacGregor

10,000TEU will increase by over 5%.

Viitanen further explains that it is important to understand different cargo profile use, for example different

weights and sizes of containers and their routes, to be able to develop more efficient cargo handling systems. [NA](#)

Almaco revamps the cruise experience

The demand for more luxurious interiors and features onboard vessels is keeping Almaco busy in 2014

Cruise accommodations are increasing in capacity on the existing fleet by the conversion of existing public spaces into new cabins or adding new decks where new cabins are installed. Almaco says that is very well suited for this type of work based on its experience and its prefabricated modular technology that allows for extremely short dry-docks and guarantees consistent quality in all the cabins.

Ana Albert, VP sales and marketing, Almaco explains: “Short time frames are always a challenge as so much work needs to be carried out in many areas of the ship. For us, we achieve great time-savings by prefabricating as many cabins as possible ahead of time and then by the time the dry-dock starts, we are prepared to lift and install our cabins when the areas are ready.”

Another important trend is the momentum behind energy savings, which Almaco supports with its galley energy management (GEM) system. Owners and shipyards are expected to reach the minimum energy savings requirements (EEDI) established by the IMO and Almaco’s GEM allows for up to 25% savings in the galley areas, which



Almaco will outfit *Navigator of the Seas* in 2014

for some owners can represent the 3rd largest consumer of energy, says the company. Almaco developed GEM in 2009, before any formal requirements were imposed in the industry.

Almaco highlights one project that it is working on in 2014 is the outfitting of *Navigator of the Seas*, where the vessel will be drydocked for the work to be carried out. A total of 81 new cabins will be added to decks 2, 3 and 12. The current Boardroom on deck 2 will be converted into four new cabins. The Photo Gallery, Pizza Dining and Night Club areas on deck 3 will be modified to accommodate 39 new cabins. Finally, the remaining 38 new cabins will be added to deck 12.

As part of the project, the shipyard will deliver the new aluminium housing for deck 12, which Almaco will pre-outfit prior to lifting the blocks onboard. Extensive work in prefabricating the modular cabins will be done before the drydock, which will allow Almaco to complete the new cabin areas within the designated, short, time frame.

“With *Constellation* [a previous project], given that it was the 4th ship in the class where the same work was performed, the project was carried out smoothly and within the customer’s expectations. We haven’t carried out the scope of work on any of the Voyager class ships before so *Navigator* will be challenging, but we’re fully prepared,” says Albert. [NA](#)

Halton Marine's latest MARVEL

Halton has signed a contract with its Japanese partner USHIO Reinetsu Co., Ltd. to deliver its Model-based Automated Regulation of Ventilation Exhaust Level (MARVEL) demand based galley ventilation system for AIDA Cruises

The two 125,000gt 3,250 capacity AIDA passenger ships, due for delivery in 2015 from Mitsubishi Heavy Industries Ltd's, will be equipped with Halton's MARVEL system, enabling direct savings from the galley ventilation system. One of the main targets for the engineering of the new vessels was investment in energy efficient solutions.

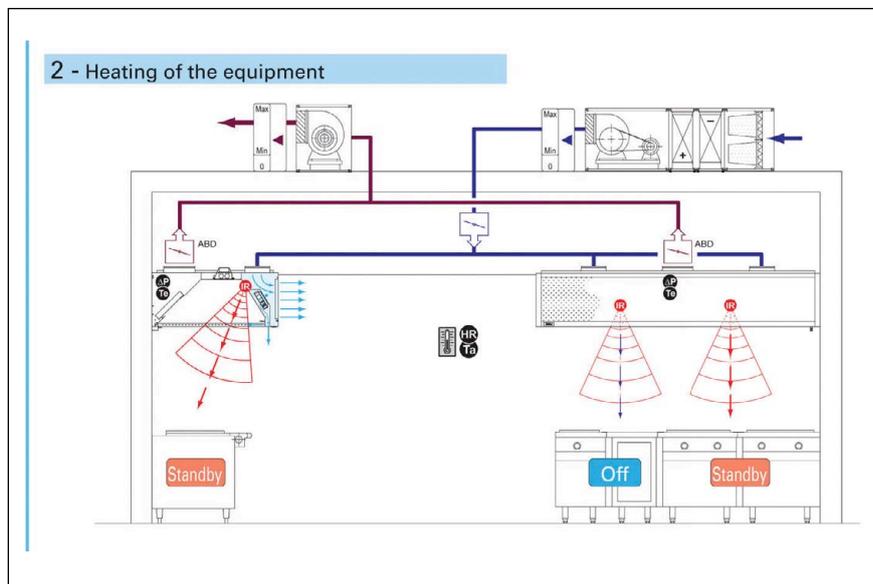
Halton's MARVEL system is an automatic, responsive and flexible demand controlled ventilation (DCV) system for galleys designed to work together with Halton hoods. Compared to traditional hoods, the Halton MARVEL system, combined with the Halton Capture Jet technology, can save up to 50% in galley energy consumption, the company claims.

With the MARVEL system the ventilation exhaust and supply air volumes are adjusted according to the real ventilation demand, as determined by its automatic cooking equipment status detection system, which uses dedicated sensors and an algorithm designed for galley applications to adjust the air volumes. The MARVEL system



Halton will be installing its MARVEL system on to the latest AIDA vessels

When cooking in the galley, sensors pick up on the temperature in the room and adjust fan speeds accordingly



also ensures comfortable conditions by maintaining pre-set temperature levels inside the galley while adjusting the exhaust and supply levels to the required minimum. The end result is that an optimised energy consumption based on actual ventilation needs is achieved.

Halton says that it has been estimated that 30% of the total energy consumption of a cruise ship consists of the air-conditioning of public spaces, including accommodation and galley ventilation. This has also been acknowledged in the shipbuilding markets and the demand for more energy efficient systems and greener technologies has increased, the company adds. The Halton MARVEL demand based ventilation system has been developed to respond to this demand by offering significantly more energy efficient solutions and increasing profitability. *NA*

We Tech drive's larger power savings

We Tech introduces its We Drive five solutions for efficient drive and shaft generators

WE Tech's solutions have been developed around its WE Drive and Shaft Generator, which it has developed to function in five different formations. These solutions are aimed at various types of vessels, such as merchant vessels (e.g. product tankers, ro-ro), special vessels (e.g. coastguard and platform supply vessels in offshore). The company has claimed that between 10% - 20% savings can be gained from these solutions.

The solutions are presented to the market in five different configurations. Man Yang, marketing communications, We Tech says that: "The five solutions are grouped according to the applications existing today and also based on what will be available in the future."

Solution one looks at economical operations by directly driven propulsion combined with a shaft generator system. Solution two looks at the take me home facility, where an auxiliary power system is installed should the main engine fail. Solution three looks at boosting the main engine's power for operating in challenging environments, such as icy conditions. Solution four incorporates a common DC-link that allows power to be distributed in an efficient way. Solution five combines the use of solution four with a hybrid power plant to once again achieve more energy efficiencies.

Yang explains that out of the five solutions: "Solution 1 and 3 have been the most popular so far. The reason is that



The We Drive that gives better power distribution

Solution 1 creates savings from PTO (Power Take Out) applications; Solution 3 boosts the main engine in ice conditions."

We Tech also offers permanent magnet shaft generators for two-stroke engines. The permanent magnet rotor is mounted on the intermediate shaft of the propulsion system. This configuration gives the engine a power boost, allowing the engine to do the work without the need of generators.

Yang notes that the benefits of the solutions will allow shipowners have more control of the operation and optimisation of the ship. "These solutions enable the main propulsion machinery to operate at variable speed, and at the same time generate electrical power needed for the ship," says Yang

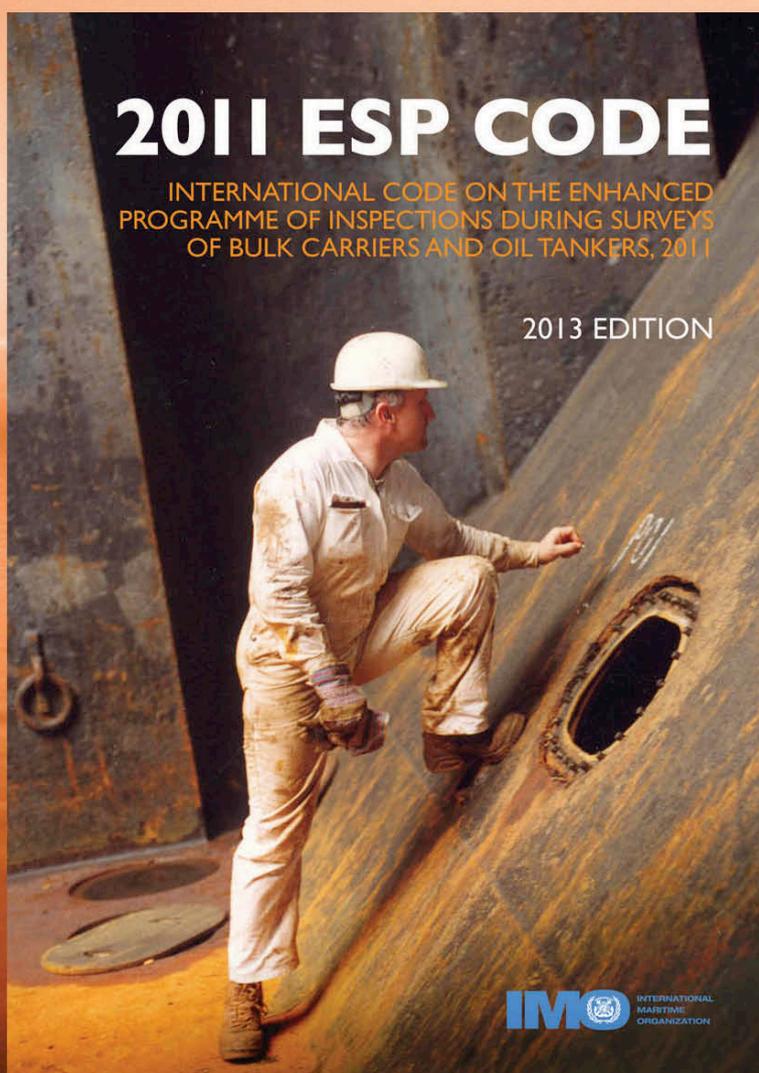
With the WE Drive and direct-drive permanent magnet Shaft Generator in PTO mode, the ships electrical power is generated by the fuel efficient 2-stroke Main Engine. This means that auxiliary generators can be stopped. Electrical power is generated at 160-170g/kWh from HFO, compared with 210-220g/kWh of more expensive Marine Diesel Oil/Marine Gas Oil (MDO/MGO) that auxiliary generator sets use. As the operating hours of the auxiliary generators thus remains at some 2,000 hours annually there will be significant savings in service and maintenance costs as well, the company says. **NA**



WE Tech permanent magnetic thruster gives 2 stroke engines added power

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Smooth operators iron out engine room vibrations

Masafumi Daifuku, Akihiro Takezawa and Mitsuru Kitamura, Hiroshima University, Hiroshima, Japan and Haruki Terashita and Yasuaki Ohtsuki, Tsuneishi Shipbuilding Co., Ltd., Hiroshima, Japan look at how to reduce vibrations from a ship's engine room

Anti-vibration characteristics are one of the most important design factors in the structures of ships. Ships suffer various serious vibrations during their operation, from sea waves outside and internal sources such as the main engine or generators.

After developing the simulation technology for ship performance including vibration analysis, some optimisation techniques have been introduced for ship design using these simulation results [1]. Structural optimisation techniques used in this research are classified into the following three categories: size, shape and topology optimisation. Among them, topology optimisation can optimise the fundamental characteristics of the structure because of its capability to change the topology (number of holes) of the target structure. However, in the context of marine structures, only a few research projects have been reported [2].

In this study on bulk carriers, we have optimised the reinforcement configuration of the engine room using topology optimisation to improve anti-vibration characteristics. Generators can be as serious a vibration source as the main engine, giving the supporting structure an important role in ensuring an acceptable environment for a ship's crew.

Design target

This paper focuses on generating optimal reinforcement for generators to reduce their vibration. The design optimisation is based on the actual structure of the ship and the experimental data of its vibration. The target ship is a 92,900gt bulk carrier and its generators have a 675kW output with five cylinders. The generators are located on the third deck. The model of the part used in this research is shown in Figure 1. The structure

modelled is restricted to the part of the third deck supporting the generators, to enable detailed vibration analysis around the generator while reducing the computational cost.

As the actual structure is surrounded by inner hull plates, the welding connections of the transverses and girders with inner hull plates are modelled as the ground spring in this model.

The modelled part of the ship has approximate maximum dimensions for each axis of L: 7,200mm × W: 11,200mm × H: 5,500mm. The model is composed of nine floors and seven girders. The thicknesses of the transverses and girders are 12mm and 9mm. The base plate of the 3rd deck is 20mm. The total weights of the whole model and the design target structures shown in Figure 1 are about 46tonnes and 13.5tonnes, respectively, excluding the weight of the generators.

The size of the seating plane and weight of the generators are about L: 3,600mm × W: 850mm and 14,380kg. The generators are handled as non-structural masses in the model. The weights of the generators are distributed on their setting area. The

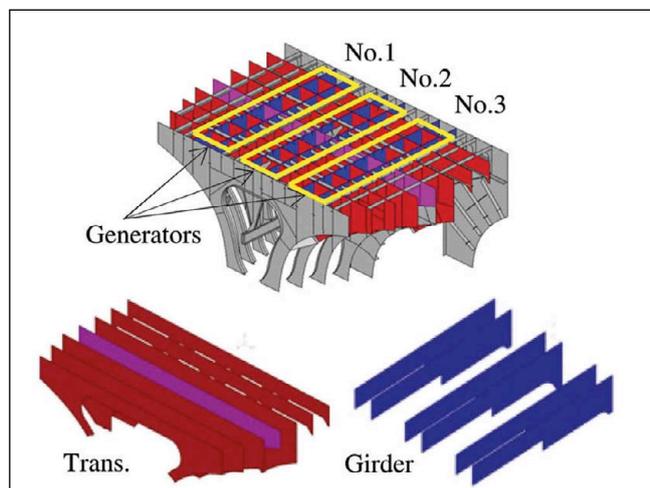
generators are numbered 1–3 as shown in Figure 1. The bottom reinforcements of the structure are the key design targets in this research. Mechanisms for the vibrations of the generators are the base plate being vibrated by the periodic vertical forces resulting from the crank movement of the generator.

Vibration analysis

The vibration propagation from the generator is regarded as steady state propagation of the sinusoidal periodic force. That is, this phenomenon is solved as a frequency response problem of the structure subjected to a periodic load. The computation of the problem is performed using finite element method (FEM) analysis. The discretised form of the vibration equation of the structure under the periodic load is represented by $(\mathbf{K} - \omega^2 \mathbf{M}) \mathbf{u} = \mathbf{F}$, where \mathbf{K} and \mathbf{M} are stiffness and mass matrices, \mathbf{u} and \mathbf{F} are amplitude and load vectors and ω is the angular frequency of the input periodic load.

Vibration analysis is first performed for the normal structure shown in Figure 1. Several parameters of the vibration

Figure 1: Overview of the design target



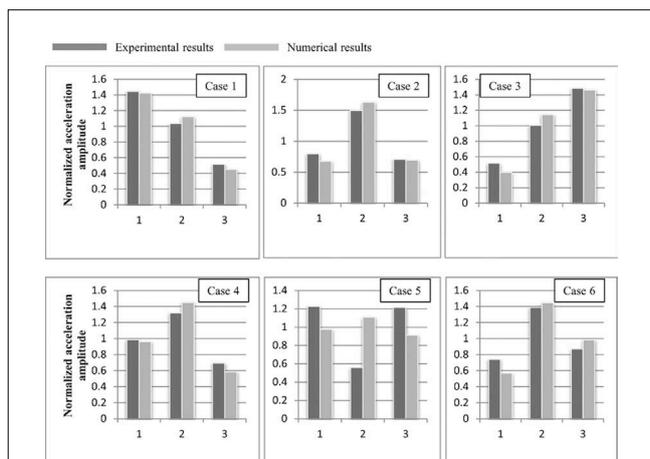


Figure 2: Comparison between the experimental and numerical vibration results

at the loading points [3]. By introducing a volume constraint, the optimisation problem is formulated as follows:

$$\text{Minimise } \|\mathbf{u}_{\text{input}}(\mathbf{d})\|, \quad (1)$$

$$\text{subject to: } \|V(\mathbf{d})\| \leq V_{\text{max}}, \quad (2)$$

$$0 \leq \mathbf{d} \leq 1, \quad (3)$$

where $\mathbf{U}_{\text{input}}$ represents the amplitude vector corresponding to the loading points, \mathbf{d} is the design variable vector and V and V_{max} are the structural volume and its maximum value.

Optimisation results

As discussed in the vibration analysis section, during the voyage, any one or two generators operate in rotation according to conditions. We introduced the vibration case for all generators working simultaneously as the optimisation condition considering all these working cases. First, the thickness of the plate was set to 5/3 times the original thickness. Thus, 60% volume of the design domain corresponded to the total volume of the design domain in the original thickness. The volume constraint was then set to 55% of the original volume of the reinforcement parts. As a result, the optimisation was performed on about 92% of the volume of the original structure.

Figure 3 shows optimal configurations. Table 1 shows the performance improvement when Cases 1–6 vibrations were applied to the optimal result. The vibrations were reduced by about 10%

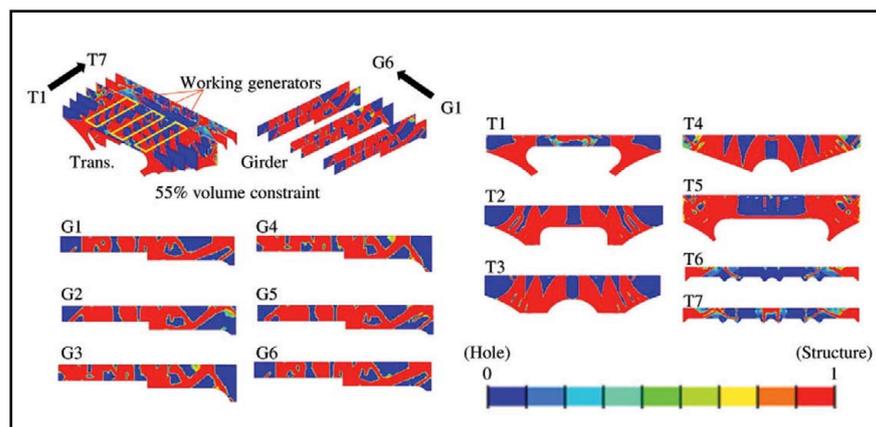
simulation are set according to the preliminary vibration tests. The periodic load applying to the base from the generator can be regarded as the inertia force of the generator. This value was calculated as 9,000N by multiplying the weight and the primary acceleration of the generator. This load is applied to the model as a distributed load on the setting plane. The frequency of the periodic load is set to 30Hz, which corresponds to the second order vibration of the five cylinder generator.

In the vibration test performed in the actual ship, the measurement points were located around each generator. The same points were used as the evaluation points in the numerical analysis. Their averaged values were used for comparison. As vibration cases, the following six patterns were considered. Cases 1–3: Generator No.1, 2 or 3 is working singly, Case 4: Generators No.1 and 2 are working, Case 5: Generators No.1 and 3 are working, Case 6: Generators No.2 and 3 are working. Figure 2 shows the results of the analysis. For the sake of confidentiality, normalised values are shown in both the experimental and analysis results. Although strictly matched results were not obtained, the vibration propagation from the source generator to other generators was certainly simulated.

Solid Isotropic Material with Penalisation (SIMP) method is the most commonly used in various commercial software systems. The basic idea of SIMP is the use of a fictitious isotropic material whose Young's modulus E and mass density r is assumed to be a function of the penalised material density d given by $E^* = d^3 E$ and $p^* = dp$ where the upper asterisk represents the interpolated value of physical properties. In this research topology optimisation was performed using the commercial software Optistruct (Altair Engineering, Inc., Troy, Michigan, USA.).

The aim of this study was to generate a structure with anti-vibration characteristics. We regard vibration suppression as a reduction of the displacement vector in the frequency response problem represented by Equation (1) for the whole model. This can be achieved by minimising the amplitude

Figure 3: Optimal configurations obtained by topology optimisation under a general vibration case which assumes all generators are simultaneously working. The red and blue colours correspond to the structure and voids respectively



Topology optimisation

The basic concept of topology optimisation is the replacement of the structural optimisation problem with a material layout or distribution problem, using the density function representing the existence of the material at the specified point. The

	No.1	No.2	No.3	Average
Case 1	15.0	-17.4	-87.4	-6.3
Case 2	-19.7	8.4	-19.4	-3.4
Case 3	-87.3	-17.3	15.2	-6.0
Case 4	2.1	1.2	-35.8	-4.8
Case 5	-1.2	-18.5	-0.8	-6.9
Case 6	-36.3	1.0	2.2	-4.8

Table 1: Increase rate of the norm of average acceleration amplitude vector in the location of each generator and average value of them by optimisation under different volume constraints (%). Negative values indicate vibration reduction

in all the vibration cases while the total weight was reduced to about 92% of the original structure.

Conclusion

In this research, we optimised the reinforcement shape of the engine

room using topology optimisation for improving the anti-vibration characteristics. We achieved a 5% vibration reduction approximately with about 92% of the weight of the original structure. *NA*

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Vibration monitoring at sea

Chris Hansford, managing director of Hansford Sensors, outlines some of the challenges faced when applying vibration monitoring to marine machinery and offers advice on how to successfully install and use accelerometers on marine vessels

As machinery has become more complex and mankind has demanded greater productivity from each mechanical system, there has been a corresponding growth in the need for sophisticated vibration sensors that can help maximise the performance of many engineering processes. This is especially true at sea, where vibration monitoring is a key tool used by marine engineers to manage the availability and maintenance of a wide range of equipment with rotating shafts, including pumps, motors, fans, gearboxes and engine systems.

Since vibration is one of the main causes of failure in marine propulsion systems and auxiliary equipment, designers and engineers have invested a lot of time and energy in trying to minimise the problem. This has naturally involved examining the key causes of vibration, such as poor alignment of rotating shafts in, for example, propulsion systems and turbochargers for main or auxiliary engines. Poor alignment can be caused by inaccurate installation, wear, mechanical damage and even changes in temperature, and the resulting vibration increases friction and wear on other components, leading to premature failure. Consequently, the performance and service life of components is reduced, while operating and maintenance costs are significantly increased.

The cost of putting a ship to sea has always justified the cost of monitoring it, but in recent times the need to apply reliable preventative maintenance techniques to meet the drive for efficiency has become ever-more pressing. Thankfully, today's designers and engineers have succeeded in developing a range of tools and practices to prevent vibration and its consequences, such as alignment tools and automatic lubricators that can be applied during system construction. Indeed, components themselves are continually being refined and upgraded to offer greater resistance to vibration. However, vibration can never be entirely banished from rotating



Condition monitoring allows engineers to keep an eye on the wear and tear on many machine parts

machinery and so there has been much development in vibration monitoring technology. In particular, vibration sensors increasingly offer exceptional reliability packaged in a variety of resilient enclosures to enable their use within a wide range of applications.

The current array of sensors or accelerometers for vibration monitoring offered by companies such as Hansford Sensors can operate over a wide temperature range, measuring both high and low frequencies with low hysteresis characteristics and excellent levels of accuracy. These devices also offer a robust and reliable service, thanks to stainless steel sensor housings that can prevent the ingress of moisture, dust, oils and other contaminants.

There are two main categories: AC accelerometers, which are used with a data collector for monitoring the condition of higher value assets such as wind turbines, and 4-20mA accelerometers, which are used with a programmable logic controller (PLC) to measure lower value assets such

as fans and pumps. Both are capable of detecting imbalance, bearing condition and misalignment but AC accelerometers can also identify cavitation, looseness, gear defects and belt problems.

Accelerometers contain a piezoelectric crystal element bonded to a mass. When the sensor is subject to an accelerative force, the mass compresses the crystal, causing it to produce an electrical signal that is proportional to the level of force applied. The signal is then amplified and conditioned using inbuilt electronics that create an output signal, suitable for use by higher level data acquisition or control systems. Output data from accelerometers mounted in key locations can either be read periodically using sophisticated hand-held data collectors, for immediate analysis or subsequent downloading to a PC, or routed via switch boxes to a centralised or higher level system for continuous monitoring.

Clearly, there is some powerful technology at work here and a wealth of experience and intelligence has gone into providing it, but an accelerometer is only as good as the engineer who is responsible for it. A poorly installed or maintained accelerometer will not offer the precision or longevity of which it is capable and in the marine sector, where operating conditions are subject to a wide range of variables, the need to maximise the effectiveness of these devices is great. For example, readings taken in port will almost certainly be different from those taken when the vessel is at sea, and heavy weather will only amplify any such differences. It is in everyone's interest to specify the best accelerometers and apply the best practice in managing their performance, particularly as health and safety requirements in all industries continue to be refined. The use of remote monitoring systems enables both performance and safety levels to be maximised, as engineers are no longer required to come into close contact with potentially hazardous equipment.



AC accelerometers are used in vibration monitoring for bearing condition and misalignment, but can also identify cavitation, looseness, gear defects and belt problems

Without condition monitoring, the only way to analyse equipment is for onboard engineers to take it apart, which naturally consumes much valuable time and manpower and can only be done when the vessel is in dock. On large vessels, it may not be realistic to inspect more than, say, 20% of equipment every year, meaning that it might be five years between examinations for some machine parts. That leaves many machine parts unexamined for long periods of time and even those parts that are examined can suffer because taking machinery apart and reassembling can cause its own problems. Many marine engineers have observed that a large percentage of defects are maintenance induced, so the less they have to take things apart and put them back together, the better. In contrast, condition monitoring on equipment allows marine engineers to maintain gear far more efficiently with less manpower and maintenance. *NA*

By adopting vibration monitoring as a key tool to ensure the availability and performance of moving equipment and ensuring the correct installation and maintenance, engineers can reduce costs considerably and improve safety for crew and passengers. Hansford Sensors offers AC and 4-20mA versions of the

HS-100 and HS-420 Series, which are intrinsically safe being due to being certified to ISO standards ATEX and IEC Ex. These industrial vibration sensors can be used to monitor vibration levels on pumps, motors, fans and all other types of rotating machinery found in marine applications.

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Prüftechnik launches VIBGUARD

Vibration specialist Prüftechnik has launched its latest piece of kit for portable vibration monitoring

VIBGUARD portable is the latest version of its online monitoring system. VIBGUARD has been designed to be used by vibration experts and service providers for troubleshooting measurements on complex machines, which the company says will benefit from the ability of on-site failure analysis, since they now have the flexibility of taking their measuring equipment with them on service calls.

Professional service personnel can install the system on a range of machinery to conduct temporary measurements and then analyse them. VIBGUARD portable is IP 64 rated and

comes along in a sturdy aluminium case. The portable version of VIBGUARD can be set up quickly to measure quickly on almost all kind of machines to perform in-depth troubleshooting, the company says. Like the stationary version, VIBGUARD portable, is available in various configurations and optionally equipped with an integrated industrial PC for even more flexibility. For example, with the integrated PC and a LAN or mobile internet connection measurement data can be accessed and analysed remotely and if needed additional measurement tasks can be taken. *NA*

Prüftechnik says that VIBGUARD offers more flexibility for vibration analysis



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The Quantum experience

The first in the series of latest cruise vessels for Royal Caribbean Cruise Lines (RCCL) is due to set sail this year and onboard a new experience awaits passengers with the development of Two70° by US-based 5+ Design

Quantum of the Seas and Anthem of the Seas are the latest new generation of cruise ships, which integrate new environmental features and technology onboard. The first ship will be delivered in autumn 2014, the second ship in spring 2015.

One of the key elements onboard the new ships will be the space at the back of the vessel called Two70, representing the panoramic view from the rear of the vessel of 270degs.

The 5+ design explains that Two70° is a unique multifunctional indoor entertainment space, in the form of a glass-enclosed great room with elliptically terraced seating, a restaurant, a bar and a library. By day, the three-deck-tall room at the rear of the ship will serve as a gathering spot where guests can enjoy meals, games, reading and lounging while surrounded by a 270degs view of the water outside the window walls. By night, the room will morph into a venue for parties, dancing and performances featuring actors, musicians or aerialists; all against a backdrop of digital projections that bring outdoor scenes indoors.

This space has been designed and created so that it can be used in the day as a relaxing recreational area and then transform in the evening for onboard entertainment.

Tim Magill, design principle, 5+ Design says: “The key driver for the vessel was sustainability. We have designed an area that transforms from day to night, so that it can be used around the clock rather than to leave large empty spaces onboard the ship that are not used through certain parts of the day.”

Magill says that with this new series of vessels a strategy was implemented that distinguishes these ships from previous ships. “The Oasis class was a hard act to follow,” he remarks. However, with these



5+ designs kits out *Quantum of the Seas* with latest technological gadgets to give a better experience

vessels RCCL was looking at making a vessel which was more environmental and sustainable and not just looking at the size of the vessels.

For this the ships’ design has focused on the use of the interior spaces onboard and how to fully utilise all areas onboard, by making the public spaces more multifunctional and also adapt through the cruise to be transformed in to other spaces, allowing the vessel to also operate in all seasons. Up to 4,100 guests can be accommodated on the ships, which have a tonnage of 158,000gt

“Nothing like this exists on land. A lot of attention was given to individual parts of the environment to make sure that they work together and also to give the right atmosphere,” says Magill.

One of the most challenging aspects to the design is that the area is located above the main propulsion plant and because of this further development was required to reduce the noise and vibration. Magill says that in order to reduce the noise and vibration sound dampening had to be incorporated in the area.

Two70° incorporates a lot of technology, which 5+ Design highlights as one of the main design advantages of the ship. “We’ve managed to incorporate a lot of technology whilst working with very tight space limitations. That has been where we have benefitted from technology minimising over the years. Using LED’s for lighting is environmentally friendly and also small in size.”

Magill goes on to add that cruise ships make for an interesting ‘crucible’ for testing new technologies as ships have very strict limitations in which you have to work with and see how far you can adapt these technologies for the environment they need to work in. “It also gives us a window in to land-based projects and what technology we can use for future projects,” he says.

As cruise ship companies compete to keep their passengers onboard, Magill says that these types of interiors is an important development phase for cruise ships of the future, as more vessels try and fit more onboard. **NA**

Next generation ultra-luxury cruise ship

Dr Sean McCartan, course tutor boat design and Christopher Kvilums, Student, part of the European Boat Design Innovation Group, CEPAD, Coventry University, studied how the experience onboard cruise ships can be adapted for more luxury while being greener

The ultra-luxury small cruise ship sector has experienced significant growth in recent years, which is predicted to continue, with the Mediterranean showing significant potential for this market sector. In this operational area HVAC has been shown to be a significant requirement and a major contributor to vessel auxiliary loads.

The European Boat Design Innovation Group - Interdisciplinary Research Centre (EBDIG-IRC) at Coventry University have developed a design proposal for an 'eco-luxury cruise catamaran', which integrates a Passive Design methodology within the marine design process, with the objective of reducing the energy consumption of the vessel as an ecological statement enhancing the sense of luxury within the design.

This has resulted in a potential reduction in cooling load between 519.4kWh and 1,745.3kWh per cabin per annum. The design is an engagement in luxification, an evolution of luxury in cruising, creating a new market through Design-Driven Innovation, with the objective of offering

the user an eco-luxury experience with a sense of intimacy similar to that of a superyacht. This concept design shows the potential of Passive Design as a means of reducing emissions in line with EEDI legislation, by reducing hotel loads such as HVAC systems and lighting.

The process of Design-Driven Innovation is an exploratory research project, which aims to create an entirely new market sector for a given product through changing the design meaning the user has for the product. It occurs before product development and is a design investigation similar to technological research[1]. In essence, it is the development of a design scenario through engaging with a range of interpreters in technology and cultural production.

Cultural production concerns the creation, diffusion, and consumption of cultural products. Interpreters in cultural production include: sociologists, anthropologists, marketers, media consultants, end users. Technology interpreters are experts with unique insights into technology innovation, they

include: technology suppliers; technology innovation consultants; technology firms in other industry sectors; designers; research centres and universities. Knowledge is generated from the immersion with the design discourse of the interpreter's groups. The process can be structured or unstructured and is dependent upon the nature of the relationship of the client with the interpreters.

The process can be structured or unstructured and is dependent upon the nature of the relationship of the client with the interpreters. In this project there was unstructured design discourse between researchers with the EBDIG-IRC group at Coventry University, marine HVAC specialists and a range of Passive Design experts including architects. It also included a review of the luxury travel global trend report^[2]. This informed the design scenario used to develop the design brief.

In discussing Passive Design it is important to consider the significant difference between applying the principles of Passive Design to architecture and naval architecture. An architect analyses the site of a building to determine the optimum fixed orientation of the building in the environment. Whereas, a naval architect must consider the passage of the vessel and statistically analyse the range of latitude and orientation experienced for the whole of the passage.

To this end, the latitude mid-point was chosen for the purpose of the analysis, with both North and South orientations being used to respectively represent the minimum and maximum extremes



Design driven innovation could see luxury cruise passengers getting a more environmentally friendly experience



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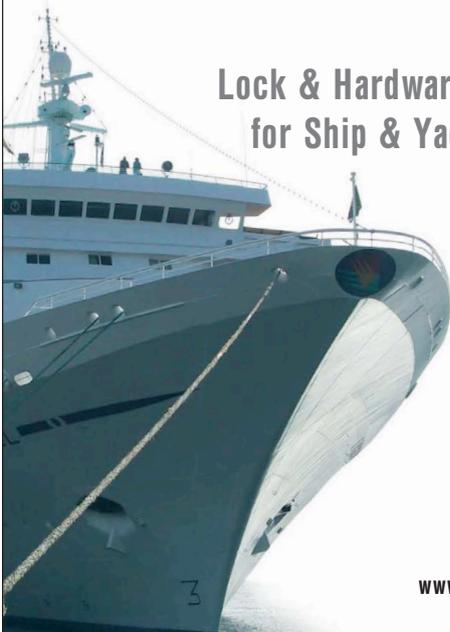


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of solar exposure that a cabin could experience under passage. Using these conditions the maximum and minimum energy saving potential of the Passive Design strategy were determined.

The integrated hull and superstructure act as a single form clasp the balconies, giving a sense of balance to the visual mass of the bridge deck, due to the perceived high shear line at the fore end of the superstructure. The general arrangement (GA) has been developed from the principles of Passive Design. The design is a hybrid of passive systems, which utilises cross ventilation and stack ventilation techniques in addition to the shading principles, to further reduce thermal and ventilation loads on the HVAC system.

The GA is configured so that high heat gain areas such as the dining area and galley are positioned in locations (upper deck) which can be purged of heat gains quickly and can take advantage of a natural lighting scheme, complimenting the locations' demands. External vertical louvers on the upper decks help funnel the prevailing wind, during desirable climatic periods so that pressure differentials occur across the vessel to induce a flow of air. This flows through the internal structure and out through the stairwells. The stairwells have venturi apertures on the Sun Deck and all deck level doors are kept open, in order to maximise stack ventilation potential. To meet SOLAS fire regulations all doors and venturi apertures are spring loaded and secured by electromagnetic locks, which are controlled by the fire safety system. These are released when fire is detected closing the doors and apertures, protecting the means of escape.

In simulations of the effect of balcony depth on cooling load, there was a marked effect in reduction from 0 to 1.5m for both North and South orientations of 28% and 58% respectively, with a lesser reduction effect between 1.5m and 2.5m, of 8% and 28% respectively. It was on the basis of these results that the balcony depth was fixed at 1.5m to evaluate the further potential coling load reduction that could be provided by louvers.

Three types of louver were evaluated: static; occupancy based modulated louver control; solar radiation based louver



Rendering of the interior of the vessel

control. The occupancy based modulated louver control is a system based on a 0o angle louver which completely closes to 90o when the client leaves the room and reopens when the door handle is opened, so that the users experience of the room is unaffected. In contrast to this the solar radiation based louver control varies the tilt angle of the louver to fixed values depending upon the level of solar radiation detected by a sensor.

For both orientations the occupancy based modulated louver control has the lowest cooling load. The combined effects of both an occupancy dependant louver system and a balcony depth of 1.5m provides a reduction in sensible cooling loads of 83% (1.7453MWh) and 59% (0.5194MWh) for south and north orientation respectively compared to a facade with no balcony depth or shading. Additionally an occupancy based louver system would benefit from the maximum natural lighting potential when the room is occupied instead of being obstructed.

In order to estimate the annual CO₂ reduction and fuel reduction achieved by these potential reductions in cooling load through Passive Design, it is assumed that the cooling load is provided by an engine operating on LNG. Considering Passive Design as a percentage of annual propulsion CO₂ for a range of vessel speeds, the reduction in HVAC CO₂ ranges between 21% and 70% at the average cruise speed of 11knots decreasing to between 4% and 13% at 22knots.

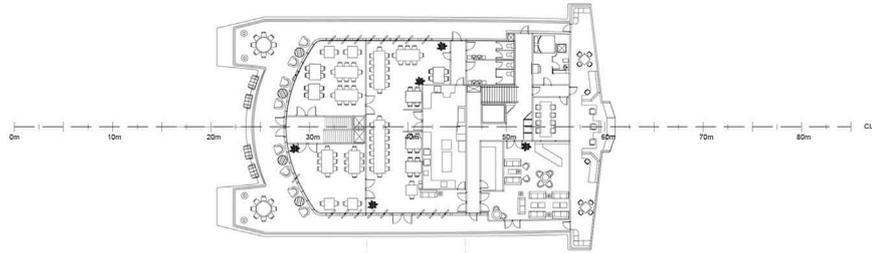
While the design proposal demonstrates the potential for engaging in the drivers of the eco-luxury market through the reduction in CO₂ from both propulsion (catamaran hull with LNG-fuelled engine) and Passive Design, it needs to be quantified in terms of Design-Driven Innovation from a user perspective. Further research will be carried out to examine the psychological impacts of shading and natural lighting schemes on users experience and concepts of luxury. This will inform future interior design methodologies. The potential of Passive Design to reduce the CO₂ and fuel consumption for large vessels, while not being the key objective of this work has been shown to be significant. On this basis Passive Design could become an integral part of a future strategy to enable large cruise ships to address EEDI and other future emission legislation. *NA*

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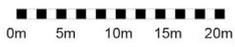
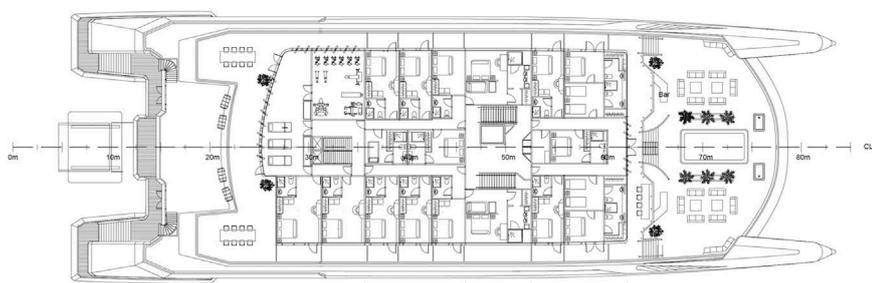
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GA of eco-luxury cruise catamaran

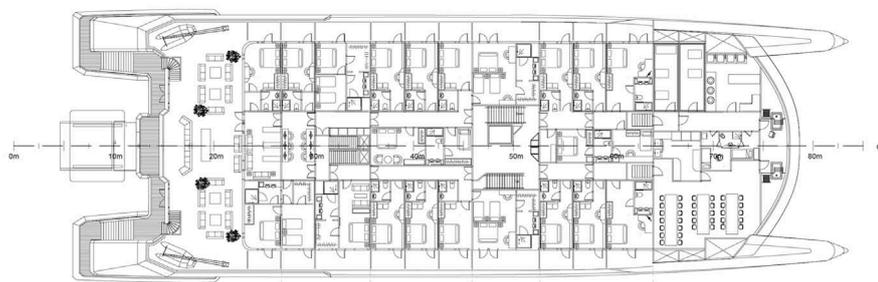
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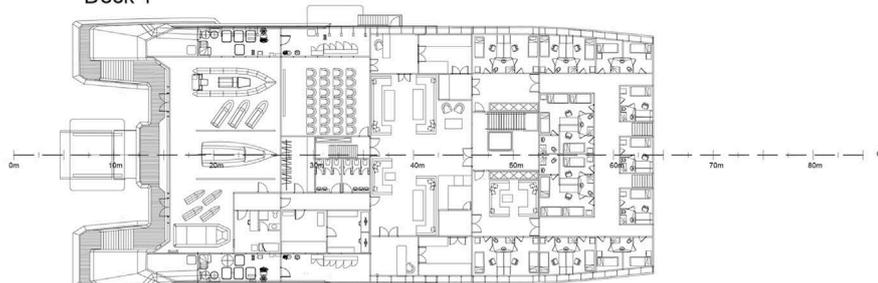
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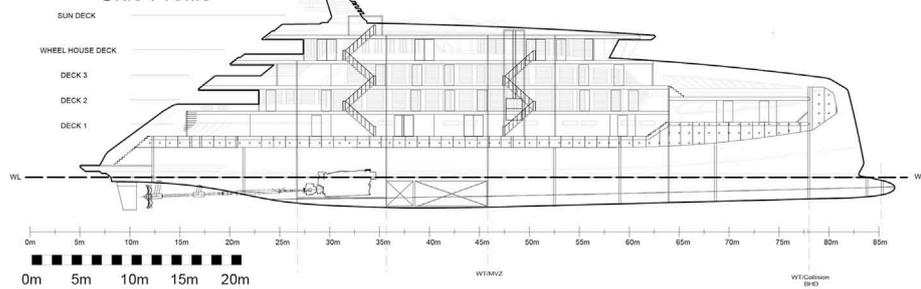
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Ovation meets new standards

UK-based marine flooring supplier Ovation has launched its latest products, Ovation Navy and Oceanic, on to the market that complies with the latest fire testing procedure standards

Ovation Navy is a large format luxury vinyl wood plank tile in 184 x 1,214mm in size. With a 2.5mm gauge and a 0.55mm wear layer and is fully IMO marine certified. The latest development has been prompted by the amendments to the standards that came into effect last year.

Adrian Ashworth says: "We are constantly seeking new and innovative products to bring to the marine market. One of the issues with the testing procedures in place for all products allowed to be installed in marine vessels is that product choice for designers and architects can be limited. As a company Ovation specialises in supplying the cruise ship, ferry, luxury yacht and offshore platform sectors and it is a key role of our business to widen the choice available as much as possible. New and more stringent testing procedures now in place could well limit this choice still further in the future and we are keen to secure availability for our customers."

Ashworth comments that as all products that pass the stringent IMO testing procedures are of a very high quality, there is no significant advantage of one product over another. However, he adds that most of the ranges from Ovation are aimed at different areas of a vessel. Oceanic and Navy are primarily aimed at the public areas for example, whereas Canopus and Canopus



Ovation Flooring gets onboard with latest fire testing procedure standards

Plus safety flooring (other Ovation products) are aimed at wet areas or bar areas where slipping may be a risk. Ovation also supplies other products aimed at crew or back areas.

However, the standards have had a knock on effect, Ashworth says: "They have affected our development greatly over the past 18 months. Some of the product changes we have carried out have been forced upon us as we plan for the future. Whilst this has undoubtedly caused us some difficulty, we see the regulations as a good thing. They have caused us to re-examine our product

offerings and we know our product range will be better in the long term. We know we can promote everything we supply to the marine industry with confidence.

Looking forward Ashworth adds that: "I would say that the full impact of the new tests will not be felt for a year or two yet. All will become apparent as more and more product certification will become due for renewal. At present, I anticipate that many products may not pass and choice will become limited for marine architects and other customers in the future." **NA**

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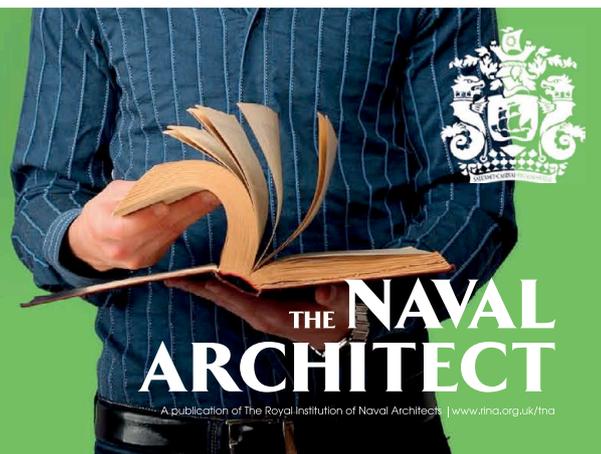


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Altro gets momentum

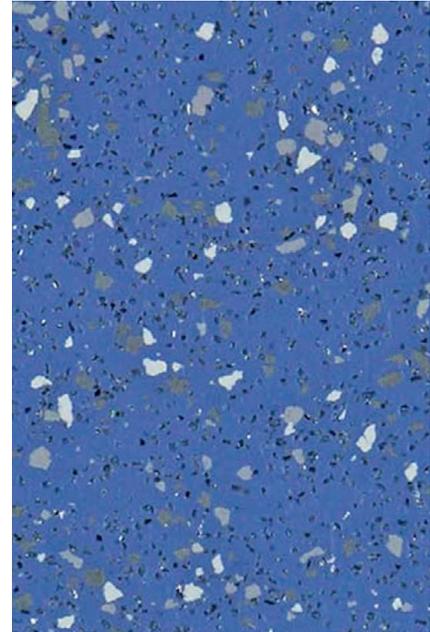
UK-based flooring specialist Altro has launched its latest flooring to the market, Altro Transflor Momentum

The development of the new flooring has been prompted by the FTP requirements that came into force last year. Altro Transflor Momentum meets the IMO/MED FTP requirements for fire, smoke and toxicity without compromising on slip resistance and durability. One of the features of the latest product is that it is more lightweight than other Altro products. “Compared with some of our other ranges, it is 0.2kg/m² lighter”, says the company.

The company claims that due to its lighter weight the product not only represents a product that is easier to install, but has the possibility to save fuel consumption as well. The inclusion of silicon carbide gives the flooring a long-term durability, minimising repair and replacement costs. For areas of intense traffic, the

product will give good durability and resilience, the company says. The inclusion of PVC contributes to it being a more robust product with the fleece backing that creates a better surface for bonding. In addition the whole floor may be welded to create a tankable flooring system, with impervious jointing, which protects the subfloor.

The Transflor Momentum comes in a selection of 12 plain and chipped colours, which the company says satisfies requirements both to match standard corporate liveries and provide design contrast with vibrant, accent colours. The range has been researched with customers to bring you a palette with a proven track record in the industry. Bespoke colours and designs are also available on request. [NA](#)



Altro launches its latest flooring product the Transflor Momentum

Plasteak seeks approval

US-based Plasteak has improved its vinyl flooring products to meet with IMO guidelines for flammability testing

The updated rules have seen many manufacturers having to rethink their standard products in order to comply with the rigid test procedures that the products are now expected to meet. Plasteak has said that it is important that their products to meet with IMO and US Coastguard certification for them to be fitted in to vessels.

“Approval by these organisations demonstrates that the flooring meets very high international standards for safety, flammability, and environmental protection. Many government and military vessels or public vessels that carry a lot of people (like cruise ships) are required to use IMO certified products. IMO material is required typically

for European vessels or passenger vessels for hire (ferries, charter boats, cruise ships or Coast Certified)”, says Jennifer Littlebear, International sales coordinator, Plasteak.

The Teak and Holly flooring products have been further developed to make sure that they passed the fire test procedures. The main difference between the old and the new version is the raw materials that allow the flooring to pass the flammability testing required for IMO Certification.

“The IMO material looks the same; however, we use a different plasticiser (the materials that allow our product to be flexible) in the formulation that allows us to have less smoke and

toxicity when subjected to flames”, says Littlebear. A wear test, indentation test, non-combustibility tests, smoke and toxicity tests, and fire resistance tests were carried out on the product.

The latest products will filter on to the market as it runs out of stock of its original product. Littlebear adds that: “As we run out of the old stock of flooring that doesn’t contain the IMO ingredients, it is being replaced by the new version of the flooring. Also, the flooring is IMO Certified but, we are waiting for one more test (an adhesive test) before this will officially be deemed US Coast Guard approved. It’s expected to be Coast Guard approved by the summer of 2014.” [NA](#)

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